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December 23, 2008

Mr. Rick Fedrizzi, President/CEO
U.S. Green Building Council
1800 Massachusetts Avenue NW
Suite 300
Washington, DC 20036

Re: Appeal

Dear Mr. Fedrizzi:

Enclosed please find an appeal of the Gold Certification for the Northland Pines High School in Eagle River, Wisconsin. The appeal is provided in both paper and electronic form, with a CD enclosed.

We await your prompt evaluation and response. Should there be any questions, please contact Mr. Mark Lentz, PE and myself.

Will you please acknowledge receipt of this appeal? Thank you.

Very truly yours,

LAWRENCE G. SPIELVOGEL, INC.

Eur Ing Int PE Larry Spielvogel, PE, CEng, FASHRAE, FCIBSE, FSLL

LGS:jca

CC: Mark Lentz, PE
Lentz Engineering Associates, Inc.
Consulting Engineers
511 Broadway
Sheboygan Falls, WI 53085-1500

Mr. Brendan Owens, LEED®AP, PE
Appellants

Enclosures

BY FEDERAL EXPRESS

Appeal of **LEED™** Certification

Dated December 23, 2008

Project:	Northland Pines High School 1800 Pleasure Island Drive Eagle River, WI 54521 USGBC Project Application No. 10001516
USGBC Submittal Date:	June 10, 2004
Certification Received:	LEED™-NC 2.1, Gold, Date: May 10, 2007
Reason for Appeal:	Project Non-Compliance with Prerequisites EA2 ANSI/ASHRAE/IESNA Standard 90.1-1999 EQ1 ANSI/ASHRAE Standard 62.1-1999

I. Executive Summary

This appeal of the award of **LEED™** NC 2.1 Gold Certification to the Northland Pines High School is being made at the request of Members of the Northland Pines High School Building Committee and other concerned taxpayers and members of the community. The appellants include:

- Mr. Ronald Ritzer, an architectural design professional and local builder of high performance homes
- Mr. Roderick McKinnon, a commercial property developer
- Mr. Patrick Smith, a construction professional
- Dr. Kevin Branham, a Doctor of Chiropractic with a Masters degree in Public Health
- Mr. Curt Hartwig, a local businessman and community leader

The engineering professionals preparing this appeal were originally retained to review the design for non-compliance with **LEED™** prerequisites due to litigation threats made by the design team against the appellants for publicly expressing their concerns for the design provided. Both reviewing professionals are nationally recognized for their expertise in the development and application of the ANSI/ASHRAE Standards upon which the **LEED™** Prerequisites are based:

- Mr. Lawrence G. Spielvogel, PE, FASHRAE
- Mr. Mark S. Lentz, PE

LEED™ 2.1 requires compliance with Prerequisites EQ 1, Minimum IAQ Performance and EA 2, Minimum Energy Performance and are mandatory for Certification to be granted:

1. **EA2** Prerequisite, Minimum Energy Performance: Compliance with ANSI/ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low Rise Residential Buildings*,

(without amendments).

2. **EQ1** Prerequisite, Minimum IAQ Performance: Compliance with ANSI/ASHRAE Standard 62.1-1999, *Ventilation for Acceptable Indoor Air Quality*, (plus approved addenda, or ANSI/ASHRAE Standard 62.1-2001 (62.1), *Ventilation for Acceptable Indoor Air Quality*, (as originally published).

Also claimed was a point for:

1. **EA1**, Prerequisite, Fundamental Building Systems Commissioning: Compliance with Section 6.2.5.4 of ANSI/ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low Rise Residential Buildings*, (without amendments) (90.1) and ASHRAE Guideline 1-1996, *The HVAC Commissioning Process*.

Complete access to final project documents was not provided or available. A brief tour of the building was made on September 23, 2008.

The following documents were reviewed.

Construction plans, specifications, and addenda
Selected air handling unit submittal data
Final Testing and Balancing Report
Record temperature control documents
Product manufacturers' data
USGBC Point summary
ASHRAE Standards
Wisconsin Codes

The appellants are challenging the award of **LEEDTM NC 2.1** Gold Certification for Northland Pines High School on the basis that the design and construction of this facility do not meet **LEEDTM** prerequisites EA2 and EQ1. Most of these deficiencies indicated were identified by the reviewing professionals and provided to the design team prior to bid. As such, the design team was made aware of and afforded the opportunity to correct the deficiencies identified.

- EA1, Prerequisite, Fundamental Building Systems Commissioning was not complied with. The first three steps of the Commissioning Process include review of design intent, basis of design documentation, and incorporation of commissioning requirements into the Construction Documents. All are required prior to bidding and construction. The reviewing professionals have been unable to confirm that any were performed. Had a competently executed Design Review been performed by the Commissioning Agent, as required by **LEEDTM NC 2.1**, ANSI/ASHRAE/IESNA Standard 90.1-1999 and ASHRAE Guideline 1-1996, the majority of the EA2 and EQ1 violations identified by the reviewing professionals should have been identified by the Commissioning Agent and corrected by the design team prior to the issuance of the Construction Documents for bid.

- EA2, Prerequisite, Minimum Energy Performance: The design of the HVAC systems and other listed elements of the building do not comply with all of the requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999. The scope and number of prerequisites violations was pervasive.

- EQ1, Prerequisite, Minimum IAQ Performance: The design of the HVAC systems failed to comply with ANSI/ASHRAE Standard 62.1-1999, *Ventilation for Acceptable Indoor Air Quality*. Validation computations were performed to determine the actual basis for ventilation rates and to determine what the actual ventilation requirements would have been had the required Ventilation Rate Procedure computations been performed. These computations established that the actual basis for ventilation was the Wisconsin Enrolled Code, which produces significantly lower ventilation rates at both individual zones and at the system level than those which would have otherwise been required to comply with ANSI/ASHRAE Standard 62.1-1999.

It is not possible to identify all potential violations without access to the design team's documents and computations. However, a total of 2,333 violations of ANSI/ASHRAE/IESNA Standard 90.1-1999 and ANSI/ASHRAE Standard 62.1-1999, with addenda, are identified. Since not all aspects of this facility are evaluated, the full extent of the violations is undoubtedly greater than indicated here. Violations identified are limited to only those items which are readily apparent from a review of the construction documents by knowledgeable persons.

LEED™ 2.1 requires the facilities to meet the requirements of ANSI/ASHRAE 62.1-1999 using the Ventilation Rate Procedure. ANSI/ASHRAE 62.1-1999 requires specific minimum rates of outdoor air be provided to each occupied zone whenever it is occupied and requires special controls on VAV systems to assure that minimum ventilation rates are provided. The Ventilation Rate Procedure requires specific computations be performed. Official interpretations published by ASHRAE clarify specific issues with respect to those computation requirements. The Ventilation Rate Procedure also requires that the ventilation rates for HVAC systems serving multiple zones using recirculation be computed using Equation 6-1, the Multiple Spaces Equation. These requirements and computations are easy to perform, straight forward, and produce predictable and definitive results.

Seven VAV Reheat air handling systems employing recirculation of air serve the most heavily occupied areas of the facility. VAV systems have been recognized as problem IAQ systems in the ASHRAE Systems and Equipment Handbooks since 1992[1,2,3,4], are subject to special requirements in ASHRAE 62.1-1999[5], which are facts that are or should be well known to HVAC designers. Furthermore, ANSI/ASHRAE/IESNA Standard 90.1-1999 contains restrictions on the use of simultaneous heating and cooling and mixed air control which have significant implications for how this type of system is designed. Because of these issues, the VAV systems were subjected to close scrutiny by the reviewing professionals.

Conformance computations were independently prepared by the reviewing professionals to determine whether these systems would provide the minimum rates of ventilation, both as designed and as constructed, and under all conditions of operation as required by Standards 62.1 and 90.1. The compliance computations prepared were based entirely upon parameters taken directly from the Plans and Specifications, the final Testing and Balancing Report, and record temperature control documents. These documents included such information as room numbers, room names, room areas, and final design and actually delivered air flows. See Appendix 1. When not otherwise indicated on the Plans, occupancy levels used for computing ventilation rates were taken from the Tables in Standard 62.1. These computations clearly demonstrate that the ventilation rates actually provided in the school consistently fail to meet the minimum requirements of the prerequisite standards. Further investigation found that actual HVAC system ventilation rates were, in fact, designed to comply with the substantially less rigorous and less stringent requirements of the Wisconsin Code.

The compliance computations indicated a wholesale failure to perform and apply the required ventilation computations using the ANSI/ASHRAE Standard 62.1-1999, Ventilation Rate Method that is required under EQ Prerequisite 1, while ignoring the simultaneous heating and cooling restrictions of Section 6.3.2.1 of EA Prerequisite 2 (as well as the Wisconsin Enrolled Code). This particular violation of the **LEED 2.1™** prerequisites had major implications for the outdoor air fractions required at all seven VAV air handling systems and for compliance with Section 6.3.6.1 of ANSI/ASHRAE/IESNA Standard 90.1-1999, *Exhaust Air Energy Recovery*. No energy recovery is employed on any of the 46 exhaust fans on this facility or the approximately 91,000 cfm of exhaust on the buildings. That energy recovery equipment which was installed was installed in the "return" air path, making it functionally useless. The unrecovered exhaust air path represents a heating load of approximately 12,000 Mbh, or approximately 75% of the entire boiler plant's heating capacity. Fan motor horsepower limitations of Section 6.3.3.1 through 6.3.3.3 of ANSI/ASHRAE/IESNA Standard 90.1-1999 were consistently ignored. Other violations are also identified.

From a practical standpoint, it is impossible to correct the above violations without completely redesigning the HVAC systems.

Plans and Specifications were initially reviewed prior to bid. Air quantity computations complying with the ANSI/ASHRAE Standard 62.1-1999 Ventilation Rate Method proscribed by **LEED™ 2.1** were prepared at that time using occupancy and air delivery rates taken directly from the construction documents. These computations and a partial list of prerequisite violations numbering in excess of 600 violations were presented to the design team at a public meeting of the School Board.

An incomplete list of 136 separate Wisconsin Enrolled Code violations was also presented at that time. Code enforcement by Wisconsin Code Authorities was inconsistent, only requiring some of the code violations to be corrected. The Code Authorities refused to enforce any of the requirements of either ANSI/ASHRAE/IESNA Standard 90.1-1999 or ANSI/ASHRAE Standard 62.1-2001, and did so in writing. The facilities were essentially constructed to the original pre-bid HVAC design. The design was initially submitted to USGBC subsequent to project completion, making any design modifications cost prohibitive and for all purposes practically impossible. The appellants submitted relevant information to USGBC regarding the prerequisite violations at the time of design with the anticipation that USGBC would use that information in reviewing the application. It was to the great surprise and dismay of the appellants that USGBC awarded this facility a Gold Certification.

Numerous other observations were made relative to compliance with other mandatory provisions of both ANSI/ASHRAE 62.1-1999 and ANSI/ASHRAE/IESNA Standard 90.1-1999. Based on compliance computations and other observations, the reviewing professionals have determined that the requirements of both Prerequisites EA2 and EQ1 were substantially ignored. Furthermore, documentation of the extent of the violations of ANSI/ASHRAE Standard 62.1-1999, with addenda, and ANSI/ASHRAE/IESNA Standard 90.1-1999, without addenda, demonstrates that violations are neither incidental nor inconsequential. The violations have major adverse implications for the quality of the built environment and facility energy usage. The cost and scope of changes required to correct the apparent defects in the design of the primary air handling systems, exhaust air systems, and primary heating and cooling plants of this facility will be very significant.

The following tables contain a summary of ANSI/ASHRAE Standard 62.1-2001 and ANSI/ASHRAE/IESNA Standard 90.1-1999 violations for the systems as designed, and as constructed.

Table 1 in Appendix 2 provides a summary of violations of ANSI/ASHRAE/IESNA Standard 90.1-1999, without addenda.

Table 2 in Appendix 3 provides a summary of violations of ANSI/ASHRAE Standard 62.1-1999, with addenda (published complete as ANSI/ASHRAE Standard 62.1-2001.)

It is the position of the appellants that it is not in the interests of USGBC, or the "Green" movement, to permit the Northland Pines High School to retain it's **LEED 2.1™** Gold Certification. Because of the pervasive nature and extent of the violations observed, the pre- and post- review actions by the design team, plus the fact that the design team was made aware of the non-compliance issues prior to construction when they could still have made appropriate modifications, it is the belief and contention of the appellants that the design team knowingly and intentionally failed to comply with either prerequisite throughout the design and construction process.

The design team promised **LEED™** Silver Certification to the School Board and the public throughout the design process. Prior to issuance of the Project for bidding, the appellants were threatened by the design team with legal action if they did not cease questioning the design. When presented with the critique prior to the receipt of bids, the design team's response was that the design only had to meet minimum Wisconsin Code requirements and did not have to meet the requirements of either ANSI/ASHRAE Standard 62.1-1999 or ANSI/ASHRAE/IESNA Standard 90.1-1999, even though they were **LEED™** prerequisites. They also publicly attacked the professional reputations of the reviewing professionals. Subsequent to the critique and throughout construction, they failed to correct the overwhelming majority of both prerequisite Standard and Wisconsin Code violations identified. Since the designers were notified of the deficiencies and made no attempt to either address or correct the deficiencies identified, the design team self-certified a design that they knew, or should have known, to be noncompliant with **LEED™** requirements.

For USGBC to permit this project to retain **LEED™** certification in any form would establish the precedent that it is acceptable for designers to falsely represent that substandard installations comply with **LEED^{TM}** prerequisites and national standards of minimum due professional care. Such an action would be a slap in the face to those diligent design professionals who do follow the rules and threatens the very credibility of **LEED^{TM}** certification.

That USGBC provided this Project with a **LEED 2.1^{TM}** Gold Certification demonstrates major weaknesses in the **LEED^{TM}** review process which need to be corrected. Those weaknesses include (1) the lack of a credible third party review of applications and construction documents, (2) allowing designers to self-certify their designs, (3) failure to require the inclusion of compliance computations for certification, and (4) assuming that code authorities will either understand or enforce ASHRAE Standards. These practices are an open invitation to fraud. USGBC acceptance of a Certificate of Occupancy as compliance with building codes does not necessarily mean compliance with **LEED^{TM}** prerequisites.

II. PROJECT HISTORY

A **LEED™** Silver certification had been publicly promised by the design team at Northland Pines School District (NPSD) meetings. Several members of the NPSD Building Committee were construction professionals. Another individual was a local medical practitioner with a formal public health background. These and other individuals and taxpayers recognized and were concerned about deficiencies they perceived in the design of the HVAC systems. These individuals sought to influence the outcome by raising their concerns. Instead of being listened to, the dissenting Building Committee members were subjected to public attack and ridicule at School Board meetings, threatened with arrest by the NPSD Board President and threatened with litigation by the design team.

As a direct result of the legal assault by the designers, two independent professional engineers were separately engaged by different Building Committee members and taxpayers to review the Construction Documents for compliance with **LEED™** criteria and compliance with **LEED™** prerequisites, ANSI/ASHRAE Standard 62.1-1999 and ANSI/ASHRAE/IESNA Standard 90.1-1999, for their personal defense against threatened litigation. It is this same group of people who have become the appellants in this matter.

The initial pre-bid review identified approximately six-hundred separate violations of ANSI/ASHRAE Standard 62.1-1999 and ANSI/ASHRAE/IESNA Standard 90.1-1999. Since the appellants were not certain which version of **LEED™** the design team was seeking certification under, compliance computations were initially performed using two Ventilation Rate Procedure Computational methods: the methods used for compliance prior to and subsequent to the issuance of Addendum N to ANSI/ASHRAE Standard 62.1-2001.

Many of the violations noted were also violations of the Wisconsin Enrolled Building Code in force at the time. As required by the Wisconsin Rules of Professional Conduct for Architects, Engineers, Designers and Surveyors, A-E 8, Article A-E 8.08, this information was also provided to the Authority Having Jurisdiction, the Wisconsin Department of Commerce, Safety & Building Division, which is responsible for plan review. For a copy of the Wisconsin Rules of Professional Conduct for Architects, Engineers, Designers and Surveyors, A-E 8, please refer to Appendix 4.

It is a matter of record that this project had serious difficulties getting approval for construction from the Wisconsin Department of Commerce. No documents itemizing the extent of the changes required by the Authority Having Jurisdiction, nor any record of the changes made, have been made available to either the reviewing professionals or the appellants. The Testing and Balancing Report and some equipment submittals were reluctantly made available to the appellants by Northland Pines School District. Some of the information, such as record temperature control documents were obtained from installing contractors and subcontractors. The design team has been completely uncooperative. However, it was possible to discern most of the ventilation system changes made by comparing the Testing and Balancing Report with the original Construction Documents. Most of the changes made were consistent with code violations identified in the pre-bid evaluation and were apparently required by the Authority Having Jurisdiction. Of the changes identified, the information was consistent with the information provided by the reviewing professionals to the authority having jurisdiction.

It was apparent from the preconstruction review that the original design failed to meet **LEED™** prerequisites. It was also apparent from the postconstruction review that the final design also failed to meet **LEED™** prerequisites. As construction had proceeded according to the original Construction Documents, the appellants were both surprised and dismayed that **LEED™ 2.1-NC** Gold Certification was granted to this project. For this reason, it was decided an appeal was necessary.

III. COMPARISON OF WISCONSIN ENROLLED BUILDING CODE WITH ANSI/ASHRAE STANDARDS

Wisconsin Enrolled Code: The Wisconsin Enrolled Code has in the past been called the Wisconsin Commercial Code. The code in effect at the time of the design of this facility was substantially less rigorous than **LEED™** prerequisites. Wisconsin adopted the 2000 International Codes as the basis for the Wisconsin Enrolled Building Code in 2002, but with substantial modifications.

Ventilation: One of the most significant modifications Wisconsin made to the 2000 International Codes was to substitute its own ventilation requirements for those of Section 4 of the 2000 International Mechanical Code. Wisconsin's ventilation rate was 7.5 cfm per person for all occupancies, half or less than that required by ANSI/ASHRAE Standard 62-1989. In addition, it does not require use of the "multiple spaces equation," and permitted the outdoor ventilation rates to be simply summed and diversified on the basis of table or actual occupancy at the system. This created significant disparities between minimum Wisconsin Code legal requirements and those necessary to comply with ANSI/ASHRAE Standard 62-1989.

While some deviation would be reasonably anticipated between design and conformance computations performed by different parties, given that we are starting with the same peak flow numbers, the overall outdoor air fractions should be very similar if the same computational procedures were employed by both parties. The Wisconsin Enrolled Code and ANSI/ASHRAE Standard 62.1-2001 ventilation computation methodologies are substantially different and therefore produce substantially different results. The reviewing professionals looked at both. The ventilation requirements of the Wisconsin Enrolled Code are substantially different than those of ANSI/ASHRAE Standard 62.1-2001 resulting in significantly lower system outdoor air fractions. An HVAC system may easily comply with Wisconsin Code requirements and fall far short of compliance with ANSI/ASHRAE Standard 62.1-2001.

Energy: At the time of design, Wisconsin had adopted the 2000 International Energy Conservation Code and adopted ANSI/ASHRAE/IESNA Standard 90.1-1989 as a reference but not as a requirement. (See Appendix 5, Comm 63.0900) for energy conservation. At the time Wisconsin adopted these requirements, U. S. DOE has already adopted ANSI/ASHRAE/IESNA Standard 90.1-1999 as the basis for Federal Law, leaving Wisconsin in technical violation of the 1992 Energy Policy Act. In practice Wisconsin only enforces those provisions which it had explicitly adopted into Comm 63 which made it one of the weakest energy conservation codes in the United States.

As a result of the substantial disparities between Wisconsin's substandard Commercial Building Code and applicable Standards, and a substantial lack of enforcement, design practices in Wisconsin have not kept pace with applicable National Standards. In fact, most new building projects in Wisconsin do not meet the requirements of either ANSI/ASHRAE Standard 62.1 or 90.1. Even fewer meet both.

Enforcement: The Authority Having Jurisdiction (AHJ) who reviewed the HVAC systems for this facility declined to enforce any provision of any version of ANSI/ASHRAE Standard 62 as Standard

62 compliance is not required in Wisconsin Enrolled Code. Even though ANSI/ASHRAE/IESNA Standard 90.1-1989 had been adopted as a reference in the Code, the AHJ responsible for this project explicitly declined to enforce any provisions of ANSI/ASHRAE/IESNA Standard 90.1-1989, which had not been explicitly adopted into the language of the Wisconsin Enrolled Building Code (See Appendix 6, Correspondence with Randall Dahmen, PE, the Wisconsin Department of Commerce HVAC plan reviewer for NPHS). Finally, it appears that this facility was allowed to be constructed in violation of the Wisconsin Enrolled Code as the review of the final Testing and Balancing Reports showed that numerous code violations were allowed to remain uncorrected.

ASHRAE Standard 62.1-1999, with Amendments (62.1-2001): **LEED™-NC 2.1** requires compliance with the more rigorous requirements of either ANSI/ASHRAE Standard 62.1-1999 (with approved addenda) or the local ventilation code, Comm 64.05 (See Appendix 7). There are few differences between the requirements of ANSI/ASHRAE Standard 62-1989, ANSI/ASHRAE Standard 62.1-1999, and ANSI/ASHRAE Standard 62.1-2001 other than the requirement of special controls for VAV systems. Approved addenda to ASHRAE Standard 62.1-1999 are incorporated into ANSI/ASHRAE Standard 62.1-2001, and listed in Appendix H of that Standard. ANSI/ASHRAE Standard 62.1-2001, without addenda, actually requires higher ventilation rates than ANSI/ASHRAE Standard 62.1-2004, and is therefor the more rigorous.

To summarize the requirements of all versions of ANSI/ASHRAE Standard 62 since 1989, they require that requisite ventilation must be provided to each occupied space whenever the space is occupied. To accomplish this, ANSI/ASHRAE Standard 62.1 requires that minimum ventilation rates be computed for each individual space. In addition to increasing ventilation rates, the other major change has to do with how ventilation has to be computed at the air handling system. When outdoor air is introduced through unitary equipment serving discrete zones, or dedicated, or 100% outdoor air systems, the ventilation required is simple to both compute and deliver. However, when outdoor air is introduced through a mixed air path and serves multiple zones, as is the case with this project, ANSI/ASHRAE Standard 62.1 requires that the critical zone dictate the amount of outdoor air to be provided at the air handling unit. The Multiple Spaces Equation is required to be employed to reduce the over-ventilation penalty by permitting the designer to take credit for the over-ventilation that will occur in most spaces and compute a lesser amount of outdoor air to be processed at the air handling unit.

Appendix 8, Interpretation IC 62-1999-39 to 62.1 covers a multitude of issues specifically relevant to educational facilities.

Variable Volume Systems: Variable air volume systems represent a special case. Formal interpretations have been published by ASHRAE in response to questions raised regarding ASHRAE Standard 62 since 1989. Two of those interpretations are directly relevant to this project and are included in Appendices 8 and 9. The Multiple Spaces Equation (6-1), as first presented in the body of Standard 62-1989 applies only to constant volume systems. Section 6.1.3.1 of ANSI/ASHRAE Standard 62.1 requires the use of Equation 6-1 for the computation of adjusted outdoor air flow rates at the air handling unit. Section 5.3 requires special controls be provided to assure adequate ventilation throughout occupied spaces whenever they are occupied. ANSI/ASHRAE Standard 62.1

also has specific documentation requirements to be found in Sections 4.1, 5.2, 6., 6.1.3, 6.1.3.1, 6.1.3.2, 6.1.3.3, and 6.3. Section 6.3 requires that IAQ computations and assumptions not only be made a part of the permanent design file, but also provided to the building operator for current and future use.

As published, the Multiple Spaces Equation (6-1) applies only to constant volume air handling systems. VAV systems represent a very special case that is technically covered in the language of the Standard, but which was poorly explained in the text of the Standard until Addendum N to ANSI/ASHRAE Standard 62.1-2001 was adopted. However, this requirement is explained in detail in Interpretation IC 62-1999-28, Appendix 9, which explains the proper use of the Multiple Spaces Equation with VAV systems employing recirculation and the basis for that interpretation within the Standard.

Interpretation IC 62-1999-28 holds that the outdoor air fraction for each zone served by a VAV system (Zi) must be computed using the minimum air delivery rate of the critical zone for both heating and cooling applications. And, because each occupiable space has the potential to be the dominant space under some condition, the values of Zi must be computed for every space at both heating and cooling conditions. Even though this interpretation has been in effect since June 26, 1995, copies of the interpretations (originally IC 62-1989-21), were included with the Standard at the time of purchase from ASHRAE and are available for free from ASHRAE. VAV systems have remained notoriously problematic because most designers fail to become familiar with the Standard, fail to read the interpretations, and fail to perform the required computations correctly. For this reason, and the fact that most occupied spaces in this building are served by VAV Reheat systems, special scrutiny was paid to the design of the VAV Reheat systems on this project.

ASHRAE Standard 90.1-1999: **LEED™ 2.1 NC** requires compliance with the requirements of ASHRAE/IESNA Standard 90.1-1999 (without amendments) or the local energy code whichever is more rigorous. For this project, that was the 2000 International Energy Conservation Code, as modified in Comm 63 of the Wisconsin Enrolled Code. Both the Wisconsin Enrolled Code and the 2000 International Energy Conservation Code are based on the substantially less stringent ANSI/ASHRAE/IESNA Standard 90.1-1989.

At the time of design, ANSI/ASHRAE/IESNA Standard 90.1-1999 had been adopted as the basis of Federal law and ANSI/ASHRAE/IESNA Standard 90.1-2001 was the standard of minimum due professional care. For the purposes of this evaluation, the requirements of ASHRAE/IESNA Standard 90.1-1999 (without amendments) are used.

Joint ASHRAE Standard 62.1-1999 (2001)/ ASHRAE Standard 62.1-1999 ASHRAE Standard 62.1-1999 Issues: There are two major areas of convergence and coordination between ANSI/ASHRAE/IESNA Standard 90.1-1999 and ASHRAE Standard 62.1-2001. Both have major implications for the design of VAV systems.

1. Standard 62.1 requires that the HVAC system have the ability to provide the requisite amount of ventilation to each space under all conditions of flow. Educational facilities have

high occupancy densities and therefore high ventilation requirements which almost invariably result in requiring 100% outdoor air ventilation at times, and exhaust energy recovery, to comply with the requirements of both ANSI/ASHRAE/IESNA Standard 90.1-1999 and ANSI/ASHRAE Standard 62.1-2001. When this does not happen, it is usually a strong indication of either excessive over-design of cooling systems or questionable building envelope design.

2. Section 6.3.2.1 of ANSI/ASHRAE/IESNA Standard 90.1-1999 provides a blanket prohibition of the use of reheat. Reheat is only permitted under limited and specific exceptions to that prohibition. Constant volume terminal reheat systems are prohibited. Exceptions (a)(1), (a)(2) and (a)(3) specifically limit minimum VAV air terminal unit flows. Exceptions (a)(4) provides a specific trade-off mechanism permitting Authorities Having Jurisdiction limited discretion in accepting deviations from exceptions (a)(1), (a)(2) and (a)(3). Exception (b) relates to special pressure relationships which neither applies to this project and has become irrelevant with available control technologies. Exception (d) involves the use of on-site recovered energy which does not apply to this project.

Discussion: VAV systems employing the mixed air path have been formally identified by ASHRAE as poor air quality systems in every ASHRAE Systems and Equipment Handbook published since 1992[1,2,3,4]. The convergence of the above requirements affects the way the Ventilation Rate Procedure required by **LEED™** must be computed. Since there are seven (7) HVAC systems of this type on this project, they were all investigated by the reviewing professionals for compliance.

Ventilation Rate Procedure Computations for VAV Systems: The ventilation rate procedure required in ANSI/ASHRAE Standard 62.1 involves very simple computations which are quickly and easily performed in any spreadsheet program. The procedure would involve the following steps.

1. The designer must determine the ventilation requirements for each space.
    a. If the occupancy is known, this is arrived at by simply multiplying the actual number of people to be accommodated by the ventilation rate prescribed in Table 2 of the Standard.
    b. If the occupancy is unknown, Table 2 occupancy values are assumed.
    c. The amount of outdoor air for each space must then be divided by the ventilation effectiveness of the space. For the purpose of the Ventilation Rate Procedure compliance calculations, the reviewing professionals gave the design team the benefit of the doubt by assuming a ventilation effectiveness of 1.0.
    d. The uncorrected outdoor air requirement is then determined by adding up the outdoor air requirements for all of the spaces.

2. The designer must then compute the cooling loads for the spaces and the diversified flow required at the system. In the process of reviewing of the design team's design air flow rates, we would expect to see cooling flow rates ranging from 0.7 to 1.2 cfm/sf for well designed schools with a code compliant building envelope. These values were used as a "rule of thumb" of to evaluate whether the design numbers are probably realistic or excessively

conservative. With a maximum of 2.64 cfm/sf, a median value of 1.43, and an overall average of 1.3 cfm/sf, and knowing that inappropriate cooling design conditions were used, we believe that a comprehensive evaluation of the cooling loads computations would probably indicate that the cooling loads are probably substantially over-estimated. This would have substantial design and energy use and cost implications for the operation of the facility.

3. Once Steps 1 and 2 are completed, it is possible to compute the uncorrected outdoor air fraction ***(X)*** for use with the Multiple Spaces Equation.

4. Once the cooling loads and ventilation rates are known, the designer would have to establish the permissible minimum air flow limits for the VAV air terminal units in accordance with the exceptions to Section 6.3.2.1 of ASHRAE Standard 90.1-1999 which, for this facility, would be limited to 0.4 cfm/sf, 30% of maximum cooling air flow, or the amount of outdoor air required

5. Once the flow limits are determined, the outdoor air fraction ***(Zi)*** required for each space served by a VAV Reheat system must be computed at minimum air flow rates. The compliance calculations prepared by the reviewing professionals found that, when computed in the manner required by ANSI/ASHRAE Standard 62.1-1999, and clarified in ASHRAE Interpretation IC 62-1999-28, the value of ***Zi*** computed for 62 of 134 spaces (46%) was 1, and the median value was 0.7. This meant that 46% of the spaces required 100% outdoor air at the air handing unit to provide adequate ventilation requirements at the spaces to satisfy the requirements of ANSI/ASHRAE Standard 62.1-1999.

6. Once the values for ***Zi*** are computed for each space, the largest value of ***Zi*** becomes ***Zc*** which is then used to compute the corrected outdoor air fraction ***(Y)*** required at each air handling unit using the Multiple Spaces Equation where:

$$Y = X / (1 + X - Zc) \tag{6-1}$$

7. The exceptions to Section 6.3.2.1 of ANSI/ASHRAE/IESNA Standard 90.1-1999 permits the Authority Having Jurisdiction to accept trade-offs allowing higher reheat flows that *"reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in outdoor air intake in accordance with the multiple space requirements defined in ASHRAE Standard 62."* (Exception 4) The outdoor air fraction at the air handling unit can be sometimes be reduced by adjusting the minimum flow rates in lightly occupied, over-ventilated spaces below the limits permitted by Standard 90.1, and adding the amount of the reduction to the minimum flow rates of those spaces driving the outdoor air fraction at the unit. While this can be useful in dealing with relatively low density occupancies where a relatively small number of spaces have substantially higher outdoor air requirements, the effort is wasted in high density occupancies where ventilation needs dominate a significant number of areas.

8. Section 6.3 of ANSI/ASHRAE Standard 62.1-1999 requires that the above computations be made a part of the permanent project record and should be made available for operation of the system within a reasonable time after installation.

Aside from the fact that greater levels of ventilation are required, the major variation from pre-1989 ventilation design criteria was the requirement to use the Multiple Spaces Equation to actually be able to deliver the requisite amount of ventilation to each individual zone. Ventilation Rate Procedure compliance computations were prepared by the reviewing professionals using the design team's occupancy and cooling parameters taken from the Construction Documents, revised to reflect the final air balance reports. These computations can be reviewed in Appendix 1.

Violations: None of the VAV Reheat air handling systems at Northland Pines High School were found to be even marginally compliant with either **LEED™** prerequisites EA2 or EQ1 at the time of bid. The constant volume terminal reheat system (such as AC-3) was of a type expressly prohibited under Section 6.3.2.1 of Standard 90.1-1999. This comprised more than half of the air handling systems serving this facility. In spite of the fact that these deficiencies were identified and brought to the attention of the design team prior to the receipt of bids, project completion documentation shows that most of these deficiencies were never corrected. This means that the design team knowingly submitted and falsely certified a non-compliant design to USGBC for **LEED™ 2.1 NC** certification.

Comments: The use of VAV Reheat in any form should raise red flags on any **LEED™** certification application. The issue is not the difficulty of the computations for ANSI/ASHRAE Standard 62.1-1999 compliance, but what those computations require of the designers. Anyone who regularly performs the computations required for ANSI/ASHRAE Standard 62.1-1999 Ventilation Rate Procedure and **LEED™** compliance learns several things about VAV Reheat systems very quickly.

1. Mathematically, it is extremely difficult to achieve ANSI/ASHRAE Standard 62.1 compliance with a VAV Reheat system and provide design adjusted minimum outdoor air rates ***(Y)*** less than 50% in any application. This is because the critical outdoor air fraction must be computed for each space by dividing the outdoor air requirements by the terminal minimum air flow rate (refer to ANSI/ASHRAE Standard 62.1 Interpretation IC 62-1999-28). That rate is functionally limited to approximately 30% by ANSI/ASHRAE/IESNA Standard 90.1. In high density occupancies like schools, VAV Reheat systems invariably require 100% outdoor air unless there is a very significant internal heat gain or the cooling loads are overstated.

2. VAV Reheat air terminal units serving high density areas like classrooms will require unique minimum flow values because Standard 62.1 ventilation rates are often greater than the minimum setting limit established by exceptions to Section 6.3.2.1 of ANSI/ASHRAE/IESNA Standard 90.1-1999. This typically results in non-uniform turn down ratios and high adjusted outdoor air fractions to meet ventilation requirements. The presence of uniform turn down ratios on VAV Reheat air terminal units has a high correlation with failure to perform the required calculations.

3. Special controls are required for VAV Reheat systems under both ANSI/ASHRAE Standard 62.1-1999 and ANSI/ASHRAE/IESNA Standard 90.1-1999 to assure that adequate ventilation is provided whenever spaces are occupied.

4. When the required amount of outdoor air rises above 70% of minimum flow or about 21% of peak cooling flow in any space, energy recovery becomes a requirement of section 6.3.6 of ANSI/ASHRAE/IESNA Standard 90.1-1999.

The above observations are not characteristic of any individual project, but of VAV system compliant with both ANSI/ASHRAE Standard 62.1 and ANSI/ASHRAE/IESNA Standard 90.1. Understanding the above makes non-compliant VAV designs readily identifiable. If the necessary system features are not there, or non-compliant features are there, the system probably does not comply and the design should be reviewed in depth.

Since the reheat air terminal unit minimum flow rate issue also constituted Wisconsin Code violations, and was brought to the attention of the Authority Having Jurisdiction, these violations should have been corrected in full when the systems were installed. Curiously, these changes were only partially implemented, and only to selected air handling units. Corrective modifications to bring minimum VAV air terminal unit flow rates into compliance with Wisconsin code were made on only 3 of the 7 VAV systems on this project. Corrections made to minimum outdoor air flow rates were only sufficient to bring the seven VAV systems into marginal compliance with Wisconsin Code requirements for ventilation. The requirements of ANSI/ASHRAE Standard 62.1-1999 were completely ignored.

Summary: The above observations demonstrate that virtually all ANSI/ASHRAE Standard 62.1-1999 and almost all of the ANSI/ASHRAE/IESNA Standard 90.1-1999 violations noted at the time of bid fully intact upon project completion. A similar conclusion can be drawn with respect to Wisconsin Code violations. Prudent and responsible engineering design practices would require that the design team research and correct the deficiencies identified prior to bid.

IV. NON-COMPLIANCE WITH LEED™ PREREQUISITES

Compliance with Prerequisites EQ 1, Minimum IAQ Performance and EA 2, Minimum Energy Performance is mandatory for **LEED™ 2.1** Certification to be granted:

- EA1, Prerequisite, Fundamental Building Systems Commissioning: Compliance with Section 6.2.5.4 of ANSI/ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low Rise Residential Buildings*, (without amendments) and ASHRAE Guideline 1-1996, *The HVAC Commissioning Process*.

- EA2, Prerequisite, Minimum Energy Performance: Compliance with ANSI/ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low Rise Residential Buildings*, (without amendments).

- EQ1, Prerequisite, Minimum IAQ Performance: Compliance with ANSI/ASHRAE Standard 62.1-1999, *Ventilation for Acceptable Indoor Air Quality*, (plus approved addenda, or ANSI/ASHRAE Standard 62.1-2001, *Ventilation for Acceptable Indoor Air Quality*, as originally published)..

No attempt has been made by the reviewing professionals to independently develop separate thermal load computations or Energy Cost Budget Method calculations. While such information may be useful in litigation to establish design error, that was not the objective. The purpose of the computations prepared was to establish the status of compliance with specific provisions of the **LEED™** prerequisites. The information upon which these calculations are based was derived entirely from the Construction Documents, revised plans obtained from contractors, the Testing and Balancing report and record Temperature Control documents, and limited access granted to the facility. The purpose of this section of the Appeal is to illustrate the scope, magnitude and consequences of the violations to the attention of USGBC.

Supplemental documentation attached identifies defects by reference to the specific provision of the Standard violated, contain a description of the deficiency, a discussion of the nature of the defect, the extent to which the defects affect the performance of the systems, and the number of defects identified. Compliance computations conforming to the requirements of the prerequisite Standards and other documents are provided in Appendices. Basic parameters used in the compliance computations were taken directly from the Construction Documents. Formal published interpretations by the governing ASHRAE committees (SSPC's) are referenced and copies provided where different interpretations are anticipated from the design team.

Text from the ASHRAE Standards is shown indented and in italics.

<u>ANSI/ASHRAE/IESNA Standard 90.1-1999:</u> **LEED™ NC2.1** requires compliance with the more rigorous requirements of ASHRAE/IESNA Standard 90.1-1999 (without amendments), or the local energy code, Comm 63. For this Project the local Code required compliance with the 2000 International Energy Conservation Code, with a reference to ANSI/ASHRAE/IESNA Standard 90.1-

1989 (without amendments) adopted by reference in Comm 63 of the Wisconsin Enrolled Code. Both are less stringent than ANSI/ASHRAE/IESNA Standard 90.1-1999. At the time of design, ANSI/ASHRAE/IESNA Standard 90.1-1999 had been adopted as the basis of Federal law and ANSI/ASHRAE/IESNA Standard 90.1-2001 was the standard of minimum due professional care. Until recently, Wisconsin has been in non-compliance with the 1992 EPACT since July 15, 2004, the mandatory date for adoption of ANSI/ASHRAE/IESNA Standard 90.1-1999 or its equivalent as the basis of it's Energy Code. For the purposes of this evaluation, the requirements of ASHRAE/IESNA Standard 90.1-1999 (without amendments) are used.

A sum total of **1,268** individual violations of ANSI/ASHRAE/IESNA Standard 90.1-1999 have been identified in just the HVAC systems, and this is only a partial list since the review was not of the complete HVAC systems and the reviewing professionals did not have access to design team project records or complete access to the building.

Because the reviewing professionals do not have access to the designer's computations and have not performed detailed building thermal load computations, additional violations of the Standard may have occurred.

6.1 General

6.1.1 HVAC Scope. *All mechanical equipment and systems serving the building heating, cooling, or ventilating needs shall meet the requirements of Section 6.*

6.1.2 Compliance. *Compliance with Section 6 shall be achieved by meeting all requirements for either*

(a) 6.1.3 (Simplified Approach Option for HVAC Systems), or
(b) 6.2 (Mandatory Provisions) and 6.3 (Prescriptive Path), or
© 6.2 (Mandatory Provisions) in conjunction with Section 11 (Energy Cost Budget Method).

ANSI/ASHRAE/IESNA Standard 90.1-1999 Compliance Path: The Simplified Approach Option is only applicable to facilities of 25,000 square feet of gross floor area, or less. Since this facility has 251,000 gross square feet of floor area, this compliance path is not permitted.

It is acknowledged by the reviewing professionals and the appellants that the design team claimed to have performed DOE-2 analyses during the preliminary design phase. However, it was publically acknowledged by the design team, and documented on videotape, that the DOE-2 simulations were performed prior to defining the HVAC systems.

Such computations would have failed to comply with the compliance requirements of the Energy Cost Budget Method defined under Section 11.1.2 of ANSI/ASHRAE/IESNA Standard 90.1-1999. Section 11.1.5 of ANSI/ASHRAE/IESNA Standard 90.1-1999 also requires that these computations be made a part of the permanent project record and submitted to the Authority Having Jurisdiction for approval. Such documentation would have been required to include:

- The energy cost budget for both the budget building and the proposed design,
- A list of specific features analyzed for the proposed design,
- Input and output reports from the analysis, and
- A list of any error reports with explanations of the errors.

The design team actually submitted building envelope compliance documentation to the AHJ using Comcheck EZ, not DOE-2. Since this program is unacceptable to the Authority Having Jurisdiction for determining HVAC system compliance, any claim of compliance using the Energy Cost Budget Method permitted under Section 11 of ANSI/ASHRAE/IESNA Standard 90.1-1999 would be false.

Furthermore, at the time of design, Wisconsin had not adopted ANSI/ASHRAE/IESNA Standard 90.1-1999 as the basis of it's energy code. The Authority Having Jurisdiction also refused, in writing, to enforce the provisions of 90.1 (refer to Appendix 6). Therefore, the Prescriptive Path *(Section 6.3*) is the only ANSI/ASHRAE/IESNA Standard 90.1-1999 compliance path available to this project. It is upon this basis that this evaluation is made.

6.2 Mandatory Provisions

6.2.1 Mechanical Equipment Efficiency. *Equipment shown in Tables 6.2.1A through 6.2.1G shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements, unless otherwise exempted by footnotes in the table. However, equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum efficiency requirements for operation at minimum capacity or other than standard rating conditions. Equipment used to provide water heating functions as part of a combination system shall satisfy all stated requirements for the appropriate space heating or cooling category. (Inapplicable portions of Section 6.2.1 have been deleted for brevity)*

6.2.1 Violations: The water chiller originally specified was a nominal 500-ton, air-cooled chiller using a propylene glycol solution. The specified manufacturer derates that chiller's performance to 404 tons at the operating conditions specified. For an unknown reason, the designers modified the Chiller Schedule on the drawings to a 400 nominal ton machine, using the derated performance criteria for the original machine. The water chiller provided does not meet the 2.80 COP/IPLV requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999, Table 6.2.1C, and the design does not meet the exception provisions to Section 6.2.1. The equipment manufacturer is the same as specified in the Construction Documents, and according to the manufacturer's selection program, has a COP of only 2.56 at the conditions specified (8.6% below requirements in Table 6.2.1C). The design does not qualify for any allowable exception to this requirement. The primary cooling plant for this building does not meet the minimum efficiency requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999. One (1) violation is noted.

Comments: The sum of the coil flows come to 1,601 gpm and a combined cooling load of 734.1 tons of refrigeration. At the time of bid, the Construction Documents indicated a nominal 500-ton machine delivering 870 gpm of 35% propylene glycol with an initially scheduled capacity requirement of 441.9 tons of refrigeration effect. No thermal storage was provided and the equipment specified is not equipped to make ice. Given that the indicated capacity only 60% of the sum of coil loads, the initial chiller design capacity appeared to be dubious.

The reviewing professionals questioned the specified chiller performance, performed equipment selections on the chiller specified to validate that the specified performance could be achieved, and noted that the machine specified could not provide the specified capacity, could only deliver 404 tons at the temperatures and flows indicated, or 55% of the sum of the coil loads. This deficiency, and the reasons for it, were noted in the review of the bidding documents given to the designer.

Subsequently, without modifying the load-side performance criteria, the design team announced that they had found more "efficiencies" and further reduced the size of the equipment to a nominal 400-ton machine with an actual deliverable capacity of approximately 323 tons, now down to only 44% of the sum of coil loads. This raises the obvious question, "If a refrigeration machine can only deliver 90% of the originally specified performance, why would a responsible design professional reduce the size of that equipment another 20%?"

This begs the question as to whether the thermal load computations used for the facility were computed properly.

> ***6.2.2 Load Calculations.*** *Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with generally accepted engineering standards and handbooks acceptable to the adopting authority (for example, ASHRAE Handbook—Fundamentals).*

6.2.2 Violations: Design conditions for compliance with ANSI/ASHRAE/IESNA Standard 90.1-1999 are defined under Section 3.1 of the Standard. Design conditions listed on the plans indicated 95°F db and 75°F wb were used for cooling, and -30°F was used for heating. The nearest city for which weather data is readily available is Wausau, Wisconsin, which has ASHRAE 0.4% design cooling conditions of 88°F db and 71°F wb, and ASHRAE 99% design heating conditions of -15°F. The Wisconsin Code permitted design conditions of 86°F db and 75°F wb, and design heating conditions of -25°F. The design conditions employed for load calculations and equipment selection failed to comply with the requirements of ANSI/ASHRAE/IESNA Standard 90.1. Heating design conditions used also exceeded those defined for ANSI/ASHRAE/IESNA Standard 90.1-1999, and local Codes. One violation each is noted for heating and cooling load computations.

Observations: There is a significant conflict between the Wisconsin Code and ANSI/ASHRAE/IESNA Standard 90.1-1999. Standard 90.1 define limits the designer shall not exceed. The Wisconsin Code is written such that the design temperatures represent minimums which the designer must design for. Good practice would have the designer use values representing the more rigorous of the two. However, since the 1992 Energy Policy Act required all states to adopt energy codes no less stringent than ANSI/ASHRAE/IESNA Standard 90.1, federal law and the **LEED™** prerequisites take precedence. In this case, both sets of criteria were ignored and more extreme conditions were used. As such, the design heating and cooling load calculations not only failed to comply with the requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999, they constituted a violation of both federal law and an act of misconduct as defined under Wisconsin Rules of Professional Conduct for Architects, Engineers, Designers and Surveyors, A-E 8, Article A-E 8.03 (3) (a) (see Appendix 4).

This is a significant violation of ANSI/ASHRAE/IESNA Standard 90.1 that has resulted in substantial over-design of the HVAC systems. This degree of deviation has far reaching, practical adverse consequences for the design and long term energy performance of the facility.

- The cooling design conditions employed produce exaggerated space cooling loads and air flow requirements. Space cooling loads can be divided into internal and external loads. Even with maximum permissible lighting load Watt density of 1.5 W/sf and full occupancy loads, building envelope loads appear substantially larger than would be reasonably expected. It would be very informative to review the underlying assumptions behind these calculations.

- Ventilation typically constitutes somewhere between 80-90% of cooling loads. The cooling design conditions employed would produce exaggerated design ventilation cooling loads, approximately 40% greater than those that would otherwise be predicted with compliant computational methods.

- As designed, large zones are served by variable temperature, constant volume HVAC systems (AC-1, AC-4, AC-5, AC-8, AC-9, and AC-10). These systems will be incapable of managing relative humidity conditions under light loads and occupancy conditions and increase the potential for mold growth.

- Cooling loads for individual spaces and systems have been substantially overstated resulting in higher design peak air flow rates. This would have artificially increased the VAV box minimum settings allowable under ANSI/ASHRAE/IESNA Standard 90.1-1999 thereby imposing increased reheat loads on the facility in violation of Sections 6.3.1.4 and 6.3.2.1.

- It would also impact the Ventilation Rate Procedure computations required by ANSI/ASHRAE Standard 62.1-1999, artificially reducing the outdoor air fraction required at the air handling units.

- This reduction in outdoor air fraction could also impact the ANSI/ASHRAE/IESNA Standard 90.1-1999 requirements for application of energy recovery processes under Section 6.3.6.1.

The impact of the improper computation of heating and cooling loads has implications for all areas of HVAC system design. The failure to use proper design parameters is a substantial violation of ANSI/ASHRAE/IESNA Standard 90.1-1999 with major implications for design and demonstrates a serious violation of the basic intent behind **LEED™** Prerequisites and the requirements of the 1992 Energy Policy Act..

6.2.3 Controls

6.2.3.1.2 Dead Band. *Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.*

Violation: The Construction Documents do not address this requirement. There is no indication in the Temperature Control As Built record documents that this requirement was met. The failure to comply with Section 6.2.3.1.2 of ANSI/ASHRAE/IESNA Standard 90.1-1999 may only be a technical violation but is illustrative of the extent of the violations of **LEED™** Prerequisites, longstanding requirements of the State of Wisconsin Enrolled Code, and requirements of the 1992 Energy Policy Act. 79 violations are noted for heating terminal devices. VAV Reheat devices are not included in this number because even though the dead band was not required in the either the Construction Documents or record Temperature Control Documents. The physical capability is there and normally programmed in by Temperature Control contractors to reduce wear and tear on actuators.

6.2.3.2 Off-Hour Controls. *HVAC systems having a design heating or cooling capacity greater than 65,000 Btu/h and fan system power greater than 3/4 hp shall have all of the following off-hour controls: Automatic Shutdown (6.2.3.2.1), Setback Controls (6.2.3.2.2), Optimum Start Controls (6.2.3.2.3), Shutoff Damper Controls (6.2.3.2.4), and Zone Isolation (6.2.3.2.5).*

Violations: Review of the Construction Documents indicates that while the air handling systems were equipped with Shutoff Dampers (6.2.3.2.4) and Automatic Shutdown (6.2.3.2.1) controls based on time-of-day operation, Setback (6.2.3.2.2) Control was explicitly prohibited, and Optimum Start Controls (6.2.3.2.3) and Zone Isolation (6.2.3.2.5) controls were not provided. Review of the record Temperature Control Drawings indicates that these required control functions were not provided. 454 separate violations are noted for failing to specify or provide set-back and optimum start controls on 213 heating terminal devices and 14 air handling units. VAV Reheat devices are included in this number because setback control logic is not required in the either the Construction Documents or the record Temperature Control Documents.

Observations: This failure to comply with this requirement might be argued to be an oversight, or a technical violation of ANSI/ASHRAE/IESNA Standard 90.1-1999, but is illustrative of the extent to which **LEED™** Prerequisites, longstanding requirements of the State of Wisconsin Enrolled Code, and requirements of the 1992 Energy Policy Act were ignored on this project.

6.2.4 HVAC System Construction and Insulation

6.2.4.3 Duct Sealing. *Ductwork and plenums shall be sealed in accordance with Table 6.2.4.3A (Table 6.2.4.3B provides definitions of seal levels), as required to meet the requirements of 6.2.4.4, and with standard industry practice.*

Comment: In addition to being a **LEED™** prerequisite, and a requirement of ANSI/ASHRAE/IESNA Standard 90.1-1999, this requirement is also a matter of compliance with the Wisconsin Enrolled Code. The Construction Documents only minimally address this requirement. It is also a matter of record that duct leakage has been a significant problem on this project and that the building has had problems maintaining heat in the facility. Leakage has been noted as prevalent with respect to the duct board construction down stream of VAV Reheat boxes where pressure sensitive tape was employed.

> ***6.2.4.4 Duct Leakage Tests.*** *Ductwork that is designed to operate at static pressures in excess of 3 in. w.c. shall be leak tested according to industry-accepted test procedures (see Appendix E). Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested. Duct systems with pressure ratings in excess of 3 in. w.c. shall be identified on the drawings.*

Violation: The Construction Documents failed to require duct leakage testing. The failure to comply with this requirement affects the duct systems for entire building and has had major implications for actual building system performance. 73 separate violations are noted for this matter, one each for 45 exhaust fans, and two each for 14 air handling units.

> ***6.2.5 Completion Requirements***
> ***6.2.5.1 Drawings.*** *Construction documents shall require that within 90 days after the date of system acceptance, record drawings of the actual installation be provided to the building owner. Record drawings shall include as a minimum the location and performance data on each piece of equipment, general configuration of duct and pipe distribution system including sizes, and the terminal air or water design flow rates.*

Violation: The appellants were unable to obtain copies of the record Drawings for reproduction and had to rely on salvaging documents from installing contractors. One violation noted.

> ***6.2.5.3 System Balancing***
> ***6.2.5.3.3 Hydronic System Balancing.*** *Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses; then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure differential pressure increase across the pump or have test ports at each side of each pump.*
> ***Exceptions to 6.2.5.3.3****:*
> *(a) Pumps with pump motors of 10 hp or less.*
> *(b) When throttling results in no greater than 5% of the nameplate horsepower draw, or 3 hp, whichever is greater, above that required if the impeller was trimmed.*

Violation: The Testing and Balancing report indicated that the systems were balanced. Field observation of the primary heating and primary and secondary cooling pumps found that balancing had been made by adjustment of the discharge valves and that pump impellers may not have been trimmed. Four violations are noted, one for each pump identified.

Comment: The pumps in question are high head, large horsepower pumps. Total pump design heads were significantly beyond that which would be anticipated by the reviewing professionals for these applications. It is highly likely that the impellers have been trimmed to the limit possible by the pump manufacturer, and that additional balancing at the discharge valve was necessary. The pumps are being operated at conditions well beyond those permitted by ANSI/ASHRAE/IESNA Standard 90.1-1999. The failure to comply with this requirement is a substantial violation of ANSI/ASHRAE/IESNA Standard 90.1-1999 with long term energy consequences, and is indicative of the extent of the violations of **LEED™** Prerequisites.

> ***6.2.5.4 System Commissioning.*** *HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 ft^2 conditioned area, except warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems (see Appendix E) shall be provided by the designer in plans and specifications.*

Violation: Appendix E of ANSI/ASHRAE/IESNA Standard 90.1-1999 contains the reference to ASHRAE Guideline 1, *The HVAC Commissioning Process*. Under **LEED™ 2.1 NC**, Prerequisite EA1 requires six specific procedures be implemented including review of design intent, basis of design documentation, and incorporation of commissioning requirements into the Construction Documents. Establishing design intent involves establishing "occupancy requirements," "system functions, energy, and air quality and environmental performance criteria[8]." One violation is noted for the failure to issue detailed Commissioning requirements with the Construction Documents, however, substantially more may have occurred.

Comment: While the reviewing professionals and appellants are aware that a Commissioning Agent was engaged, we believe that there is substantial evidence to indicate that the Commissioning process was (1) not executed in accordance with **LEED™ 2.1 NC**, (2) not executed in accordance with ANSI/ASHRAE/IESNA Standard 90.1-1999, and (3) not executed in accordance with ASHRAE Guideline 1, 1996. No matter which way this gets spun, the requirements of **LEED™ 2.1 NC** and ANSI/ASHRAE/IESNA Standard 90.1-1999 were violated.

ANSI/ASHRAE Standard 62.1-1999 and ANSI/ASHRAE/IESNA Standard 90.1-1999 both have substantial design computation and documentation requirements which require design review by the Commissioning Agent. The nature and extent of the deficiencies observed in the design and in the field by the reviewing professionals indicate a high probability that the design team either failed to prepare the necessary computations, failed to engage Commissioning Services in time to provide the required design review process, or that Commissioning Services were not performed in a competent manner by the Commissioning Agent.

The problems with this design should have been readily apparent to anyone familiar with the requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999 and computational procedures of ANSI/ASHRAE Standard 62.1-1999. Indicators of non-compliant designs include:

1. The use of VAV reheat systems using a recirculation path without the benefit of:
   a. An outdoor air injection fan or parallel dedicated outdoor air system.
   b. The necessary controls to ensure adequate outdoor air delivery at low flow conditions at all air handling units.
   c. This would indicate a solution probably noncompliant with both ANSI/ASHRAE Standard 62.1 and ANSI/ASHRAE/IESNA Standard 90.1.

2. Uniform VAV Reheat air terminal unit air flow percentages approximating 30%. This would suggest some awareness of the reheat limitations of ANSI/ASHRAE/IESNA Standard 90.1, but a lack of awareness of the fact that the 30% of peak flow had been deleted from ANSI/ASHRAE/IESNA Standard 90.1-1999 and indicative of failure to perform the Ventilation Rate Procedure computations required by ANSI/ASHRAE Standard 62.1-1999.

3. Uniform VAV Reheat air terminal unit air flow percentages greater than 30%. This would suggest both lack of awareness of the reheat limitations of ANSI/ASHRAE/IESNA Standard 90.1-1999 and indicative of failure to perform the Ventilation Rate Procedure computations required by ANSI/ASHRAE Standard 62.1-1999.

4. Minimum outdoor air percentages lower than 50%. This indicates the improper use of the Multiple Spaces Equation for VAV systems, if the ANSI/ASHRAE Standard 62.1 Ventilation Rate Procedure computations have been performed at all.

Had the Commissioning Process reviews required by **LEED™ 2.1 NC** and ASHRAE Guideline-1 been performed, most, if not all of the deficiencies identified by the reviewing professionals should have been identified by the Commissioning Agent and corrected by the design team prior to the issuance of Construction Documents.

As of seven days prior to the Bid Date, the Construction Documents should have, but failed, to include detailed commissioning specifications. Issuance of commissioning requirements subsequent to the bid date would not have satisfied the requirements of **LEED™ 2.1 NC** and would have caused in the installing Contractors to not including the cost of their Commissioning responsibilities in their bids.

6.3 Prescriptive Requirements

Comment: The prescriptive path is deemed by the reviewing professionals to be the appropriate and only ANSI/ASHRAE/IESNA Standard 90.1-1999 compliance path available for this project, given the failure of the design team to meet the requirements of the Energy Cost Budget Method.

> ***6.3.1 Economizers.*** *Each cooling system that has a fan and has capacity greater than or equal to the size listed in Table 6.3.1 shall include either an air or water economizer meeting the requirements of 6.3.1.1 through 6.3.1.4. (Exceptions to 6.3.1: are not applicable and are not listed for brevity.)*

6.3.1.1 Air Economizers

6.3.1.1.1 Design Capacity. *Air economizer systems shall be capable of modulating outside air and return air dampers to provide up to 100% of the design supply air quantity as outside air for cooling.*

6.3.1.1.2 Control Signal. *Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment* ***and shall not be controlled by only mixed air temperature****.* *(*Emphasis added)

> ***Exception to 6.3.1.1.2:*** *The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-zone systems).*

Violation: Air economizers were provided in all air handling systems. However, the air economizers employed for all seven VAV Reheat systems not only employed mixed air control, which is permitted, but included a mixed air low limit, which is prohibited in variable air volume system types. The requirements for special controls by ANSI/ASHRAE Standard 62.1, Section 5.3, were not addressed in either the Construction Documents, nor were they installed as a part of the Temperature Control System. The requirements were not included in the Construction Documents, Neither the necessary hardware nor the necessary logic is indicated to have been provided in the record Temperature Control documents. This constitutes multiple, serious violations of both ANSI/ASHRAE/IESNA Standard 90.1-1999 and essentially prevent compliance with ANSI/ASHRAE Standard 62.1 with the system types provided. Seven violations are noted, one for each VAV air handling unit.

Comment: To comply with the requirements of ANSI/ASHRAE Standard 62.1, Section 5.3, the systems must be able to deliver the requisite amount of outdoor air to each occupied space. As ambient temperatures go below 55°F, mixed air control acts to reduce the outdoor air fraction on the system at the air handling unit. At the same time, cooling loads to the space from building envelope elements also tend to decline, decreasing the amount of air provided by VAV systems to the spaces. To maintain a given rate of supply air delivery to a space as the amount of primary air delivered to that space declines, the outdoor air fraction must increase with declining primary flow, not decrease as would normally occur with mixed air control. A mixed air low limit control also prevents the necessary control action and thoroughly compromises the system's ability to provide the requisite amount of outdoor air at minimum flow conditions.

To accomplish this objective with VAV Reheat systems, where ventilation air is introduced through a mixed air path, as is done with these systems, the control system must continuously monitor the required outdoor air fraction at each zone served and the actual outdoor air fraction, and have the ability to actively adjust the outdoor air fraction at the air handling system to accommodate the needs of the critical space in real time.

The equation for these computations is found in the multiple spaces provisions of ANSI/ASHRAE Standard 62.1, Section 6.1.3.1, Equation (6-1). The necessary logic must be specified in the Construction Documents, and provided in the Temperature Control System. Specific measurement equipment is required to accomplish this. None of the required equipment or control logic was either specified or installed. Instead, a control strategy that would completely compromise this objective was specified and installed.

This violation is extremely serious. It completely compromised compliance with **LEED™ 2.1 NC** Prerequisite EQ1 for more than half of the air handling systems in the building. Those eight systems (HRAC-1, HRAC-2, HRAC-3, HRAC-4, AC-2, AC-3, AC-6, and AC-7) provide 54% of the total building air delivery capacity and serve the most densely and continuously occupied areas serving the primary function of the building. This alone is a basis for revocation of the **LEED™ 2.1 NC** Gold Certification. However, this is not the only nor the most serious disqualifying defect in the design and construction of this facility.

> ***6.3.1.1.3 High Limit Shutoff***. *All air economizers shall be capable of automatically reducing outside air intake to the minimum quantities required by 6.1.2 of ASHRAE Standard 62 when outside air intake will no longer reduce cooling energy usage. High limit shutoff control types for specific climates shall be chosen from Table 6.3.1.1.3A. High limit shutoff control settings for these control types shall be those listed in Table 6.3.1.1.3B.*

Violation: The hi limit shutoff temperatures specified is not as required in Table 6.3.1.1.3B on all air handling systems. 14 total violations, one for each of 14 air handling systems.

Comment: This is a minor technicality readily corrected through system software. However it represents one more example of failure to observe prerequisite requirements.

> ***6.3.1.4 Economizer Heating System Impact.*** *HVAC system design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation*.

Violation: Violations associated with Sections 6.3.2.1, 6.3.6.1 and ANSI/ASHRAE Standard 62.1-1999, Section 6.1.3.1 resulted in significantly increasing building heating energy use and heating capacity requirements. The reviewing professionals have determined that the increase in heating capacity required is approximately 400%.

Comment: Please review the information provided regarding violations of the above sections.

> ***6.3.2 Simultaneous Heating and Cooling Limitation***
> ***6.3.2.1 Zone Controls.*** *Zone thermostatic controls shall be capable of operating in sequence the supply of heating and cooling energy to the zone. Such controls shall prevent*
> *(1) reheating,*
> *(2) recooling,*
> *(3) mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical refrigeration or by economizer systems, and*
> *(4) other simultaneous operation of heating and cooling systems to the same zone.*

Exceptions to 6.3.2.1*:*

(a) Zones for which the volume of air that is reheated, recooled, or mixed is no greater than the larger of the following:

(1) ***The volume of outside air required to meet the ventilation requirements of 6.1.3 of ASHRAE Standard 62 for the zone.*** (Emphasis added) *For variable air volume systems, the minimum volume controller shall be certified by the manufacturer to be able to maintain this minimum flow rate within 10%.*

Comments on Exception (a)(1): Outdoor air ventilation rates required for Standard 62.1-1999 must be computed to determine the correct minimum flows required for this exception and, for variable air volume systems, the minimum volume controller must meet the ventilation requirements of 6.1.3 of ASHRAE Standard 62 within 10%. Since the Construction Documents and the record Temperature Control Documents indicate that no mechanism to meet this requirement was provided, this exception does not apply.

(2) ***0.4 cfm/ft2 of the zone conditioned floor area****,* (Emphasis added) *provided that the temperature of the primary system air is, by design or through reset controls, 0-12°F below the design space heating temperature when outside air temperatures are below 60°F for reheat systems and the cold deck of mixing systems and 0-12°F above design space temperature when outside air temperatures are above 60°F for recooling systems and the hot deck of mixing systems. For multiple zone systems, each zone need not comply with this exception provided the average of all zones served by the system that have both heating and cooling ability comply.*

Comment on Exception (a)(2): There are two tests here. This provision permits the use of reheat up to 0.4 CFM/ft^2, however, a cold deck reset must be provided. Since no cold deck reset was provided for with any of the subject systems, this exception does not apply.

(3) ***300 cfm****.* (Emphasis added) *This exception is for zones whose peak flow rate totals no more than 10% of the total fan system flow rate.*

Comment on Exception (a)(3): This provision permits the use of reheat up to an air delivery rate of not more than 300 cfm provided the sum of their peak flow rates do not exceed 10% of the total air delivery capacity of the air handling unit. Only 10 of the 134 VAV air terminal units, and none of the 11 booster coils provided for AC-3 qualify for this exception.

(4) ***Any higher rate that can be demonstrated****, to the satisfaction of the authority having jurisdiction,* ***to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in outdoor air intake in accordance with the multiple space requirements defined in ASHRAE Standard 62.*** (Emphasis added)

Comment on Exception (a)(4): This provision permits the use of reheat upon the approval of the AHJ only on the basis of offsetting airflows computed using Equation 6-1 from Standard 62.1. Since the compliance computations clearly establish that the design of the HVAC systems at this facility are not based upon Standard 62.1 criteria, this exception does not apply.

> *(b) Zones where special pressurization relationships, cross contamination requirements, or code-required minimum circulation rates are such that variable air volume systems are impractical.*

Comment on Exception (b): Given the control capabilities that have been developed for VAV systems to permit them maintain special pressure relationships and prevent cross contamination issues, this provision is an anachronism and extraordinarily difficult to justify. Furthermore, nothing in the applicable codes or standards would justify the application of this criteria to any occupancy category found on this project. Since almost all of the spaces are served by VAV systems, this exception simply does not apply.

> *(c)Zones where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered (including condenser heat) or site solar energy source.*

Comment on Exception (c): Since no energy recovery, solar or other renewable energy resource is employed to offset reheat energy, this exception does not apply.

Violations: Section 6.3.2.1 of ANSI/ASHRAE/IESNA Standard 90.1-1999 is a blanket prohibition of simultaneous heating and cooling. Reheat is permitted only under limited exceptions to this provision. The only exception that could have conceivably applied to the design of the VAV Reheat boxes would have been exception (a)(1).

There are four distinct and separate violations to Section 6.3.2.1.

1) outdoor air ventilation rates required for Standard 62.1-1999 compliance are required to be used to compute ANSI/ASHRAE/IESNA Standard 90.1-1999 minimum flow quantities. Standard 90.1 establishes Standard 62.1 minimums as Standard 90.1 maximums. Compliance computations show that, as designed, minimum ventilation rates either exceeded that required on 133 of 134 VAV Reheat boxes. As designed, 99.3% failed to comply with this requirement. As installed, 134 of 134 VAV Reheat boxes (100%) also failed to comply with the requirements of this Exception.

2) Exception (a)(2) permits minimum flow rates to be based on 0.4 cfm/ft2 when a cold deck reset function is provided. When measured as a ratio of flow per unit floor area, actual minimum air flow rates varied from 0.14 to 1.76 cfm/ft2, demonstrating that Exception (a)(2) was not the basis for the exception. From the Construction Documents, it was apparent that minimum air flow rates were actually computed to achieve one of three leaving discharge air temperatures for heating purposes; 85°F, 90°F, or 95°F. Furthermore, VAV box minimums were reset to 30% for summer operation. Neither of these practices are permitted under ANSI/ASHRAE/IESNA Standard 90.1-1999. As such, neither bases for determination of minimum air blows for 134 of 134 devices (100%) failed to comply with the requirements of this Exception, for a subtotal of 268 separate violations.

3) For variable air volume systems, the minimum volume controller must meet the ventilation requirements of 6.1.3 of ASHRAE Standard 62 within 10%. Review of the specifications and record Temperature Control Documents indicate that the designers failed to any mechanism to meet this requirement a part of the Construction Documents and no mechanism was not provided during construction. 134 of 134 (100%) of the installed devices failed to comply with the requirements of this Exception.

In addition, the limitations of exception 6.3.2.1 (a)(3) make air handling system AC-3, serving 11 reheat coils, 9 of which exceed the capacity limitations, and the sum of the 11 coils, a prohibited system type.

Comment: Since these violations were also violations of the Wisconsin Enrolled Code, it was reported to the Authority Having Jurisdiction as required by the Wisconsin Rules of Professional Conduct for Architects, Engineers, Designers and Surveyors, A-E 8, Article A-E 8.08. Between the time of bid, and the completion of construction, the number of Code non-compliant devices was reduced from 119 to 76, or 57% of the installed reheat air terminals installed. These conditions are currently in violation of the provisions of the Wisconsin Enrolled Code.

These were flagrant and widespread violations with significant implications for the design and installation of not only the VAV Reheat boxes, but for 8 of 14 air handling systems. It also has significant implications for the size and energy use characteristics of both primary heating and cooling plants.

> ***6.3.3 Air System Design and Control.*** *HVAC systems having a total fan system power exceeding 5 hp shall meet the provisions of 6.3.3.1 through 6.3.3.3 unless otherwise noted.*

TABLE 6.3.3.1 - FAN POWER LIMITATION
Allowable Nameplate Motor Power

Supply Air Volume	Constant Volume	Variable Volume
<20,000 cfm	1.2 hp/1000 cfm	1.7 hp/1000 cfm
20,000 cfm	1.1 hp/1000 cfm	1.5 hp/1000 cfm

> ***6.3.3.1 Fan Power Limitation.***
> *(a) The ratio of the fan system power to the supply fan airflow rate (main fan) of each HVAC system at design conditions shall not exceed the allowable fan system power shown in Table 6.3.3.1.*
> *(b) Where air systems require air treatment or filtering systems with pressure drops over 1 in. w.c. when filters are clean, or heat recovery coils or devices, or direct evaporative humidifiers/coolers, or other devices to serve process loads in the airstream, the allowable fan system power may be adjusted using the pressure credit in the allowable fan system equation at the end of 6.3.3.1.*
> *(c)If the temperature difference between design room temperature and supply air temperature*

at cooling design conditions that is used to calculate design zone supply airflow is larger than 20°F, the allowable fan system power may be adjusted using the temperature ratio in the allowable fan system power equation at the end of 6.3.3.1.

Allowable Fan System Power = [Table 6.3.3.1 Fan Power Limitation ´ (Temperature Ratio) + Pressure Credit + Relief Fan Credit] where:

Table 6.3.3.1 Fan Power Limitation = Table Value ´CFM/1000

Temperature Ratio = $(T_{t\text{-}stat} - T_S) / 20$ *(11.1)*

Pressure Credit (hp) = Sum of [$_{CFM}$ *´ (SPn – 1.0) / 3718] + Sum of [*CFM_{HR} *´* SP_{HR}*/3718]*

Relief Fan Credit HP (kW) = $F_{R\ HP}$ *(kW) ´ [1 – (*CFM_{RF} */* CFM_n*)]*

CFMn = supply air volume of the unit with the filtering system (cfm)

CFM_{HR} *= supply air volume of heat recovery coils or direct evaporative humidified/cooler (cfm)*

CFM_{RF} *= relief fan air volume at normal cooling design operation*

SP_n *= air pressure drop of the filtering system when filters are clean (in. w.g.)*

SP_{HR} *= air pressure drop of heat recovery coils or direct evaporative humidifier/cooler (in. w.g.).*

$T_{t\text{-}stat}$ *= room thermostat set point*

T_S *= design supply air temperature for the zone in which the thermostat is located*

F_R *= name plate rating of the relief fan in hp*

Violation: 12 of 14 air handling systems exceeded the permissible motor horsepower requirements at design and as constructed after the reviewing professionals considered possible credits. The ANSI/ASHRAE/IESNA Standard 90.1-1999 permissible motor horsepower was 266.7 motor horsepower. For the systems as designed, the sum of the fan motor horsepower came to 496 hp, 186% of the permissible limit. As installed, however, 12 of 14 air handling systems still exceeded the permissible motor horsepower limits even though installed motor horsepower was reduced to 391.2 hp, a net reduction of 105.9 hp. Total fan horsepower remained 46.7% greater than permitted under ANSI/ASHRAE/IESNA Standard 90.1-1999. See Appendix 10.

Comment: It would not be unusual for one system or another to exceed motor horsepower limitations. However, it appears that this requirement was initially simply ignored. An effort was apparently made to reduce motor horsepower during construction when approximately 105.9 fan motor horsepower was stripped from the project. However, it still fails the test. Further reductions would have impacted both equipment selections and duct design.

6.3.3.2 Variable Air Volume (VAV) Fan Control (Including Systems Using Series Fan Power Boxes).

6.3.3.2.1 Part-Load Fan Power Limitation. *Individual VAV fans with motors 30 hp and larger shall have other controls and devices that will result in fan motor demand of no more than 30% of design wattage at 50% of design air volume when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data.*

Comment: Insufficient data was available to evaluate this issue.

6.3.3.2.2 Static Pressure Sensor Location. *Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is no greater than one-third the total design fan static pressure, except for direct digital control systems with zone reset capability where it may be at the fan discharge. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each*

> *major branch to ensure that static pressure can be maintained in each.*

Comment: Insufficient data was available to evaluate this issue.

> ***6.3.3.2.3 Set Point Reset.*** *For systems with direct digital control of individual zone boxes reporting to the central control panel, static pressure set point shall be reset based on the zone requiring the most pressure; i.e., the set point is reset lower until one zone damper is nearly wide open.*

Violation: Static pressure reset was not provided for in either the Construction Documents or indicated as having been furnished in the record Temperature Control Drawings. Eight violations are noted, one each for 7 VAV air handling units plus one for the Gymnasium system.

Comment: This measure is a technical violation which could be rectified through programming modifications. As such, it may not seem significant, however it serves as one more indication of the flagrant manner with which the requirements of **LEED™** prerequisites were ignored by this design team. This is a defect affecting the performance of 7 air handling systems.

> ***6.3.4 Hydronic System Design and Control.*** *HVAC hydronic systems having a total pump system power exceeding 10 hp shall meet provisions of 6.3.4.1 through 6.3.4.3.*
> ***6.3.4.1 Hydronic Variable Flow Systems.*** *HVAC pumping systems shall include control valves designed to modulate or step open and close as a function of load, shall be designed for variable fluid flow, and shall be capable of reducing pump flow rates to 50% or less of the design flow rate. Individual pumps serving variable flow systems having a pump head exceeding 100 ft and motor exceeding 50 hp shall have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30% of design wattage at 50% of design water flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.*
> ***Exceptions to 6.3.4.1****:*
> *(a) Systems where the minimum flow is less than the minimum flow required by the equipment manufacturer for the proper operation of equipment served by the system, such as chillers, and where total pump system power is 75 hp or less.*
> *(b) Systems that include no more than three control valves.*

Violation: Differential pressure for heating system secondary pump (150 ft) and secondary chilled water pump (also 150 ft) are measured too close to the pumps and not across the hydraulically most remote control valve. The pump head is so great the control valves will not be able to perform properly. Three (3) violations identified, one each for the chilled water secondary pump and the two heating water secondary pumps.

Comment: The engineering pump head seems to be grossly excessive.

6.3.6 Energy Recovery

6.3.6.1 Exhaust Air Energy Recovery*. Individual fan systems that have both a design supply air capacity of 5000 cfm or greater and have a minimum outside air supply of 70% or greater of the design supply air quantity shall have an energy recovery system with at least 50% recovery effectiveness. Fifty percent energy recovery effectiveness shall mean a change in the enthalpy of the outdoor air supply equal to 50% of the difference between the outdoor air and return air at design conditions. Provision shall be made to bypass or control the heat recovery system to permit air economizer operation as required by 6.3.1.1.*

Exceptions to 6.3.6.1

(a) Laboratory systems meeting 6.3.7.2.

(b) Systems serving spaces that are not cooled and that are heated to less than 60 F.

© Systems exhausting toxic, flammable, paint or corrosive fumes or dust.

(d) Commercial kitchen hoods (grease) classified as Type 1 by NFPA 96.

(e) Where more than 60% of the outdoor heating energy is provided from site-recovered or site solar energy.

(f) Heating systems in climates with less than 3600 HDD65.

(g) Cooling systems in climates with a 2.5% cooling design wet-bulb temperature less than 65°F.

(h) Where the largest exhaust source is less than 75% of the design outdoor airflow.

(I) Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.

Violation: While individual exhaust fans are not individually sufficient to overcome Exception (h), ANSI/ASHRAE Standard 62.1 compliance computations indicate that VAV systems AC-2, 6 and 7, and HRAC-1, 2, 3, and 4 all require 100% outdoor air capabilities to meet minimum requirements.

Comments: The energy recovery wheels provided on HRAC units have several major deficiencies.

1) They are sufficiently sized to only meet minimum Wisconsin Code requirements and not adequate to meet Standard 62.1 ventilation requirements.

2) None of the energy to be recovered comes from any of the over 90,000 cfm of exhaust air from 42 different exhaust systems affecting 12 of 14 air handling units.

3) The energy recovery provided comes from the return air paths which would otherwise be recycled through recirculation. This technological misapplication not only eliminates any energy benefit from the energy recovery equipment employed, but imposes unnecessary and unproductive fan energy penalties on the systems.

In short, all seven VAV air handling units should have been equipped with central exhausts and made 100% outside air to comply with the combined requirements of ANSI/ASHRAE Standard 62.1-1999 and ANSI/ASHRAE/IESNA Standard 90.1-1999. This is a major deficiency which by itself accounts for 10,452 MBH of heating capacity and 11,877 MBH (75%) of the 16,000 MBH installed boiler capacity. 54 separate violations are identified.

<u>ANSI/ASHRAE Standard 62.1-1999 (2001):</u> **LEED™ NC 2.1** requires compliance with the more rigorous requirements of ANSI/ASHRAE Standard 62.1-1999 (with approved addenda) or the local ventilation Code, Comm 64. Approved addenda to ANSI/ASHRAE Standard 62.1-1999 are incorporated into ANSI/ASHRAE Standard 62.1-2001, and listed in Appendix H of that Standard. In addition, ASHRAE has published formal interpretations in response to questions raised regarding ANSI/ASHRAE Standard 62 since 1989. Several of these interpretations apply to this project and are referenced.

Both ANSI/ASHRAE Standard 62.1-1999 and Comm 64 prescribe minimum ventilation rates on the basis of air flow per occupant. Comm 64 ventilation requirements differ substantially from those required by ANSI/ASHRAE Standard 62.1-1999 in both rate per occupant ventilation and method of calculation. Comm 64.05 permits ventilation to be averaged across the system whereas ANSI/ASHRAE Standard 62.1-1999 requires every space to receive the required rate of ventilation under all conditions of occupancy.

For compliance with **LEED™ NC 2.1** prerequisites, ventilation must be computed using Table 2 ventilation rates and the Ventilation Rate Method as defined in ANSI/ASHRAE Standard 62.1-1999.

A sum total of **1,065** individual violations of ANSI/ASHRAE Standard 62.1-1999, plus addenda, have been identified with the HVAC systems, and this is only a partial list since the review was not of the complete HVAC systems and the reviewing professionals did not have access to design team project records.

Because the reviewing professionals do not have access to the designer's computations and have not performed detailed building thermal load computations, additional violations of the ASHRAE Standards may have occurred.

> ***4.1 Ventilation Rate Procedure:*** *Acceptable air quality is achieved by providing ventilation air of the specified quality and quantity to the space (see 6.1).*

Violation: The ventilation rate procedure was not employed. This is known to have substantial implications for 134 individual spaces for which compliance computations were performed by the reviewing professionals.

> ***5.2*** *Ventilating systems shall be designed and installed so that the ventilation air is supplied throughout the occupied zone. The design documentation shall state assumptions that were made in the design with respect to ventilation rates and air distribution.*

Violation: Compliance computations were performed by the reviewing professionals to determine the requisite ventilation rates for 134 space and outdoor air ventilation requirements for seven air handling units; HRAC-1, 2, 3 and 4, and AC-2, 6 and 7. It was determined on the basis of computations that the ANSI/ASHRAE Standard 62.1-1999 Ventilation Rate Procedure, a prerequisite for **LEED™ NC 2.1** certification, was not employed for this design. A total of 141 individual violations are identified for failing to perform the required computations each space investigated (134) and each air handling unit for which compliance computations were performed (7).

Comment: Compliance computations were performed by the reviewing professionals to determine the ventilation rates required to meet the requirements of ANSI/ASHRAE Standard 62.1-1999 for 134 space and outdoor air ventilation requirements for seven air handling units; HRAC-1, 2, 3 and 4, and AC-2, 6 and 7. In addition, computations were performed using the ventilation requirements of the Wisconsin Enrolled Code in effect at the time of the project to determine which set of ventilation criteria was actually used. Since the design team has never submitted the required computations to the reviewing professionals, and the validation computations indicate a less rigorous set of ventilation criteria was used in the design, it is deemed highly unlikely that the requisite documentation exists or could be produced.

> ***5.2*** *Ventilating systems shall be designed and installed so that the ventilation air is supplied throughout the occupied zone. The design documentation shall state assumptions that were made in the design with respect to ventilation rates and air distribution.*

Violation: It is most unlikely that the design team can produce competently prepared compliance documentation for this project. A non-compliant methodology was employed for this project. Computing adequate ventilation with VAV systems are clarified in formal ASHRAE Interpretations (see Appendix D, ANSI/ASHRAE Standard 62.1 and Interpretation IC 62-1999-28.) Computation of outdoor air fractions at the space (***Zi***) for VAV Reheat systems must be computed by dividing the outdoor air requirement by the minimum flow computed in compliance with the Exceptions to the requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999, Section 6.3.2.1. Compliance computations demonstrating compliance with the requirements of Standard 62.1-1999 for the subject spaces can not exist. It is apparent from the compliance computations prepared by the reviewing professionals that different criteria were used. A total of 141 individual violations are identified for this Section.

Comments: The number of actual violations will substantially exceed those identified in this document as the design professionals did not perform calculations for every space in the building. When challenged on this issue, the design team stated, in a public meeting recorded on videotape, that they were not required to comply with ASHRAE Standards and that all they had to do was meet minimum code requirements. And, that is exactly what they did. As a result, any claim of compliance with ANSI/ASHRAE Standard 62.1-1999 would be false.

> ***5.3*** *When the supply of air is reduced during times the space is occupied (e.g., in variable-air-volume systems), provision shall be made to maintain acceptable indoor air quality throughout the occupied zone.*

Violation: Neither VAV Reheat boxes nor air handling systems have the hardware or control logic to meet this requirement. Where systems are designed to recirculate air, special controls must be provided to measure and monitor actual flow rates at each VAV reheat box and to monitor outdoor air and total system flow rate to permit the system to adjust it's outdoor air fraction to comply with the recirculation requirements of ANSI/ASHRAE Standard 62.1-1999, Section 6.1.3.2. A total of 141 individual violations are identified for this Section.

> ***5.5.1 Resistance to Mold Growth.*** *Material surfaces shall be determined to be resistant to mold growth in accordance with a standardized test method, such as Underwriters Laboratories, Inc. (UL) 181 "Mold Growth and Humidity Test," ASTM C 1338 "Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings," or other comparable test methods.*
> ***Exception to 5.5.1:*** *Sheet metal surfaces and metal fasteners.* ***Note:*** *Even with this resistance, any airstream surface that is continuously wetted is still subject to microbial growth.*

Violation: Construction Documents do not require compliance that duct board or duct liner comply with either UL181 "Mold Growth and Humidity Test," ASTM C 1338 "Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings." Fiberglass duct is used throughout the project on seven VAV systems downstream of 134 VAV boxes. Duct liner is employed throughout the facility on low pressure supply and return ducts. A total of 28 individual violations are identified for this Section.

Comment: A vague reference to UL 181 is made in Part 1 of Specification Section 15890B, but not with respect to any product. ASTM C1338 is not even referenced. We can not determine whether any of the products provided comply or not.

> ***5.5.2 Resistance to Erosion.*** *Airstream surface materials shall be evaluated in accordance with the Underwriters Laboratories, Inc. (UL) 181 "Erosion Test" and shall not break away, crack, peel, flake off, or show evidence of delamination or continued erosion under test conditions.*
> ***Exception to 5.5.2:*** *Sheet metal surfaces and metal fasteners.*

Violation: Construction Documents do not require compliance that duct board or duct liner comply with either UL181 *"Erosion Test."* A total of 28 individual violations are identified for this Section.

Comment: A vague reference to UL 181 is made in Part 1 of Specification Section 15890B, but not with respect to any product. We can not determine whether any of the products provided comply or not.

> ***5.8 Particulate Matter Removal.*** *Particulate matter filters or air cleaners having a minimum efficiency reporting value (MERV) of not less than 6 when rated in accordance with ASHRAE Standard 52.2-1999[32] shall be provided upstream of all cooling coils or other devices with wetted surfaces through which air is supplied to an occupiable space.*

Comment: The Construction Documents are extremely vague as to what kind of filters are to be provided. The Air Handling Unit Specifications calls for "2" thick low velocity throwaway filters" and the air handling unit schedules call for "2" Pleated" filters. This installation may, or may not, comply. At very best, compliance is marginal.

> ***5.10*** *High humidities can support the growth of pathogenic or allergenic organisms (see Reference 19). Examples include certain species of fungi, associated mycotoxins, and dust mites. This growth is enhanced by the presence of materials with high cellulose, even with low nitrogen content, such as fiberboard, dust, lint, skin particles, and dander. Areas of concern include bathrooms and bedrooms. Therefore, bathrooms shall conform to the ventilation rates in Table 2.3. Relative humidity in habitable spaces preferably should be maintained between 30% and 60% relative humidity (see Reference 10) to minimize growth of allergenic or pathogenic organisms.*

Violation: There is no effective humidity control with this facility. Humidification is not provided during cold weather operation. For summer operation, reheat is not available to temper the supply air. Under these conditions, under-occupied spaces are highly likely to sub-cool with 30% minimum air flows at lower than design conditions leading to loss of thermal comfort and excessive humidity. A total of 14 individual violations are identified for this Section.

Comment: This would merely require the operation of the reheat system during warm weather.

> ***5.11*** *Microbial contamination in buildings is often a function of moisture incursion from sources such as stagnant water in HVAC air distribution systems and cooling towers. Air-handling unit condensate pans shall be designed for self-drainage to preclude the buildup of microbial slime. Provision shall be made for periodic in-situ cleaning of cooling coils and condensate pans. Air-handling and fan coil units shall be easily accessible for inspection and preventive maintenance. Steam is preferred as a moisture source for humidifiers, but care should be exercised to avoid contamination from boiler water or steam supply additives. If cold water humidifiers are specified, the water shall originate from a potable source, and, if recirculated, the system will require frequent maintenance and blow-down. Care should be exercised to avoid particulate contamination due to evaporation of spray water. Standing water used in conjunction with water sprays in HVAC air distribution systems should be treated to avoid microbial buildup. If the relative humidity in occupied spaces and low velocity ducts and plenums exceeds 70%, fungal contamination (for example, mold, mildew, etc.) can occur. Special care should be taken to avoid entrainment of moisture drift from cooling towers into the makeup air and building vents.*

Violation: With fiberglass duct liner, no effective humidity control, for this facility, and a lack of summer reheat, spaces are likely to experience excessive humidity and create an environment conducive to the growth of mold and mildew. A total of 14 individual violations are identified for this Section.

Comment: This would merely require the operation of the reheat system during warm weather.

> ***6.1.3 Ventilation Requirements.*** *Indoor air quality shall be considered acceptable if the required rates of acceptable outdoor air in Table 2 are provided for the occupied space.*

Table 2 lists the required ventilation rates in cfm (L/s) per person or cfm/ft^2 (L/s·m^2) for a variety of indoor spaces. In most cases, the contamination produced is presumed to be in proportion to the number of persons in the space. In other cases, the contamination is presumed to be chiefly due to other factors and the ventilating rates given are based on more appropriate parameters. Where appropriate, the table lists the estimated density of people for design purposes. Where occupant density differs from that in Table 2, use the per occupant ventilation rate for the anticipated occupancy load. The ventilation rates for specified occupied spaces listed in Table 2 were selected to reflect the consensus that the provision of acceptable outdoor air at these rates would achieve an acceptable level of indoor air quality by reasonably diluting human bioeffluents, particulate matter, odors, and other contaminants common to those spaces.

Violation: Ventilation rates from Table 2 were not employed for the design of this facility. It is in total non-compliance. 134 individual violations are identified for this Section for 134 rooms.

Comment: This is a complete failure to comply with **LEED™** prerequisites and should by itself be sufficient to withdraw **LEED™ NC 2.1** Certification

6.1.3.1 Multiple Spaces. *Where more than one space is served by a common supply system, the ratio of outdoor to supply air required to satisfy the ventilation and thermal control requirements may differ from space to space. The system outdoor air quantity shall then be determined using Equation*
6-1 (see References 23 and 24).

$$Y = X/[l + X - Z] \qquad (6\text{-}1)$$

where
Y = Vot/ Vst = corrected fraction of outdoor air in system supply
X = Von/Vst = uncorrected fraction of outdoor air in system supply
Z = Voc/Vsc = fraction of outdoor air in critical space. The critical space is that space with the greatest required fraction of outdoor air in the supply to this space.
Vot = corrected total outdoor air flow rate
Vst = total supply flow rate, i.e., the sum of all supply for all branches of the system
Von = sum of outdoor air flow rates for all branches on system
Voc = outdoor air flow rate required in critical spaces
Vsc = supply flow rate in critical space

The procedure is as follows:
1. Calculate the uncorrected outdoor air fraction by dividing the sum of all the branch outdoor air requirements by the sum of all the branch supply flow rates.
2. Calculate the critical space outdoor air fraction by dividing the critical space outdoor air requirement by the critical space supply flow rate.
3. Evaluate Equation 6-1 to find the corrected fraction of outdoor air to be provided in the system supply.

Rooms provided with exhaust air systems, such as kitchens, baths, toilet rooms, and smoking lounges, may utilize air supplied through adjacent habitable or occupiable spaces to compensate for the air exhausted. The air supplied shall be of sufficient quantity to meet the requirements of Table 2. In some cases, the number of persons cannot be estimated accurately or varies considerably. In other cases, a space may require ventilation to remove contamination generated within the space but unrelated to human occupancy (e.g., outgassing from building materials or furnishings). For these cases, Table 2 lists quantities in cfm/ft^2 *(*$L/s{\cdot}m^2$*) or an equivalent term. If human carcinogens or other harmful contaminants are suspected to be present in the occupied space, other relevant standards or guidelines (e.g., OSHA, EPA) must supersede the ventilation rate procedure.*

When spaces are unoccupied, ventilation is not generally required unless it is needed to prevent accumulation of contaminants injurious to people, contents, or structure. Design documentation shall specify all significant assumptions about occupants and contaminants.

Violation: Ventilation rates were not computed using the required multiple spaces equation for this facility. It is in total non-compliance. A total of 141 individual violations are identified for this Section for 134 rooms and 7 air handling units.

Comment: This is a complete failure to comply with **LEED™** prerequisites and should by itself be sufficient to withdraw **LEED™ NC 2.1** Certification.

6.1.3.2 Recirculation Criteria. *The requirements for ventilation air quantities given in Table 2 are for 100% outdoor air when the outdoor air quality meets the specifications for acceptable outdoor air quality given in 6.1.1. While these quantities are for 100% outdoor air, they also set the amount of air required to dilute contaminants to acceptable levels. Therefore, it is necessary that at least this amount of air be delivered to the conditioned space at all times the building is in use except as modified in 6.1.3.4.*

Properly cleaned air may be recirculated. Under the ventilation rate procedure, for other than intermittent variable occupancy as defined in 6.1.3.4, outdoor air flow rates may not be reduced below the requirements in Table 2. If cleaned, recirculated air is used to reduce the outdoor air flow rate below the values shown in Table 2, the Air Quality Procedure, 6.2, must be used. The air-cleaning system for the recirculated air may be located in the recirculated air or in the mixed outdoor and recirculated airstream (see Figure 1).

The recirculation rate for the system is determined by the air-cleaning system efficiency. The recirculation rate must be increased to achieve full benefit of the air-cleaning system. The air-cleaning used to clean recirculated air should be designed to reduce particulate and, where necessary and feasible, gaseous contaminants. The system shall be capable of providing indoor air quality equivalent to that obtained using outdoor air at a rate specified in Table 2. Appendix D may be referenced for assistance in calculating the air flow requirements for commonly used air distribution systems.

Violation: Neither the ventilation rates from Table 2 nor the multiple spaces equation were employed for the design and construction of this facility. The room controls and air handling systems lack the necessary controls to provide the required ventilation whenever a room is occupied. It is in total non-compliance. A total of 141 individual violations are identified for this Section for 134 rooms and 7 air handling units.

Comment: This is a complete failure to comply with **LEED™** prerequisites and should by itself be sufficient to withdraw **LEED™ NC 2.1** Certification.

> ***6.3 Design Documentation Procedures.*** *Design criteria and assumptions shall be documented and should be made available for operation of the system within a reasonable time after installation. See Sections 4 and 6 as well as 5.2 and 6.1.3 regarding assumptions that should be detailed in the documentation.*

Violation: Since the proper ventilation rates and computational methods were not employed, a total of 141 individual violations are identified for this Section for 134 rooms and 7 air handling units.

Comment: This is a complete failure to comply with **LEED™** prerequisites and should by itself be sufficient to withdraw **LEED™ NC 2.1** Certification.

> ***7.1 Construction Phase***
> ***7.1.3 Protection of Materials****. When recommended by the manufacturer, building materials shall be protected from rain and other sources of moisture by appropriate in-transit and on-site procedures. Porous materials with visible microbial growth shall not be installed. Nonporous materials with visible microbial growth shall be decontaminated.*

Violation: No requirements for protection of materials at the project site are included in the Construction Documents. The matter is not addressed. A total of 1 individual violation is identified for this Section for the entire project..

> ***7.2.6 Documentation.*** *The following ventilation system documentation shall be provided to the building owner or his/her designee, retained within the building, and made available to the building operating personnel:*
> *(a) An operating and maintenance manual describing basic data relating to the operation and maintenance of ventilation systems and equipment as installed.*
> *(b) HVAC controls information consisting of diagrams, schematics, control sequence narratives, and maintenance and/or calibration information.*
> *© An air balance report documenting the work performed for 7.2.2.*
> *(d) Construction drawings of record, control drawings, and final design drawings.*
> *(e) Design criteria and assumptions.*

Comment: It can not be confirmed that construction record drawings were provided.

<u>Joint ANSI/ASHRAE Standard 62.1-1999 (2001)/ ANSI/ASHRAE Standard 62.1-1999 ASHRAE Standard 62.1-1999 Issues:</u>

Violation: Section 6.1.3.2 of ASHRAE Standard 62.1-1999 requires that the HVAC system must provide the requisite amount of ventilation to each space whenever it is occupied. Interpretation IC 62-1898-21, issued by ASHRAE SSPC 62.1 on June 26, 1995, provides specific guidance on the proper use of Equation 6-1, the Multiple Spaces Equation, with variable air volume systems (refer to Appendix D). Section 6.3.2.1 of ANSI/ASHRAE/IESNA Standard 90.1-1999 contains a blanket prohibition on the use of reheat. Reheat is only permitted under limited exceptions to Section 6.3.2.1.

Comment: The convergence of the above requirements have major implications for the application of the Ventilation Rate Procedure required by **LEED™** when employing VAV systems which are known to be poor indoor air quality systems. All of the VAV air handling systems at Northland Pines violated these criteria at the time of design. These violations were brought to the attention of the system designers who refused to correct most of them prior to construction. They also constituted violations of the local building Code and were brought to the attention of the reviewing authority. Curiously, the reviewing Code authority required partial modifications to only 3 of 7 VAV systems on the project. Corrections required by the reviewing Code authority were only sufficient to bring the systems into compliance with Comm 64 for ventilation, and partial compliance with Comm 63 for reheat limitations leaving virtually all ANSI/ASHRAE Standard 62.1-1999 and ANSI/ASHRAE/IESNA Standard 90.1-1999 violations intact

V. SUMMARY

Further documents in support of this appeal are in the Appendices. They include the Appendix 11, the current USGBC Appeal procedures, Appendix 12, the USGBC website posting of the credit summary for the building, Appendices 13 to 15, the HVAC schedule drawings, Appendix 16, a photo of the air cooled chiller, Appendix 17, a photo of the pump flow setting indicating that pump impellers were not trimmed, and Appendix 18, showing the storage and use of toxic ethylene glycol. Electronic copies of all documents are included on a CD that accompanies the appeal. Further documentation is available upon request, such as plans, specifications, shop drawings, photos, and recordings of School Board meetings.

VI. CONCLUSIONS

Therefore, to a reasonable degree of engineering and scientific certainty, the Northland Pines High School does not comply with many of the minimum requirements of either ANSI/ASHRAE/IESNA Standard 90.1-1999 or ANSI/ASHRAE Standard 62.1-1999. Failure to comply with even one requirement of either standard is sufficient to demonstrate non-compliance with the mandatory **LEED™** prerequisites. Therefore, Gold Certification for this building must be revoked and the plaque removed.

The design team and the Owner knew before construction began that there were multiple requirements in the prerequisites that were not met. Yet, they not only failed to make corrections, but they also certified that the building complies, when they knew or should have known it does not.

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VII. REFERENCES

1. ASHRAE. 1992 *Systems and Equipment Handbook*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., pp 2.4.
2. ASHRAE. 1996 *Systems and Equipment Handbook*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., pp 2.5.
3. ASHRAE. 2000 *Systems and Equipment Handbook*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., pp 2.8.
4. ASHRAE. 2004 *Systems and Equipment Handbook*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., pp 2.8.
5. ASHRAE. 2001 *Ventilation for Acceptable Indoor Air Quality*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., Section 5.3.
6. ASHRAE. 1999 *Energy Standard for Buildings Except Low Rise Residential Buildings*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., Section 6.3.1.1.2.
7. ASHRAE. 1999 *Energy Standard for Buildings Except Low Rise Residential Buildings*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., Section 6.3.2.1.
8. ASHRAE. 1996 Guideline 1, *The HVAC Commissioning Process*. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., Section 5.2.1.1.

VIII. LIST OF APPENDICES

Appendix 1: Compliance Calculations
Appendix 2: Table 1 Standard 90.1 Non-Compliance List
Appendix 3: Table 2 Standard 62.1 Non-Compliance List
Appendix 4: A-E 8, Wisconsin Rules of Professional Conduct for Architects, Engineers, Designers and Surveyors
Appendix 5: Wisconsin Enrolled Building Code, Section 63
Appendix 6: Correspondence with Randall Dahmen, PE, AHJ, Refusal to Enforce ASHRAE Standards.
Appendix 7: Wisconsin Enrolled Building Code, Section 64
Appendix 8: ANSI/ASHRAE Standard 62.1 Interpretation IC 62-1999-39
Appendix 9: ANSI/ASHRAE Standard 62.1 Interpretation IC 62-1999-28
Appendix 10: Fan Power Calculations
Appendix 11: USGBC Appeals
Appendix 12: USGBC Website
Appendix 13: Drawing H1.1
Appendix 14: Drawing H1.2
Appendix 15: Drawing H1.3
Appendix 16: Air Cooled Chiller
Appendix 17: Pump Flow Adjustment
Appendix 18: Toxic Ethylene Glycol

Notes: Only the first pages of Appendices 4, 5, and 7 are included in the paper version of the appeal. Complete copies are in the electronic version. Appendices 13, 14, and 15 are best read when printed at full size.

AIR HANDLING SYSTEM COMPLIANCE SUMMARY

AS DESIGNED Vs. COMPLIANT DESIGN COMPARISON

UNIT	MIN OUTDOOR AIR AT DESIGN CONDITIONS							
	AS DESIGNED @		WIS CODE @			62.1 COMPLIACE		
	MAX FLOW	MIN FLOW	MIN OA	SPEC OA	PASS/FAIL	MIN OA	MIN % OA	MIN FLOW LIMIT
HRAC-1	18000	13415	2978	3800	PASS	6160	100%	6160
HRAC-2	22000	18085	3653	4530	PASS	8400	100%	8400
HRAC-3	17000	14870	4283	4900	PASS	8600	100%	8600
HRAC-4	20000	17935	4793	3800	FAIL	9605	100%	9605
AC-2	12500	10400	2700	2690	FAIL	5420	100%	5420
AC-6	7000	4775	735	700	FAIL	1960	100%	1960
AC-7	11500	8420	1958	2325	PASS	3925	100%	3925

AS INSTALLED Vs. COMPLIANT DESIGN COMPARISON

UNIT	SYSTEM MINIMUM PERCENT OUTDOOR AIR							
	AS BALANCED		WIS CODE @			62.1 COMPLIACE		
	MAX FLOW	MIN FLOW	MIN OA	WINTER MIN	PASS/FAIL	HEATING	-	COOLING
HRAC-1	18568	13265	2978	4120	PASS	FAIL	-	FAIL
HRAC-2	23122	17329	3653	5082	PASS	FAIL	-	FAIL
HRAC-3	17018	14870	4283	4980	PASS	FAIL	-	FAIL
HRAC-4	21585	7494	4793	5793	PASS	FAIL	-	FAIL
AC-2	12144	4674	2700	3282	PASS	FAIL	-	FAIL
AC-6	7266	4775	735	860	PASS	FAIL	-	FAIL
AC-7	12642	3870	1958	2506	PASS	FAIL	-	FAIL

62.1-1999 AHU VENTILATION RATE VALIDATION COMPUTATIONS

AIR HANDLING UNIT	**HRAC-1**
DESIGN TOTAL AIR	18000
DESIGN MINIMUM AIR	13415
SYSTEM THERMAL DIVERSITY	87%
DESIGN MINIMUM OUTSIDE AIR	3800
OUTDOOR AIR FRACTION, COOLING DESIGN	21%
OUTDOOR AIR FRACTION, HEATING DESIGN	28%
FINAL TOTAL AIR COOLING	18568
FINAL TOTAL AIR HEATING	13265
FINAL OUTDOOR AIR, COOLING DESIGN	5860
FINAL OUTDOOR AIR, HEATING DESIGN	4120
FINAL OUTDOOR AIR FRACTION, COOLING DESIGN	**31.6%**
FINAL OUTDOOR AIR FRACTION, HEATING DESIGN	**31.1%**

STANDARD 62.1-1999 OUTDOOR AIR FRACTION COMPLIANCE COMPUTATIONS

REQUIRED OA FRACTION = Y (= X / (1 + X - Zc))

		STD 62.1 COMPLIANT	
		COOLING	**HEATING**
		FAIL	**FAIL**
		100%	**100%**
X=	0.17	18000	6970
Zc = Outdoor Air Fraction For Critical Space	1.00	1.00	1.00

VAV BOX No.	ROOM NAME	AREA SF	PEOPLE	62.1-1999 MIN OA CFM	62.1-1999 *Zi*	MAX FLOW CFM	CFM/SF	MINIMUM AIR FLOWS (CFM) 90.1-1999 LIMIT	DESIGN AT BID	AS BALANCED	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BID	AS BALANCED
V-1	CLASSROOM	720	31	233	0.78	1000	1.39	300	680	680	FAIL	FAIL
V-2	CLASSROOM	728	50	375	1.00	1000	1.37	375	680	680	FAIL	FAIL
V-3	TPC	329	3	23	0.17	450	1.37	135	300	135	FAIL	PASS
V-4	CLASSROOM	724	34	255	0.85	1000	1.38	300	665	680	FAIL	FAIL
V-5	CORRIDOR	1971	0	0	0.00	1250	0.63	789	625	625	PASS	PASS
V-6	2-D ART	1498	51	383	0.64	1800	1.20	599	1200	1200	FAIL	FAIL
V-7	3-D ART	1580	62	465	0.74	1800	1.14	632	1290	1290	FAIL	FAIL
V-8	OFFICE	456	8	60	0.24	840	1.84	252	575	575	FAIL	FAIL
V-9	DRAFTING	1408	25	188	0.32	1950	1.38	585	1300	1300	FAIL	FAIL
V-10	BUS CLASSROOM	1154	45	338	0.63	1800	1.56	540	1030	1030	FAIL	FAIL
V-11	TECH LAB	1419	30	225	0.34	2200	1.55	660	1490	1490	FAIL	FAIL
V-12	BUS LAB	1380	25	188	0.25	2500	1.81	750	1280	1280	FAIL	FAIL
V-13	OFFICE	367	3	23	0.15	450	1.23	147	375	375	FAIL	FAIL
V-14	RECORDS	231	1	8	0.08	330	1.43	99	220	220	FAIL	FAIL
V-15	CONFERENCE	178	12	90	1.00	280	1.57	90	200	200	FAIL	FAIL
V-16	GUIDANCE OFFICE	160	2	15	0.21	240	1.50	72	200	200	FAIL	FAIL
V-17	GUIDANCE OFFICE	160	2	15	0.21	240	1.50	72	200	200	FAIL	FAIL
V-18	GUIDANCE CENTER	953	7	53	0.14	980	1.03	381	655	655	FAIL	FAIL
V-19	ITIN OFFICE	160	2	15	0.21	240	1.50	72	200	200	FAIL	FAIL
V-20	ITIN OFFICE	135	2	15	0.25	200	1.48	60	130	130	FAIL	FAIL
V-21	ITIN OFFICE	132	2	15	0.25	200	1.52	60	120	120	FAIL	FAIL
SUBTOTALS		15843	397	2978		20750	1.84					

62.1-1999 AHU VENTILATION RATE VALIDATION COMPUTATIONS

AIR HANDLING UNIT	**HRAC-2**
DESIGN TOTAL AIR	22000
DESIGN MINIMUM AIR	18085
SYSTEM THERMAL DIVERSITY	79%
DESIGN MINIMUM OUTSIDE AIR	4530
OUTDOOR AIR FRACTION, COOLING DESIGN	21%
OUTDOOR AIR FRACTION, HEATING DESIGN	25%
FINAL TOTAL AIR COOLING	23122
FINAL TOTAL AIR HEATING	17329
FINAL OUTDOOR AIR, COOLING DESIGN	7076
FINAL OUTDOOR AIR, HEATING DESIGN	5082
FINAL OUTDOOR AIR FRACTION, COOLING DESIGN	**30.6%**
FINAL OUTDOOR AIR FRACTION, HEATING DESIGN	**29.3%**

		STD 62.1 COMPLIANT	
STANDARD 62.1-1999 OUTDOOR AIR FRACTION COMPLIANCE COMPUTATIONS		**COOLING**	**HEATING**
		FAIL	**FAIL**
REQUIRED OA FRACTION = Y (= X / (1 + X - Zc))		**100%**	**100%**
***X*=**	0.13	22000	7579
***Zc* =** Outdoor Air Fraction For Critical Space	1.00	1.00	1.00

VAV BOX No.	ROOM NAME	AREA SF	PEOPLE	62.1-1999 MIN OA CFM	62.1-1999 *Zi*	MAX FLOW CFM	CFM/SF	MINIMUM AIR FLOWS (CFM) 90.1-1999 LIMIT	DESIGN AT BID	AS BALANCED	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BID	AS BALANCED
V-22	OFFICE	185	2	15	0.19	260	1.41	78	175	175	FAIL	FAIL
V-23	COPY	198	2	15	0.17	300	1.52	90	200	200	FAIL	FAIL
V-24	OTPT	274	13	98	0.81	400	1.46	120	250	250	FAIL	FAIL
V-25	CD CLASSROOM	1083	48	360	0.83	1000	0.92	433	1080	324	FAIL	PASS
V-26	PREP	302	3	23	0.17	430	1.42	129	300	300	FAIL	FAIL
V-27	CHEMISTRY	1489	53	398	0.60	2200	1.48	660	1475	1475	FAIL	FAIL
V-28	PHYSICAL SCIENCE	1564	59	443	0.67	2200	1.41	660	1500	1500	FAIL	FAIL
V-29	PREP	159	2	15	0.22	225	1.42	68	150	150	FAIL	FAIL
V-30	HEAD HOUSE	317	2	15	0.10	490	1.55	147	325	325	FAIL	FAIL
V-31	IND STUDY	609	15	113	0.43	870	1.43	261	580	580	FAIL	FAIL
V-32	BIOLOGY	1417	59	443	0.67	2200	1.55	660	1500	1500	FAIL	FAIL
V-33	CORRIDOR	3574	0	0	0.00	1000	0.28	1430	500	500	PASS	PASS
V-34	DISTANCE LEARNING	667	32	240	0.62	1300	1.95	390	690	690	FAIL	FAIL
V-35	MED STUDIO	537	25	188	0.78	800	1.49	240	425	425	FAIL	FAIL
V-36	HEAD END	432	2	15	0.06	800	1.85	240	425	425	FAIL	FAIL
V-37	COMPUTER CLASSRO	1000	27	203	0.38	1800	1.80	540	915	915	FAIL	FAIL
V-38	PREP	255	2	15	0.13	380	1.49	114	250	250	FAIL	FAIL
V-39	WORK ROOM	708	8	60	0.20	1000	1.41	300	670	670	FAIL	FAIL
V-40	STORAGE	345	0	0	0.00	500	1.45	150	335	335	FAIL	FAIL
V-41	OFFICE	204	2	15	0.17	300	1.47	90	190	190	FAIL	FAIL
V-42	IMC	1513	17	124	0.16	2600	1.72	780	1700	1700	FAIL	FAIL
V-43	LIFE SCIENCE	1517	54	405	0.61	2200	1.45	660	1500	1500	FAIL	FAIL
V-44	IMC	1513	17	124	0.16	2600	1.72	780	1700	1700	FAIL	FAIL
V-45	STAFF	499	5	38	0.17	725	1.45	218	500	500	FAIL	FAIL
V-46	WEB ROOM	365	15	113	0.54	700	1.92	210	350	350	FAIL	FAIL
V-47	CONFERENCE	195	12	90	1.00	300	1.54	90	200	200	FAIL	FAIL
V-48	CONFERENCE	195	12	90	1.00	300	1.54	90	200	200	FAIL	FAIL
SUBTOTALS		21116	487	2794		27880	1.95					

62.1-1999 AHU VENTILATION RATE VALIDATION COMPUTATIONS

AIR HANDLING UNIT	**HRAC-3**
DESIGN TOTAL AIR	17000
DESIGN MINIMUM AIR	14870
SYSTEM THERMAL DIVERSITY	84%
DESIGN MINIMUM OUTSIDE AIR	4900
OUTDOOR AIR FRACTION, COOLING DESIGN	29%
OUTDOOR AIR FRACTION, HEATING DESIGN	33%
FINAL TOTAL AIR COOLING	17018
FINAL TOTAL AIR HEATING	14870
FINAL OUTDOOR AIR, COOLING DESIGN	5250
FINAL OUTDOOR AIR, HEATING DESIGN	4980
FINAL OUTDOOR AIR FRACTION, COOLING DESIGN	**30.8%**
FINAL OUTDOOR AIR FRACTION, HEATING DESIGN	**33.5%**

STANDARD 62.1-1999 OUTDOOR AIR FRACTION COMPLIANCE COMPUTATIONS

REQUIRED OA FRACTION = Y (= X / (1 + X - Zc))

		STD 62.1 COMPLIANT	
		COOLING	**HEATING**
		FAIL	**FAIL**
		60%	**100%**
***X*=**	0.25	17000	7097
***Zc* =** Outdoor Air Fraction For Critical Space	0.83	0.83	0.83

VAV BOX No.	ROOM NAME	AREA SF	PEOPLE	62.1-1999 MIN OA CFM	62.1-1999 *Zi*	MAX FLOW CFM	CFM/SF	MINIMUM AIR FLOWS (CFM) 90.1-1999 LIMIT	MINIMUM AIR FLOWS (CFM) DESIGN AT BID	MINIMUM AIR FLOWS (CFM) AS BALANCED	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BID	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BALANCED
V-91	MATH	789	44	330	0.81	1350	1.71	405	1000	1000	FAIL	FAIL
V-92	MATH	686	42	315	0.78	1350	1.97	405	1000	1000	FAIL	FAIL
V-93	MATH	747	41	308	0.76	1350	1.81	405	1000	1000	FAIL	FAIL
V-94	MATH	935	42	315	0.78	1350	1.44	405	1000	1000	FAIL	FAIL
V-95	MATH	728	42	315	0.78	1350	1.85	405	1000	1000	FAIL	FAIL
V-96	CORRIDOR	3704	0	0	0.00	1600	0.43	1481	1200	1200	PASS	PASS
V-97	STAFF WORKROOM	337	3	23	0.17	450	1.34	135	300	300	FAIL	FAIL
V-98	FOREIGN LANGUAGE	984	44	330	0.81	1350	1.37	405	1000	1000	FAIL	FAIL
V-99	FOREIGN LANGUAGE	918	42	315	0.78	1350	1.47	405	1000	1000	FAIL	FAIL
V-100	FOREIGN LANGUAGE	935	42	315	0.78	1350	1.44	405	1000	1000	FAIL	FAIL
V-101	FOREIGN LANGUAGE	918	41	308	0.76	1350	1.47	405	1000	1000	FAIL	FAIL
V-102	FOREIGN LANGUAGE	902	42	315	0.78	1350	1.50	405	1000	1000	FAIL	FAIL
V-103	MATH	789	44	330	0.81	1350	1.71	405	1000	1000	FAIL	FAIL
V-104	L.D.CLASSROOM	765	34	255	0.83	1000	1.31	306	700	700	FAIL	FAIL
V-105	OFFICE	132	2	15	0.23	220	1.67	66	150	150	FAIL	FAIL
V-106	L.D.CLASROOM	748	33	248	0.83	1000	1.34	300	700	700	FAIL	FAIL
V-107	OFFICE	112	2	15	0.28	180	1.61	54	120	120	FAIL	FAIL
V-108	AT RISK	731	31	233	0.78	1000	1.37	300	700	700	FAIL	FAIL
SUBTOTALS		15860	571	4283		20300	1.97					

62.1-1999 AHU VENTILATION RATE VALIDATION COMPUTATIONS

AIR HANDLING UNIT	**HRAC-4**
DESIGN TOTAL AIR	20000
DESIGN MINIMUM AIR	17935
SYSTEM THERMAL DIVERSITY	80%
DESIGN MINIMUM OUTSIDE AIR	3800
OUTDOOR AIR FRACTION, COOLING DESIGN	19%
OUTDOOR AIR FRACTION, HEATING DESIGN	21%
FINAL TOTAL AIR COOLING	21585
FINAL TOTAL AIR HEATING	7494
FINAL OUTDOOR AIR, COOLING DESIGN	7312
FINAL OUTDOOR AIR, HEATING DESIGN	5793
FINAL OUTDOOR AIR FRACTION, COOLING DESIGN	**33.9%**
FINAL OUTDOOR AIR FRACTION, HEATING DESIGN	**77.3%**

STANDARD 62.1-1999 OUTDOOR AIR FRACTION COMPLIANCE COMPUTATIONS

REQUIRED OA FRACTION = Y (= X / (1 + X - Zc))

		STD 62.1 COMPLIANT	
		COOLING	**HEATING**
		FAIL	**FAIL**
		56%	**100%**
X=	0.24	20000	9395
Zc = Outdoor Air Fraction For Critical Space	0.81	0.81	0.81

VAV BOX No.	ROOM NAME	AREA SF	PEOPLE	62.1-1999 MIN OA CFM	62.1-1999 *Zi*	MAX FLOW CFM	CFM/SF	MINIMUM AIR FLOWS (CFM) 90.1-1999 LIMIT	MINIMUM AIR FLOWS (CFM) DESIGN AT BID	MINIMUM AIR FLOWS (CFM) AS BALANCED	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BID	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BALANCED
V-109	SOCIAL STUDIES	980	44	330	0.81	1350	1.38	405	1000	405	FAIL	PASS
V-110	SOCIAL STUDIES	942	42	315	0.78	1350	1.43	405	1000	405	FAIL	PASS
V-111	SOCIAL STUDIES	942	41	308	0.76	1350	1.43	405	1000	405	FAIL	PASS
V-112	SOCIAL STUDIES	942	42	315	0.78	1350	1.43	405	1000	405	FAIL	PASS
V-113	SOCIAL STUDIES	926	42	315	0.78	1350	1.46	405	1000	405	FAIL	PASS
V-114	SOCIAL STUDIES	982	44	330	0.81	1350	1.37	405	1000	405	FAIL	PASS
V-115	CORRIDOR	4838	0	0	0.00	1300	0.27	1935	1000	390	PASS	PASS
V-116	ENGLISH	980	44	330	0.81	1350	1.38	405	1000	405	FAIL	PASS
V-117	ENGLISH	918	42	315	0.78	1350	1.47	405	1000	405	FAIL	PASS
V-118	WRITING LAB	942	29	218	0.54	1350	1.43	405	1000	405	FAIL	PASS
V-119	ENGLISH	927	41	308	0.76	1350	1.46	405	1000	405	FAIL	PASS
V-120	ENGLISH	901	42	315	0.78	1350	1.50	405	1000	405	FAIL	PASS
V-121	ENGLISH	981	44	330	0.81	1350	1.38	405	1000	405	FAIL	PASS
V-122	EBBD CLASSROOM	988	38	285	0.72	1150	1.16	395	765	345	FAIL	PASS
V-123	FOOD LABS	1845	25	188	0.25	2500	1.36	750	1700	750	FAIL	PASS
V-124	OFFICE	177	2	15	0.17	300	1.69	90	250	90	FAIL	PASS
V-125	EBBD CLASSROOM	447	38	285	0.81	1180	2.64	354	785	345	FAIL	PASS
V-126	OFFICE	130	2	15	0.17	290	2.23	87	150	87	FAIL	PASS
V-127	FAMILY LIVING	1028	37	278	0.66	1400	1.36	420	940	420	FAIL	PASS
V-128	CORRIDOR	1260	0	0	0.00	690	0.55	504	345	207	PASS	PASS
SUBTOTALS		22076	639	4793		25010	2.64					

62.1-1999 AHU VENTILATION RATE VALIDATION COMPUTATIONS

AIR HANDLING UNIT	**AC-2**
DESIGN TOTAL AIR	12500
DESIGN MINIMUM AIR	10400
SYSTEM THERMAL DIVERSITY	81%
DESIGN MINIMUM OUTSIDE AIR	2690
OUTDOOR AIR FRACTION, COOLING DESIGN	22%
OUTDOOR AIR FRACTION, HEATING DESIGN	26%
FINAL TOTAL AIR COOLING	12144
FINAL TOTAL AIR HEATING	4674
FINAL OUTDOOR AIR, COOLING DESIGN	3287
FINAL OUTDOOR AIR, HEATING DESIGN	3282
FINAL OUTDOOR AIR FRACTION, COOLING DESIGN	**27.1%**
FINAL OUTDOOR AIR FRACTION, HEATING DESIGN	**70.2%**

STANDARD 62.1-1999 OUTDOOR AIR FRACTION COMPLIANCE COMPUTATIONS

REQUIRED OA FRACTION = Y (= X / (1 + X - Zc))

		STD 62.1 COMPLIANT	
		COOLING	**HEATING**
		FAIL	**FAIL**
		62%	**100%**
X=	0.22	12500	4760
Zc = Outdoor Air Fraction For Critical Space	0.87	0.87	0.87

VAV BOX No.	ROOM NAME	AREA SF	PEOPLE	62.1-1999 MIN OA CFM	62.1-1999 *Zi*	MAX FLOW CFM	CFM/SF	MINIMUM AIR FLOWS (CFM) 90.1-1999 LIMIT	MINIMUM AIR FLOWS (CFM) DESIGN AT BID	MINIMUM AIR FLOWS (CFM) AS BALANCED	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BID	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BALANCED
V-71	INST STORAGE	754	2	15	0.05	850	1.13	302	600	255	FAIL	PASS
V-72	PRACTICE	386	15	113	0.73	424	1.10	154	370	127	FAIL	PASS
V-73	OFFICE	192	2	15	0.17	300	1.56	90	200	90	FAIL	PASS
V-74	PRACTICE	320	8	60	0.47	420	1.31	128	240	125	FAIL	PASS
V-75	BAND	1304	63	469	0.76	2050	1.57	615	1370	615	FAIL	PASS
V-76	BAND	1304	63	469	0.76	2050	1.57	615	1370	615	FAIL	PASS
V-77	UNIFORM	310	1	8	0.05	500	1.61	150	330	150	FAIL	PASS
V-78	MUSIC STORAGE	164	0	0	0.00	150	0.92	65	150	45	FAIL	PASS
V-79	OFFICE	173	2	15	0.20	250	1.45	75	170	45	FAIL	PASS
V-80	VOCAL	1744	86	645	0.80	2700	1.55	810	1800	810	FAIL	PASS
V-81	ROBES	172	1	8	0.11	150	0.87	69	170	120	FAIL	FAIL
V-82	PRACTICE	312	12	90	0.72	340	1.09	125	190	102	FAIL	PASS
V-83	PRACTICE	240	6	45	0.47	315	1.31	96	180	94	FAIL	PASS
V-84	SCENE SHOP	1107	22	165	0.31	1780	1.61	534	1180	534	FAIL	PASS
V-85	DRAMA	968	45	338	0.73	1540	1.59	462	1020	460	FAIL	PASS
V-86	PIANO STORAGE	132	0	0	0.00	150	1.14	53	140	45	FAIL	PASS
V-87	COSTUME	278	1	8	0.06	430	1.55	129	290	130	FAIL	FAIL
V-88	MAKE-UP	341	18	135	0.87	520	1.52	156	340	180	FAIL	FAIL
V-89	DRESS	170	8	60	0.80	250	1.47	75	120	75	FAIL	PASS
V-90	DRESS	131	6	45	0.79	190	1.45	57	170	57	FAIL	PASS
SUBTOTALS		10501	360	2700		15359	1.61					

62.1-1999 AHU VENTILATION RATE VALIDATION COMPUTATIONS

AIR HANDLING UNIT	**AC-6**
DESIGN TOTAL AIR	7000
DESIGN MINIMUM AIR	4775
SYSTEM THERMAL DIVERSITY	97%
DESIGN MINIMUM OUTSIDE AIR	700
OUTDOOR AIR FRACTION, COOLING DESIGN	10%
OUTDOOR AIR FRACTION, HEATING DESIGN	15%
FINAL TOTAL AIR COOLING	7266
FINAL TOTAL AIR HEATING	4775
FINAL OUTDOOR AIR, COOLING DESIGN	860
FINAL OUTDOOR AIR, HEATING DESIGN	860
FINAL OUTDOOR AIR FRACTION, COOLING DESIGN	**11.8%**
FINAL OUTDOOR AIR FRACTION, HEATING DESIGN	**18.0%**

STANDARD 62.1-1999 OUTDOOR AIR FRACTION COMPLIANCE COMPUTATIONS

REQUIRED OA FRACTION = Y (= X / (1 + X - Zc))

***X*=** 0.11

***Zc* =** Outdoor Air Fraction For Critical Space 1.00

STD 62.1 COMPLIANT	
COOLING	**HEATING**
FAIL	**FAIL**
100%	**100%**
7000	2325
1.00	1.00

VAV BOX No.	ROOM NAME	AREA SF	PEOPLE	62.1-1999 MIN OA CFM	62.1-1999 *Zi*	MAX FLOW CFM	CFM/SF	MINIMUM AIR FLOWS (CFM) 90.1-1999 LIMIT	MINIMUM AIR FLOWS (CFM) DESIGN AT BID	MINIMUM AIR FLOWS (CFM) AS BALANCED	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BID	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BALANCED
V-49	LIAISON	138	2	15	0.26	190	1.38	57	130	130	FAIL	FAIL
V-50	A O D A	132	2	15	0.26	190	1.44	57	120	120	FAIL	FAIL
V-51	ARCHIVES	114	1	8	0.16	160	1.40	48	110	110	FAIL	FAIL
V-52	BREAK	194	12	90	1.00	255	1.31	90	170	170	FAIL	FAIL
V-53	CONFERENCE	194	13	98	1.00	300	1.55	98	190	190	FAIL	FAIL
V-54	PRINCIPAL	222	3	23	0.19	400	1.80	120	245	245	FAIL	FAIL
V-55	DEAN	211	2	15	0.16	310	1.47	93	210	210	FAIL	FAIL
V-56	I S S	64	2	15	0.33	150	2.34	45	70	70	FAIL	FAIL
V-57	NURSE	188	2	15	0.20	240	1.28	75	160	160	FAIL	FAIL
V-58	RECEPTION	578	6	45	0.17	880	1.52	264	590	590	FAIL	FAIL
V-59	WORK ROOM	447	4	30	0.17	510	1.14	179	340	340	FAIL	FAIL
V-60	MAIL	120	1	8	0.16	135	1.13	48	90	90	FAIL	FAIL
V-61	RECEPTION	775	4	30	0.10	530	0.68	310	360	360	FAIL	FAIL
V-62	OFFICE	170	2	15	0.21	240	1.41	72	165	165	FAIL	FAIL
V-63	OFFICE	170	2	15	0.22	230	1.35	69	160	160	FAIL	FAIL
V-64	DIST ADMIN	259	3	23	0.20	370	1.43	111	250	250	FAIL	FAIL
V-65	CONFERENCE	288	19	143	1.00	400	1.39	143	270	270	FAIL	FAIL
V-66	BREAK	158	10	75	1.00	220	1.39	75	145	145	FAIL	FAIL
V-67	OFFICE	202	2	15	0.17	290	1.44	87	190	190	FAIL	FAIL
V-68	RECORDS	515	2	15	0.07	710	1.38	213	475	475	FAIL	FAIL
V-69	OFFICE	170	2	15	0.21	240	1.41	72	160	160	FAIL	FAIL
V-70	OFFICE	181	2	15	0.19	260	1.44	78	175	175	FAIL	FAIL
SUBTOTALS		5490	98	735		7210	2.34					

62.1-1999 AHU VENTILATION RATE VALIDATION COMPUTATIONS

AIR HANDLING UNIT	**AC-7**
DESIGN TOTAL AIR	11500
DESIGN MINIMUM AIR	8420
SYSTEM THERMAL DIVERSITY	91%
DESIGN MINIMUM OUTSIDE AIR	2325
OUTDOOR AIR FRACTION, COOLING DESIGN	20%
OUTDOOR AIR FRACTION, HEATING DESIGN	28%
FINAL TOTAL AIR COOLING	12642
FINAL TOTAL AIR HEATING	3870
FINAL OUTDOOR AIR, COOLING DESIGN	2537
FINAL OUTDOOR AIR, HEATING DESIGN	2506
FINAL OUTDOOR AIR FRACTION, COOLING DESIGN	**20.1%**
FINAL OUTDOOR AIR FRACTION, HEATING DESIGN	**64.8%**

STANDARD 62.1-1999 OUTDOOR AIR FRACTION COMPLIANCE COMPUTATIONS

REQUIRED OA FRACTION = Y (= X / (1 + X - Zc))

***X*=** 0.17

***Zc* =** Outdoor Air Fraction For Critical Space 0.90

STD 62.1 COMPLIANT	
COOLING	**HEATING**
FAIL	**FAIL**
64%	**100%**
11500	3859
0.90	0.90

VAV BOX No.	ROOM NAME	AREA SF	PEOPLE	62.1-1999 MIN OA CFM	62.1-1999 *Zi*	MAX FLOW CFM	CFM/SF	MINIMUM AIR FLOWS (CFM) 90.1-1999 LIMIT	MINIMUM AIR FLOWS (CFM) DESIGN AT BID	MINIMUM AIR FLOWS (CFM) AS BALANCED	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BID	90.1-1999, SECTION 6.3.2.1 COMPLIANCE AS BALANCED
V-129	LGI CLASSROOM	2058	96	720	0.87	2600	1.26	823	1720	840	FAIL	FAIL
V-130	PE CLASSROOM	1114	56	420	0.90	1550	1.39	465	1050	465	FAIL	PASS
V-131	OFFICE	128	2	15	0.29	150	1.17	51	100	45	FAIL	PASS
V-132	WEIGHTS	1943	36	266	0.32	2800	1.44	840	1850	840	FAIL	PASS
V-133	WEIGHTS	1943	36	266	0.32	2800	1.44	840	1850	840	FAIL	PASS
V-134	FITNESS	1809	36	270	0.32	2800	1.55	840	1850	840	FAIL	PASS
SUBTOTALS		8995	261	1958		12700	1.55					

ANSI/ASHRAE STANDARD 62.1/90.1 VENTILATION VALIDATION COMPUTATIONS

VAV	AHU	RM No.	ROOM NAME	AREA (SF)	PEOPLE	FORMATION FROM BID DOCS USED FOR THIS ANALYS						SPECIFIED VAV DEVICE												VENTILATION RATES				STD 62.1/90.1-1999 COMPLIANT				DESIGN	ACT	PERCENT	MINIMUM FLOWS			90.1 COMPLIANCE		62.1 COMPLIANCE	
BOX No.						EAT	LAT	REHEAT	HEATING	HEATING	REHEAT	AS DESIGNED						AS MODIFIED			62.1/90.1 COMPLIANT			VENT RATE (CFM/P)		MIN OA					90.1 EXCESS	MIN	MIN	STD 62.1	AS	AS	62.1/90.1-99	AS	AS	AS	AS
	UNIT No.					F	F	BTUH	BTUH	TOTAL	%	MAX	MIN	300 CFM Test	CFM/SF	0.4 cfm/sf test	TURNDOWN	MAX	MIN	TURNDOWN	MAX	MIN	TURNDOWN	62.1-1999	COMM 64	62.1-1999	COMM 64	CFM/P	MIN OA	Zi	AIR FLOW %	OA	OA	MINIMUM	DESIGN	INSTALLED	COMPLIANT	DESIGN	INSTALLED	DESIGN	INSTALLED
V-1	HRAC-1	A109	CLASSROOM	720	31	55	85	14960	7480	22440	67%	1000	680	0	0.94	0.00	68.00%	1000	680	68.00%	1000	465	46.5%	15	7.5	465	233	15	465	1.00	0.0%	63	63	14%	680	680	465	FAIL	FAIL	FAIL	FAIL
V-2	HRAC-1	A106	CLASSROOM	728	50	55	85	14960	7480	22440	67%	1000	680	0	0.93	0.00	68.00%	1000	680	68.00%	1000	750	75.0%	15	7.5	750	375	15	750	1.00	0.0%	63	63	8%	680	680	750	FAIL	FAIL	FAIL	FAIL
V-3	HRAC-1	A113	TPC	329	3	55	85	6600	3300	9900	67%	450	300	0	0.91	0.00	66.67%	450	135	30.00%	450	45	10.0%	15	7.5	45	23	15	45	1.00	0.0%	29	13	28%	300	135	45	FAIL	FAIL	FAIL	FAIL
V-4	HRAC-1	A116	CLASSROOM	724	34	55	85	14630	7315	21945	67%	1000	665	0	0.92	0.00	66.50%	1000	680	68.00%	1000	510	51.0%	15	7.5	510	255	15	510	1.00	0.0%	63	63	12%	665	680	510	FAIL	FAIL	FAIL	FAIL
V-5	HRAC-1	A103	CORRIDOR	1971	0	55	85	13750	6875	20625	67%	1250	625	0	0.32	1.00	50.00%	1250	625	50.00%	1250	0	0.0%	0	7.5	0	0	15	0	0.00	0.0%	79	58	100%	625	625	0	FAIL	FAIL	FAIL	FAIL
V-6	HRAC-1	A133	2-D ART	1498	51	55	95	26400	26400	52800	50%	1800	1200	0	0.80	0.00	66.67%	1800	1200	66.67%	1800	765	42.5%	15	7.5	765	383	15	765	1.00	0.0%	114	112	15%	1200	1200	765	FAIL	FAIL	FAIL	FAIL
V-7	HRAC-1	A135	3-D ART	1580	62	55	85	28380	14190	42570	67%	1800	1290	0	0.82	0.00	71.67%	1800	1290	71.67%	1800	930	51.7%	15	7.5	930	465	15	930	1.00	0.0%	114	120	13%	1290	1290	930	FAIL	FAIL	FAIL	FAIL
V-8	HRAC-1	A131/A132	OFFICE	456	8	55	85	12650	6325	18975	67%	840	575	0	1.26	0.00	68.45%	840	575	68.45%	840	160	19.0%	20	7.5	160	60	20	160	1.00	0.0%	53	54	33%	575	575	160	FAIL	FAIL	FAIL	FAIL
V-9	HRAC-1	A117	DRAFTING	1408	25	55	85	28600	14300	42900	67%	1950	1300	0	0.92	0.00	66.67%	1950	1300	66.67%	1950	375	19.2%	15	7.5	375	188	15	375	1.00	0.0%	124	121	32%	1300	1300	375	FAIL	FAIL	FAIL	FAIL
V-10	HRAC-1	A129	BUS CLASSROOM	1154	45	55	85	22660	11330	33990	67%	1800	1030	0	0.89	0.00	57.22%	1800	1030	57.22%	1800	675	37.5%	15	7.5	675	338	15	675	1.00	0.0%	114	96	14%	1030	1030	675	FAIL	FAIL	FAIL	FAIL
V-11	HRAC-1	A120	TECH LAB	1419	30	55	85	32780	16390	49170	67%	2200	1490	0	1.05	0.00	67.73%	2200	1490	67.73%	2200	450	20.5%	15	7.5	450	225	15	450	1.00	0.0%	139	139	31%	1490	1490	450	FAIL	FAIL	FAIL	FAIL
V-12	HRAC-1	A127	BUS LAB	1380	25	55	85	28160	14080	42240	67%	2500	1280	0	0.93	0.00	51.20%	2500	1280	51.20%	2500	375	15.0%	15	7.5	375	188	15	375	1.00	0.0%	158	119	32%	1280	1280	375	FAIL	FAIL	FAIL	FAIL
V-13	HRAC-1	A128	OFFICE	367	3	55	95	8250	8250	16500	50%	450	375	0	1.02	0.00	83.33%	450	375	83.33%	450	60	13.3%	20	7.5	60	23	20	60	1.00	0.0%	29	35	58%	375	375	60	FAIL	FAIL	FAIL	FAIL
V-14	HRAC-1	B144	RECORDS	231	1	55	85	4840	2420	7260	67%	330	220	0	0.95	0.00	66.67%	330	220	66.67%	330	20	6.1%	20	7.5	20	8	20	20	1.00	0.0%	21	20	102%	220	220	20	FAIL	FAIL	FAIL	FAIL
V-15	HRAC-1	B143	CONFERENCE	178	12	55	85	4400	2200	6600	67%	280	200	1	1.12	0.00	71.43%	280	200	71.43%	280	240	85.7%	20	7.5	240	90	20	240	1.00	0.0%	18	19	8%	200	200	240	FAIL	FAIL	FAIL	FAIL
V-16	HRAC-1	B142	GUIDANCE OFFICE	160	2	55	95	4400	4400	8800	50%	240	200	1	1.25	0.00	83.33%	240	200	83.33%	240	40	16.7%	20	7.5	40	15	20	40	1.00	0.0%	15	19	47%	200	200	40	FAIL	FAIL	FAIL	FAIL
V-17	HRAC-1	B141	GUIDANCE OFFICE	160	2	55	95	4400	4400	8800	50%	240	200	1	1.25	0.00	83.33%	240	200	83.33%	240	40	16.7%	20	7.5	40	15	20	40	1.00	0.0%	15	19	47%	200	200	40	FAIL	FAIL	FAIL	FAIL
V-18	HRAC-1	B145	GUIDANCE CENTER	953	7	55	85	14410	7205	21615	67%	980	655	0	0.69	0.00	66.84%	980	655	66.84%	980	140	14.3%	20	7.5	140	53	20	140	1.00	0.0%	62	61	44%	655	655	140	FAIL	FAIL	FAIL	FAIL
V-19	HRAC-1	B140	ITIN OFFICE	160	2	55	95	4400	4400	8800	50%	240	200	1	1.25	0.00	83.33%	240	200	83.33%	240	40	16.7%	20	7.5	40	15	20	40	1.00	0.0%	15	19	47%	200	200	40	FAIL	FAIL	FAIL	FAIL
V-20	HRAC-1	B139	ITIN OFFICE	135	2	55	85	2860	1430	4290	67%	200	130	1	0.96	0.00	65.00%	200	130	65.00%	200	40	20.0%	20	7.5	40	15	20	40	1.00	0.0%	13	12	30%	130	130	40	FAIL	FAIL	FAIL	FAIL
V-21	HRAC-1	B136	ITIN OFFICE	132	2	55	85	2640	1320	3960	67%	200	120	1	0.91	0.00	60.00%	200	120	60.00%	200	40	20.0%	20	7.5	40	15	20	40	1.00	0.0%	13	11	28%	120	120	40	FAIL	FAIL	FAIL	FAIL
V-22	HRAC-2	B135	OFFICE	185	2	55	85	3850	1925	5775	67%	260	175	1	0.95	0.00	67.31%	260	175	67.31%	260	40	15.4%	20	7.5	40	15	20	40	1.00	0.0%	16	16	41%	175	175	40	FAIL	FAIL	FAIL	FAIL
V-23	HRAC-2	B134	COPY	198	2	55	85	4400	2200	6600	67%	300	200	0	1.01	0.00	66.67%	300	200	66.67%	300	40	13.3%	20	7.5	40	15	20	40	1.00	0.0%	19	19	47%	200	200	40	FAIL	FAIL	FAIL	FAIL
V-24	HRAC-2	B133	OTPT	274	13	55	85	5500	2750	8250	67%	400	250	0	0.91	0.00	62.50%	400	250	62.50%	400	260	65.0%	20	7.5	260	98	20	260	1.00	0.0%	25	23	9%	250	250	260	FAIL	FAIL	FAIL	FAIL
V-25	HRAC-2	B129	CD CLASSROOM	1083	48	55	85	23760	11880	35640	67%	1000	1080	0	1.00	0.00	108.00%	1000	324	32.40%	1000	720	72.0%	15	7.5	720	360	15	720	1.00	0.0%	63	30	4%	1080	324	720	FAIL	FAIL	FAIL	FAIL
V-26	HRAC-2	B106/B107	PREP	302	3	55	85	6600	3300	9900	67%	430	300	0	0.99	0.00	69.77%	430	300	69.77%	430	60	14.0%	20	7.5	60	23	20	60	1.00	0.0%	27	28	47%	300	300	60	FAIL	FAIL	FAIL	FAIL
V-27	HRAC-2	B105	CHEMISTRY	1489	53	55	85	32450	16225	48675	67%	2200	1475	0	0.99	0.00	67.05%	2200	1475	67.05%	2200	1060	48.2%	20	7.5	1060	398	20	1060	1.00	0.0%	139	137	13%	1475	1475	1060	FAIL	FAIL	FAIL	FAIL
V-28	HRAC-2	B111	PHYSICAL SCIENCE	1564	59	55	85	33000	16500	49500	67%	2200	1500	0	0.96	0.00	68.18%	2200	1500	68.18%	2200	1180	53.6%	20	7.5	1180	443	20	1180	1.00	0.0%	139	140	12%	1500	1500	1180	FAIL	FAIL	FAIL	FAIL
V-29	HRAC-2	B112	PREP	159	2	55	85	3300	1650	4950	67%	225	150	1	0.94	0.00	66.67%	225	150	66.67%	225	40	17.8%	20	7.5	40	15	20	40	1.00	0.0%	14	14	35%	150	150	40	FAIL	FAIL	FAIL	FAIL
V-30	HRAC-2	B113	HEAD HOUSE	317	2	55	85	7150	3575	10725	67%	490	325	0	1.03	0.00	66.33%	490	325	66.33%	490	30	6.1%	15	7.5	30	15	15	30	1.00	0.0%	31	30	101%	325	325	30	FAIL	FAIL	FAIL	FAIL
V-31	HRAC-2	B109	IND STUDY	609	15	55	85	12760	6380	19140	67%	870	580	0	0.95	0.00	66.67%	870	580	66.67%	870	225	25.9%	15	7.5	225	113	15	225	1.00	0.0%	55	54	24%	580	580	225	FAIL	FAIL	FAIL	FAIL
V-32	HRAC-2	B115	BIOLOGY	1417	59	55	85	33000	16500	49500	67%	2200	1500	0	1.06	0.00	68.18%	2200	1500	68.18%	2200	1180	53.6%	20	7.5	1180	443	20	1180	1.00	0.0%	139	140	12%	1500	1500	1180	FAIL	FAIL	FAIL	FAIL
V-33	HRAC-2	B119	CORRIDOR	3574	0	55	85	11000	5500	16500	67%	1000	500	0	0.14	1.00	50.00%	1000	500	50.00%	1000	0	0.0%	0	7.5	0	0	15	0	0.00	0.0%	63	47	100%	500	500	0	FAIL	FAIL	FAIL	FAIL
V-34	HRAC-2	B126	DISTANCE LEARNING	667	32	55	85	15180	7590	22770	67%	1300	690	0	1.03	0.00	53.08%	1300	690	53.08%	1300	480	36.9%	15	7.5	480	240	15	480	1.00	0.0%	82	64	13%	690	690	480	FAIL	FAIL	FAIL	FAIL
V-35	HRAC-2	B125	MED STUDIO	537	25	55	85	9350	4675	14025	67%	800	425	0	0.79	0.00	53.13%	800	425	53.13%	800	375	46.9%	15	7.5	375	188	15	375	1.00	0.0%	51	40	11%	425	425	375	FAIL	FAIL	FAIL	FAIL
V-36	HRAC-2	B124	HEAD END	432	2	55	85	9350	4675	14025	67%	800	425	0	0.98	0.00	53.13%	800	425	53.13%	800	30	3.8%	15	7.5	30	15	15	30	1.00	0.0%	51	40	132%	425	425	30	FAIL	FAIL	FAIL	FAIL
V-37	HRAC-2	B123	COMPUTER CLASSROOM	1000	27	55	85	20130	10065	30195	67%	1800	915	0	0.92	0.00	50.83%	1800	915	50.83%	1800	405	22.5%	15	7.5	405	203	15	405	1.00	0.0%	114	85	21%	915	915	405	FAIL	FAIL	FAIL	FAIL
V-38	HRAC-2	B117	PREP	255	2	55	85	5500	2750	8250	67%	380	250	0	0.98	0.00	65.79%	380	250	65.79%	380	30	7.9%	15	7.5	30	15	15	30	1.00	0.0%	24	23	78%	250	250	30	FAIL	FAIL	FAIL	FAIL
V-39	HRAC-2	B122	WORK ROOM	708	8	55	85	14740	7370	22110	67%	1000	670	0	0.95	0.00	67.00%	1000	670	67.00%	1000	120	12.0%	15	7.5	120	60	15	120	1.00	0.0%	63	62	52%	670	670	120	FAIL	FAIL	FAIL	FAIL
V-40	HRAC-2	B121	STORAGE	345	0	55	85	7370	3685	11055	67%	500	335	0	0.97	0.00	67.00%	500	335	67.00%	500	0	0.0%	15	7.5	0	0	15	0	0.00	0.0%	32	31	100%	335	335	0	FAIL	FAIL	FAIL	FAIL
V-41	HRAC-2	B120	OFFICE	204	2	55	85	4180	2090	6270	67%	300	190	0	0.93	0.00	63.33%	300	190	63.33%	300	40	13.3%	20	7.5	40	15	20	40	1.00	0.0%	19	18	44%	190	190	40	FAIL	FAIL	FAIL	FAIL
V-42	HRAC-2	C109	IMC	1513	16.5	55	85	37400	18700	56100	67%	2600	1700	0	1.12	0.00	65.38%	2600	1700	65.38%	2600	248	9.5%	15	7.5	248	124	15	248	1.00	0.0%	165	158	64%	1700	1700	248	FAIL	FAIL	FAIL	FAIL
V-43	HRAC-2	B118	LIFE SCIENCE	1517	54	55	85	33000	16500	49500	67%	2200	1500	0	0.99	0.00	68.18%	2200	1500	68.18%	2200	810	36.8%	15	7.5	810	405	15	810	1.00	0.0%	139	140	17%	1500	1500	810	FAIL	FAIL	FAIL	FAIL
V-44	HRAC-2	C109	IMC	1513	16.5	55	85	37400	18700	56100	67%	2600	1700	0	1.12	0.00	65.38%	2600	1700	65.38%	2600	248	9.5%	15	7.5	248	124	15	248	1.00	0.0%	165	158	64%	1700	1700	248	FAIL	FAIL	FAIL	FAIL
V-45	HRAC-2	C107	STAFF	499	5	55	85	11000	5500	16500	67%	725	500	0	1.00	0.00	68.97%	725	500	68.97%	725	75	10.3%	15	7.5	75	38	15	75	1.00	0.0%	46	47	62%	500	500	75	FAIL	FAIL	FAIL	FAIL
V-46	HRAC-2	C112	WEB ROOM	365	15	55	85	7700	3850	11550	67%	700	350	0	0.96	0.00	50.00%	700	350	50.00%	700	225	32.1%	15	7.5	225	113	15	225	1.00	0.0%	44	33	14%	350	350	225	FAIL	FAIL	FAIL	FAIL
V-47	HRAC-2	C111	CONFERENCE	195	12	55	85	4400	2200	6600	67%	300	200	0	1.03	0.00	66.67%	300	200	66.67%	300	240	80.0%	20	7.5	240	90	20	240	1.00	0.0%	19	19	8%	200	200	240	FAIL	FAIL	FAIL	FAIL
V-48	HRAC-2	C110	CONFERENCE	195	12	55	85	4400	2200	6600	67%	300	200	0	1.03	0.00	66.67%	300	200	66.67%	300	240	80.0%	20	7.5	240	90	20	240	1.00	0.0%	19	19	8%	200	200	240	FAIL	FAIL	FAIL	FAIL
V-49	AC-6	C113	LIAISON	138	2	55	85	2860	1430	4290	67%	190	130	1	0.94	0.00	68.42%	190	130	68.42%	190	40	21.1%	20	7.5	40	15	20	40	1.00	0.0%	12	12	30%	130	130	40	FAIL	FAIL	FAIL	FAIL
V-50	AC-6	C114	A O D A	132	2	55	85	2640	1320	3960	67%	190	120	1	0.91	0.00	63.16%	190	120	63.16%	190	40	21.1%	20	7.5	40	15	20	40	1.00	0.0%	12	11	28%	120	120	40	FAIL	FAIL	FAIL	FAIL
V-51	AC-6	C115	ARCHIVES	114	1	55	85	2420	1210	3630	67%	160	110	1	0.96	0.00	68.75%	160	110	68.75%	160	20	12.5%	20	7.5	20	8	20	20	1.00	0.0%	10	10	51%	110	110	20	FAIL	FAIL	FAIL	FAIL
V-52	AC-6	C116	BREAK	194	12	55	85	3740	1870	5610	67%	255	170	1	0.88	0.00	66.67%	255	170	66.67%	255	240	94.1%	20	7.5	240	90	20	240	1.00	0.0%	16	16	7%	170	170	240	FAIL	FAIL	FAIL	FAIL
V-53	AC-6	C117	CONFERENCE	194	13	55	85	4180	2090	6270	67%	300	190	0	0.98	0.00	63.33%	300	190	63.33%	300	260	86.7%	20	7.5	260	98	20	260	1.00	0.0%	19	18	7%	190	190	260	FAIL	FAIL	FAIL	FAIL
V-54	AC-6	C118	PRINCIPAL	222	3	55	85	5390	2695	8085	67%	400	245	0	1.10	0.00	61.25%	400	245	61.25%	400	60	15.0%	20	7.5	60	23	20	60	1.00	0.0%	25	23	38%	245	245	60	FAIL	FAIL	FAIL	FAIL
V-55	AC-6	C119	DEAN	211	2	55	85	4620	2310	6930	67%	310	210	0	1.00	0.00	67.74%	310	210	67.74%	310	40	12.9%	20	7.5	40	15	20	40	1.00	0.0%	20	20	49%	210	210	40	FAIL	FAIL	FAIL	FAIL
V-56	AC-6	C128/C129	I S S	64	2	55	85	1540	770	2310	67%	150	70	1	1.09	0.00	46.67%	150	70	46.67%	150	40	26.7%	20	7.5	40	15	20	40	1.00	0.0%	10	7	16%	70	70	40	FAIL	FAIL	FAIL	FAIL
V-57	AC-6	C127	NURSE	188	2	55	85	3520	1760	5280	67%	240	160	1	0.85	0.00	66.67%	240	160	66.67%	240	40	16.7%	20	7.5	40	15	20	40	1.00	0.0%	15	15	37%	160	160	40	FAIL	FAIL	FAIL	FAIL
V-58	AC-6	C120	RECEPTION	578	6	55	85	12980	6490	19470	67%	880	590	0	1.02	0.00	67.05%	880	590	67.05%	880	120	13.6%	20	7.5	120	45	20	120	1.00	0.0%	56	55	46%	590	590	120	FAIL	FAIL	FAIL	FAIL
V-59	AC-6	C121	WORK ROOM	447	4	55	85	7480	3740	11220	67%	510	340	0	0.76	0.00	66.67%	510	340	66.67%	510	80	15.7%	20	7.5	80	30	20	80	1.00	0.0%	32	32	40%	340	340	80	FAIL	FAIL	FAIL	FAIL
V-60	AC-6	C122	MAIL	120	1	55	85	1980	990	2970	67%	135	90	1	0.75	0.00	66.67%	135	90	66.67%	135	20	14.8%	20	7.5	20	8	20	20	1.00	0.0%	9	8	42%	90	90	20	FAIL	FAIL	FAIL	FAIL
V-61	AC-6	D101	RECEPTION	775	4	55	85	7920	3960	11880	67%	530	360	0	0.46	0.00	67.92%	530	360	67.92%	530	80	15.1%	20	7.5	80	30	20	80	1.00	0.0%	34	34	42%	360	360	80	FAIL	FAIL	FAIL	FAIL
V-62	AC-6	D114	OFFICE	170	2	55	85	3630	1815	5445	67%	240	165	1	0.97	0.00	68.75%	240	165	68.75%	240	40	16.7%	20	7.5	40	15	20	40	1.00	0.0%	15	15	38%	165	165	40	FAIL	FAIL	FAIL	FAIL
V-63	AC-6	D113	OFFICE	170	2	55	85	3520	1760	5280	67%	230	160	1	0.94	0.00	69.57%	230	160	69.57%	230	40	17.4%	20	7.5	40	15	20	40	1.00	0.0%	15	15	37%	160	160	40	FAIL	FAIL	FAIL	FAIL
V-64	AC-6	D103	DIST ADMIN	259	3	55	85	5500	2750	8250	67%	370	250	0	0.97	0.00	67.57%	370	250	67.57%	370	60	16.2%	20	7.5	60	23	20	60	1.00	0.0%	23	23	39%	250	250	60	FAIL	FAIL	FAIL	FAIL
V-65	AC-6	D104	CONFERENCE	288	19	55	85	5940	2970	8910	67%	400	270	0	0.94	0.00	67.50%	400	270	67.50%	400	380	95.0%	20	7.5	380	143	20	380	1.00	0.0%	25	25	7%	270	270	380	FAIL	FAIL	FAIL	FAIL
V-66	AC-6	D110	BREAK	158	10	55	85	3190	1595	4785	67%	220	145	1	0.92	0.00	65.91%	220	145	65.91%	220	200	90.9%	20	7.5	200	75	20	200	1.00	0.0%	14	14	7%	145	145	200	FAIL	FAIL	FAIL	FAIL
V-67	AC-6	D105	OFFICE	202	2	55	85	4180	2090	6270	67%	290	190	1	0.94	0.00	65.52%	290	190	65.52%	290	40	13.8%	20	7.5	40	15	20	40	1.00	0.0%	18	18	44%	190	190	40	FAIL	FAIL	FAIL	FAIL
V-68	AC-6	D108	RECORDS	515	2	55	85	10450	5225	15675	67%	710	475	0	0.92	0.00	66.90%	710	475	66.90%	710	40	5.6%	20	7.5	40	15	20	40	1.00	0.0%	45	44	111%	475	475	40	FAIL	FAIL	FAIL	FAIL
V-69	AC-6	D106	OFFICE	170	2	55	85	3520	1760	5280	67%	240	160	1	0.94	0.00	66.67%	240	160	66.67%	240	40	16.7%	20	7.5	40	15	20	40	1.00	0.0%	15	15	37%	160	160	40	FAIL	FAIL	FAIL	FAIL
V-70	AC-6	D107	OFFICE	181	2	55	85	3850	1925	5775	67%	260	175	1	0.97	0.00	67.31%	260	175	67.31%	260	40	15.4%	20	7.5	40	15	20	40	1.00	0.0%	16	16	41%	175	175	40	FAIL	FAIL	FAIL	FAIL
V-71	AC-2	D118	INST STORAGE	754	2	55	85	13200	6600	19800	67%	850	600	0	0.80	0.00	70.59%	850	255	30.00%	850	30	3.5%	15	7.5	30	15	15	30	1.00	0.0%	54	24	79%	600	255	30	FAIL	FAIL	FAIL	FAIL
V-72	AC-2	D121	PRACTICE	386	15	55	85	8140	4070	12210	67%	424	370	0	0.96	0.00	87.26%	424	127	29.95%	424	225	53.1%	15	7.5	225	113	15	225	1.00	0.0%	27	12	5%	370	127	225	FAIL	FAIL	FAIL	FAIL
V-73	AC-2	D119	OFFICE	192	2	55	85	4400	2200	6600	67%	300	200	0	1.04	0.00	66.67%	300	90	30.00%	300	40	13.3%	20	7.5	40	15	20	40	1.00	0.0%	19	8	21%	200	90	40	FAIL	FAIL	FAIL	FAIL
V-74	AC-2	D122-125	PRACTICE	320	8	55	85	5280	2640	7920	67%	420	240	0	0.75	0.00	57.14%	420	125	29.76%	420	120	28.6%	15	7.5	120	60	15	120	1.00	0.0%	27	12	10%	240	125	120	FAIL	FAIL	FAIL	FAIL
V-75	AC-2	D127	BAND	1304	62.5	55	85	30140	15070	45210	67%	2050	1370	0	1.05	0.00	66.83%	2050	615	30.00%	2050	938	45.7%	15	7.5	938	469	15	938	1.00	0.0%	130	57	6%	1370	615	938	FAIL	FAIL	FAIL	FAIL
V-76	AC-2	D127	BAND	1304	62.5	55	85	30140	15070	45210	67%	2050	1370	0	1.05	0.00	66.83%	2050	615	30.00%	2050	938	45.7%	15	7.5	938	469	15	938	1.00	0.0%	130	57	6%	1370	615	938	FAIL	FAIL	FAIL	FAIL
V-77	AC-2	D126	UNIFORM	310	1	55	85	7260	3630	10890	67%	500	330	0	1.06	0.00	66.00%	500	150	30.00%	500	15	3.0%	15	7.5	15	8	15	15	1.00	0.0%	32	14	93%	330	150	15	FAIL	FAIL	FAIL	FAIL
V-78	AC-2	D-154	MUSIC STORAGE	164	0	55	85	3300	1650	4950	67%	150	150	1	0.92	0.00	100.00%	150	45	30.00%	150	0	0.0%	15	7.5	0	0	15	0	0.00	0.0%	10	4	100%	150	45	0	FAIL	FAIL	FAIL	FAIL
V-79	AC-2	D-130	OFFICE	173	2	55	85	3740	1870	5610	67%	250	170	1	0.98	0.00	68.00%	250	45	18.00%	250	40	16.0%	20	7.5	40	15	20	40	1.00	0.0%	16	4	10%	170	45	40	FAIL	FAIL	FAIL	FAIL
V-80	AC-2	D-128	VOCAL	1744	86	55	85	39600	19800	59400	67%	2700	1800	0	1.03	0.00	66.67%	2700	810	30.00%	2700	1290	47.8%	15	7.5	1290	645	15	1290	1.00	0.0%	171	75	6%	1800	810	1290	FAIL	FAIL	FAIL	FAIL
V-81	AC-2	D-131	ROBES	172	1	55	85	3740	1870	5610	67%	150	170	1	0.99	0.00	113.33%	150	120	80.00%	150	15	10.0%	15	7.5	15	8	15	15	1.00	0.0%	10	11	75%	170	120	15	FAIL	FAIL	FAIL	FAIL
V-82	AC-2	D-132	PRACTICE	312	12	55	85	4180	2090	6270	67%	340	190	0	0.61	0.00	55.88%	340	102	30.00%	340	180	52.9%	15	7.5	180	90	15	180	1.00	0.0%	22	10	5%	190	102	180	FAIL	FAIL	FAIL	FAIL
V-83	AC-2	D-133-135	PRACTICE	240	6	55	85	3960	1980	5940	67%	315	180	0	0.75	0.00	57.14%	315	94	29.84%	315	90	28.6%	15	7.5	90	45	15	90	1.00	0.0%	20	9	10%	180	94	90	FAIL	FAIL	FAIL	FAIL
V-84	AC-2	D-136	SCENE SHOP	1107	22	55	85	25960	12980	38940	67%	1780	1180	0	1.07	0.00	66.29%	1780	534	30.00%	1780	330	18.5%	15	7.5	330	165	15	330	1.00	0.0%	113	50	15%	1180	534	330	FAIL	FAIL	FAIL	FAIL
V-85	AC-2	D-137	DRAMA	968	45	55	85	22440	11220	33660	67%	1540	1020	0	1.05	0.00	66.23%	1540	460	29.87%	1540	675	43.8%	15	7.5	675	338	15	675	1.00	0.0%	98	43	6%	1020	460	675	FAIL	FAIL	FAIL	FAIL
V-86	AC-2	D-159	PIANO STORAGE	132	0	55	85	3080	1540	4620	67%	150	140	1	1.06	0.00	93.33%	150	45	30.00%	150	0	0.0%	15	7.5	0	0	15	0	0.00	0.0%	10	4	100%	140	45	0	FAIL	FAIL	FAIL	FAIL
V-87	AC-2	E-106	COSTUME	278	1	55	85	6380	3190	9570	67%	430	290	0	1.04	0.00	67.44%	430	130	30.23%	430	15	3.5%	15	7.5	15	8	15	15	1.00	0.0%	27	12	81%	290	130	15	FAIL	FAIL	FAIL	FAIL
V-88	AC-2	E-107	MAKE-UP	341	18	55	85	7480	3740	11220	67%	520	340	0	1.00	0.00	65.38%	520	180	34.62%	520	270	51.9%	15	7.5	270	135	15	270	1.00	0.0%	33	17	6%	340	180	270	FAIL	FAIL	FAIL	FAIL
V-89	AC-2	E-109	DRESS	170	8	55	85	2640	1320	3960	67%	250	120	1	0.71	0.00	48.00%	250	75	30.00%	250	120	48.0%	15	7.5	120	60	15	120	1.00	0.0%	16	7	6%	120	75	120	PASS	FAIL	FAIL	FAIL
V-90	AC-2	E-108	DRESS	131	6	55	85	3740	1870	5610	67%	190	170	1	1.30	0.00	89.47%	190	57	30.00%	190	90	47.4%	15	7.5	90	45	15	90	1.00	0.0%	12	5	6%	170	57	90	FAIL	FAIL	FAIL	FAIL
V-91	HRAC-3	A-234	MATH	789	44	55	95	22000	22000	44000	50%	1350	1000	0	1.27	0.00	74.07%	1350	1000	74.07%	1350	660	48.9%	15	7.5	660	330	15	660	1.00	0.0%	86	93	14%	1000	1000	660	FAIL	FAIL	FAIL	FAIL
V-92	HRAC-3	A-232	MATH	686	42	55	95	22000	22000	44000	50%	1350	1000	0	1.46	0.00	74.07%	1350	1000	74.07%	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	93	15%	1000	1000	630	FAIL	FAIL	FAIL	FAIL
V-93	HRAC-3	A-231	MATH	747	41	55	95	22000	22000	44000	50%	1350	1000	0	1.34	0.00	74.07%	1350	1000	74.07%	1350	615	45.6%	15	7.5	615	308	15	615	1.00	0.0%	86	93	15%	1000	1000	615	FAIL	FAIL	FAIL	FAIL
V-94	HRAC-3	A-229	MATH	935	42	55	95	22000	22000	44000	50%	1350	1000	0	1.07	0.00	74.07%	1350	1000	74.07%	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	93	15%	1000	1000	630	FAIL	FAIL	FAIL	FAIL
V-95	HRAC-3	A-227	MATH	728	42	55	95	22000	22000	44000	50%	1350	1000	0	1.37	0.00	74.07%	1350	1000	74.07%	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	93	15%	1000	1000	630	FAIL	FAIL	FAIL	FAIL
V-96	HRAC-3	A-203	CORRIDOR	3704	0	55	85	26400	13200	39600	67%	1600	1200	0	0.32	1.00	75.00%	1600	1200	75.00%	1600	0	0.0%	15	7.5	0	0	15	0	0.00	0.0%	101	112	100%	1200	1200	0	FAIL	FAIL	FAIL	FAIL

ANSI/ASHRAE STANDARD 62.1/90.1 VENTILATION VALIDATION COMPUTATIONS

VAV BOX No.	AHU UNIT No.	RM No.	ROOM NAME	AREA (SF)	PEOPLE	FORMATION FROM BID DOCS USED FOR THIS ANALYS						SPECIFIED VAV DEVICE								
												AS DESIGNED						AS MODIFIED		
						EAT F	LAT F	REHEAT BTUH	HEATING BTUH	HEATING TOTAL	REHEAT %	MAX	MIN	300 CFM Test	CFM/SF	0.4 cfm/sf test	TURNDOWN	MAX	MIN	TURNDOWN
V-97	HRAC-3	A-210	STAFF WORKROOM	337	3	55	85	6600	3300	9900	67%	450	300	0	0.89	0.00	66.67%	450	300	66.67%
V-98	HRAC-3	A-213	FOREIGN LANGUAGE	984	44	55	95	22000	22000	44000	50%	1350	1000	0	1.02	0.00	74.07%	1350	1000	74.07%
V-99	HRAC-3	A-214	FOREIGN LANGUAGE	918	42	55	95	22000	22000	44000	50%	1350	1000	0	1.09	0.00	74.07%	1350	1000	74.07%
V-100	HRAC-3	A-216	FOREIGN LANGUAGE	935	42	55	95	22000	22000	44000	50%	1350	1000	0	1.07	0.00	74.07%	1350	1000	74.07%
V-101	HRAC-3	A-218	FOREIGN LANGUAGE	918	41	55	95	22000	22000	44000	50%	1350	1000	0	1.09	0.00	74.07%	1350	1000	74.07%
V-102	HRAC-3	A-219	FOREIGN LANGUAGE	902	42	55	95	22000	22000	44000	50%	1350	1000	0	1.11	0.00	74.07%	1350	1000	74.07%
V-103	HRAC-3	A-226	MATH	789	44	55	95	22000	22000	44000	50%	1350	1000	0	1.27	0.00	74.07%	1350	1000	74.07%
V-104	HRAC-3	B-231	L.D.CLASSROOM	765	34	55	85	15400	7700	23100	67%	1000	700	0	0.92	0.00	70.00%	1000	700	70.00%
V-105	HRAC-3	B-230	OFFICE	132	2	55	95	3300	3300	6600	50%	220	150	1	1.14	0.00	68.18%	220	150	68.18%
V-106	HRAC-3	B-227	L.D.CLASROOM	748	33	55	85	15400	7700	23100	67%	1000	700	0	0.94	0.00	70.00%	1000	700	70.00%
V-107	HRAC-3	B-206	OFFICE	112	2	55	95	2640	2640	5280	50%	180	120	1	1.07	0.00	66.67%	180	120	66.67%
V-108	HRAC-3	B-207	AT RISK	731	31	55	85	15400	7700	23100	67%	1000	700	0	0.96	0.00	70.00%	1000	700	70.00%
V-109	HRAC-4	B-226	SOCIAL STUDIES	980	44	55	95	22000	22000	44000	50%	1350	1000	0	1.02	0.00	74.07%	1350	405	30.00%
V-110	HRAC-4	B-224	SOCIAL STUDIES	942	42	55	95	22000	22000	44000	50%	1350	1000	0	1.06	0.00	74.07%	1350	405	30.00%
V-111	HRAC-4	B-223	SOCIAL STUDIES	942	41	55	95	22000	22000	44000	50%	1350	1000	0	1.06	0.00	74.07%	1350	405	30.00%
V-112	HRAC-4	B-221	SOCIAL STUDIES	942	42	55	95	22000	22000	44000	50%	1350	1000	0	1.06	0.00	74.07%	1350	405	30.00%
V-113	HRAC-4	B-219	SOCIAL STUDIES	926	42	55	95	22000	22000	44000	50%	1350	1000	0	1.08	0.00	74.07%	1350	405	30.00%
V-114	HRAC-4	B-218	SOCIAL STUDIES	982	44	55	95	22000	22000	44000	50%	1350	1000	0	1.02	0.00	74.07%	1350	405	30.00%
V-115	HRAC-4	B-204	CORRIDOR	4838	0	55	95	22000	22000	44000	50%	1300	1000	0	0.21	1.00	76.92%	1300	390	30.00%
V-116	HRAC-4	B-208	ENGLISH	980	44	55	95	22000	22000	44000	50%	1350	1000	0	1.02	0.00	74.07%	1350	405	30.00%
V-117	HRAC-4	B-209	ENGLISH	918	42	55	90	22000	16500	38500	57%	1350	1000	0	1.09	0.00	74.07%	1350	405	30.00%
V-118	HRAC-4	B-211	WRITING LAB	942	29	55	95	22000	22000	44000	50%	1350	1000	0	1.06	0.00	74.07%	1350	405	30.00%
V-119	HRAC-4	B-213	ENGLISH	927	41	55	85	22000	11000	33000	67%	1350	1000	0	1.08	0.00	74.07%	1350	405	30.00%
V-120	HRAC-4	B-214	ENGLISH	901	42	55	90	22000	16500	38500	57%	1350	1000	0	1.11	0.00	74.07%	1350	405	30.00%
V-121	HRAC-4	B-216	ENGLISH	981	44	55	85	22000	11000	33000	67%	1350	1000	0	1.02	0.00	74.07%	1350	405	30.00%
V-122	HRAC-4	B-217	EBBD CLASSROOM	988	38	55	85	16830	8415	25245	67%	1150	765	0	0.77	0.00	66.52%	1150	345	30.00%
V-123	HRAC-4	C-208	FOOD LABS	1845	25	55	85	37400	18700	56100	67%	2500	1700	0	0.92	0.00	68.00%	2500	750	30.00%
V-124	HRAC-4	C-204	OFFICE	177	2	55	90	5500	4125	9625	57%	300	250	0	1.41	0.00	83.33%	300	90	30.00%
V-125	HRAC-4	C-203	EBBD CLASSROOM	447	38	55	85	17270	8635	25905	67%	1180	785	0	1.76	0.00	66.53%	1180	345	29.24%
V-126	HRAC-4	C-209	OFFICE	130	2	55	90	3300	2475	5775	57%	290	150	1	1.15	0.00	51.72%	290	87	30.00%
V-127	HRAC-4	C-211	FAMILY LIVING	1028	37	55	85	20680	10340	31020	67%	1400	940	0	0.91	0.00	67.14%	1400	420	30.00%
V-128	HRAC-4	C-202	CORRIDOR	1260	0	55	85	7590	3795	11385	67%	690	345	0	0.27	1.00	50.00%	690	207	30.00%
V-129	AC-7	E-202	LGI CLASSROOM	2058	96	55	85	37840	18920	56760	67%	2600	1720	0	0.84	0.00	66.15%	2600	840	32.31%
V-130	AC-7	E-207	PE CLASSROOM	1114	56	55	85	23100	11550	34650	67%	1550	1050	0	0.94	0.00	67.74%	1550	465	30.00%
V-131	AC-7	F-206	OFFICE	128	2	55	85	2200	1100	3300	67%	150	100	1	0.78	0.00	66.67%	150	45	30.00%
V-132	AC-7	F-205	WEIGHTS	1943	35.5	55	85	40700	20350	61050	67%	2800	1850	0	0.95	0.00	66.07%	2800	840	30.00%
V-133	AC-7	F-205	WEIGHTS	1943	35.5	55	85	40700	20350	61050	67%	2800	1850	0	0.95	0.00	66.07%	2800	840	30.00%
V-134	AC-7	F-203	FITNESS	1809	36	55	85	40700	20350	61050	67%	2800	1850	0	1.02	0.00	66.07%	2800	840	30.00%

VAV BOX No.	SPECIFIED VAV DEVICE			VENTILATION RATES				STD 62.1/90.1-1999 COMPLIANT				DESIGN	ACT	PERCENT	MINIMUM FLOWS			90.1 COMPLIANCE		62.1 COMPLIANCE	
	62.1/90.1 COMPLIANT			VENT RATE (CFM/P)		MIN OA					90.1 EXCESS	MIN	MIN	STD 62.1	AS	AS	62.1/90.1-99	AS	AS	AS	AS
	MAX	MIN	TURNDOWN	62.1-1999	COMM 64	62.1-1999	COMM 64	CFM/P	MIN OA	*Zi*	AIR FLOW %	OA	OA	MINIMUM	DESIGN	INSTALLED	COMPLIANT	DESIGN	INSTALLED	DESIGN	INSTALLED
V-97	450	60	13.3%	20	7.5	60	23	20	60	1.00	0.0%	29	28	47%	300	300	60	FAIL	FAIL	FAIL	FAIL
V-98	1350	660	48.9%	15	7.5	660	330	15	660	1.00	0.0%	86	93	14%	1000	1000	660	FAIL	FAIL	FAIL	FAIL
V-99	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	93	15%	1000	1000	630	FAIL	FAIL	FAIL	FAIL
V-100	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	93	15%	1000	1000	630	FAIL	FAIL	FAIL	FAIL
V-101	1350	615	45.6%	15	7.5	615	308	15	615	1.00	0.0%	86	93	15%	1000	1000	615	FAIL	FAIL	FAIL	FAIL
V-102	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	93	15%	1000	1000	630	FAIL	FAIL	FAIL	FAIL
V-103	1350	660	48.9%	15	7.5	660	330	15	660	1.00	0.0%	86	93	14%	1000	1000	660	FAIL	FAIL	FAIL	FAIL
V-104	1000	510	51.0%	15	7.5	510	255	15	510	1.00	0.0%	63	65	13%	700	700	510	FAIL	FAIL	FAIL	FAIL
V-105	220	40	18.2%	20	7.5	40	15	20	40	1.00	0.0%	14	14	35%	150	150	40	FAIL	FAIL	FAIL	FAIL
V-106	1000	495	49.5%	15	7.5	495	248	15	495	1.00	0.0%	63	65	13%	700	700	495	FAIL	FAIL	FAIL	FAIL
V-107	180	40	22.2%	20	7.5	40	15	20	40	1.00	0.0%	11	11	28%	120	120	40	FAIL	FAIL	FAIL	FAIL
V-108	1000	465	46.5%	15	7.5	465	233	15	465	1.00	0.0%	63	65	14%	700	700	465	FAIL	FAIL	FAIL	FAIL
V-109	1350	660	48.9%	15	7.5	660	330	15	660	1.00	0.0%	86	38	6%	1000	405	660	FAIL	FAIL	FAIL	FAIL
V-110	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	38	6%	1000	405	630	FAIL	FAIL	FAIL	FAIL
V-111	1350	615	45.6%	15	7.5	615	308	15	615	1.00	0.0%	86	38	6%	1000	405	615	FAIL	FAIL	FAIL	FAIL
V-112	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	38	6%	1000	405	630	FAIL	FAIL	FAIL	FAIL
V-113	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	38	6%	1000	405	630	FAIL	FAIL	FAIL	FAIL
V-114	1350	660	48.9%	15	7.5	660	330	15	660	1.00	0.0%	86	38	6%	1000	405	660	FAIL	FAIL	FAIL	FAIL
V-115	1300	0	0.0%	15	7.5	0	0	15	0	0.00	0.0%	82	36	100%	1000	390	0	FAIL	FAIL	FAIL	FAIL
V-116	1350	660	48.9%	15	7.5	660	330	15	660	1.00	0.0%	86	38	6%	1000	405	660	FAIL	FAIL	FAIL	FAIL
V-117	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	38	6%	1000	405	630	FAIL	FAIL	FAIL	FAIL
V-118	1350	435	32.2%	15	7.5	435	218	15	435	1.00	0.0%	86	38	9%	1000	405	435	FAIL	FAIL	FAIL	FAIL
V-119	1350	615	45.6%	15	7.5	615	308	15	615	1.00	0.0%	86	38	6%	1000	405	615	FAIL	FAIL	FAIL	FAIL
V-120	1350	630	46.7%	15	7.5	630	315	15	630	1.00	0.0%	86	38	6%	1000	405	630	FAIL	FAIL	FAIL	FAIL
V-121	1350	660	48.9%	15	7.5	660	330	15	660	1.00	0.0%	86	38	6%	1000	405	660	FAIL	FAIL	FAIL	FAIL
V-122	1150	570	49.6%	15	7.5	570	285	15	570	1.00	0.0%	73	32	6%	765	345	570	FAIL	FAIL	FAIL	FAIL
V-123	2500	375	15.0%	15	7.5	375	188	15	375	1.00	0.0%	158	70	19%	1700	750	375	FAIL	FAIL	FAIL	FAIL
V-124	300	40	13.3%	20	7.5	40	15	20	40	1.00	0.0%	19	8	21%	250	90	40	FAIL	FAIL	FAIL	FAIL
V-125	1180	570	48.3%	15	7.5	570	285	15	570	1.00	0.0%	75	32	6%	785	345	570	FAIL	FAIL	FAIL	FAIL
V-126	290	40	13.8%	20	7.5	40	15	20	40	1.00	0.0%	18	8	20%	150	87	40	FAIL	FAIL	FAIL	FAIL
V-127	1400	555	39.6%	15	7.5	555	278	15	555	1.00	0.0%	89	39	7%	940	420	555	FAIL	FAIL	FAIL	FAIL
V-128	690	0	0.0%	15	7.5	0	0	15	0	0.00	0.0%	44	19	100%	345	207	0	FAIL	FAIL	FAIL	FAIL
V-129	2600	1440	55.4%	15	7.5	1440	720	15	1440	1.00	0.0%	165	78	5%	1720	840	1440	FAIL	FAIL	FAIL	FAIL
V-130	1550	840	54.2%	15	7.5	840	420	15	840	1.00	0.0%	98	43	5%	1050	465	840	FAIL	FAIL	FAIL	FAIL
V-131	150	40	26.7%	20	7.5	40	15	20	40	1.00	0.0%	10	4	10%	100	45	40	FAIL	FAIL	FAIL	FAIL
V-132	2800	533	19.0%	15	7.5	533	266	15	533	1.00	0.0%	177	78	15%	1850	840	533	FAIL	FAIL	FAIL	FAIL
V-133	2800	533	19.0%	15	7.5	533	266	15	533	1.00	0.0%	177	78	15%	1850	840	533	FAIL	FAIL	FAIL	FAIL
V-134	2800	540	19.3%	15	7.5	540	270	15	540	1.00	0.0%	177	78	14%	1850	840	540	FAIL	FAIL	FAIL	FAIL

Table 1 - Standard 90.1-1999 Compliance Check List

Section	Title	Applicability	Compliant (Y, N, NA)	Violations (EA)	Comment
6.1	General	Applicable	N		
6.1.1	HVAC Scope	Applicable	Y		
6.1.2	Compliance	Applicable	N	1268	All requirements of 6.2 apply
6.1.3	Simplified	Not applicable	NA	-	Project is too large
6.2	Mandatory Provisions	Applicable	-	-	-
6.2.1	Mechanical Equipment Efficiency	Applicable	N	1	Chiller fails to meet efficiency requirements of Table 6.2.1 A
6.2.2	Load Calculations	Applicable	N	2	Improper summer and winter design conditions used
6.2.3	Controls	Applicable	N	-	-
6.2.3.1	Thermostatic Controls	Applicable	N	-	-
6.2.3.1.1	General	Applicable	Y	-	Exceptions do not come into play
6.2.3.1.2	Dead-Band (5 degrees F)	Applicable	N	79	Deadband not required or addressed in design. Exceptions do not come into play
6.2.3.1.3	Set-Point Overlap Restriction	Not applicable	NA	-	Multiple thermostats not used
6.2.3.2	Off-Hour Controls	Applicable	N		
6.2.3.2.1	Automatic Shutdown	Applicable	Y	-	-
6.2.3.2.2	Setback Controls	Applicable	N	227	No setback control is specified.
6.2.3.2.3	Optimum Start Controls	Applicable	N	227	Not required in Specifications, not indicted provided in TG Record Documents
6.2.3.2.4	Shutoff Damper Controls	Applicable	Y	-	-
6.2.3.2.5	Zone Isolation	Not applicable	NA	-	-
6.2.3.3	Gravity Vent Controls	Applicable	Y	-	-
6.2.3.3.1	Stair and Vent Shaft Controls	Not applicable	NA	-	-
6.2.3.3.2	Gravity Hoods, Vents and Ventilators	Applicable	Y	-	-
6.2.3.4	Heat Pump Auxiliary Heat Control	Not applicable	NA	-	-
6.2.3.5	Enclosed Parking Garage Ventilation	Not applicable	NA	-	-
6.2.3.6	Humidifier Preheat	Not applicable	NA	-	-
6.2.3.7	Humidification and Dehumidification	Not applicable	NA	-	-
6.2.3.8	Freeze Protection and Snow/Ice Melting Systems	Not applicable	NA	-	-
6.2.3.9	Ventilation Controls For High Occupancy Areas	Applicable	Y	-	-
6.2.4	HVAC System Construction and Insulation	Applicable	N		
6.2.4.1	General	Applicable	Y	-	-
6.2.4.2	Duct and Plenum Insulation	Applicable	Y	-	-
6.2.4.3	Duct Sealing	Applicable	Y	-	-
6.2.4.4	Duct Leakage Tests	Applicable	N	73	Testing not required project wide
6.2.4.5	Piping Insulation	Applicable	Y	-	-
6.2.5	Completion Requirements	Applicable	N	-	-
6.2.5.1	Drawings	Applicable	N	1	Not Provided
6.2.5.2	Manuals	Applicable	Y	-	-
6.2.5.3	Systems Balancing	Applicable	Y	-	-
6.2.5.3.1	General	Applicable	Y	-	-
6.2.5.3.2	Air System Balancing	Applicable	Y	-	-
6.2.5.3.3	Hydronic System Balancing	Applicable	N	4	Primary heating pump balance valves shut 80% indicating failure to adequately trim pump impeller or pump is improperly sized
6.2.5.4	Systems Commissioning	Applicable	N	1	Detailed instructions for commissioning HVAC systems were not provided by designer in plans and specifications.
6.3	Prescriptive Path	Applicable	N	-	-
6.3.1	Economizers	Applicable	N	-	Economizers provided failed to comply with Sections 6.3.1.1 through 6.3.1.4.
6.3.1.1	Air Economizers	Applicable	N	-	Non-compliant on 13 of 14 systems
6.3.1.1.1	Design Capacity	Applicable	Y	-	-

Table 1 - Standard 90.1-1999 Compliance Check List					
Section	Title	Applicability	Compliant (Y, N, NA)	Violations (EA)	Comment
6.3.1.1.2	Control Signal	Applicable	N	7	All VAV Reheat system air-side economizers controlled solely from mixed air temperature
6.3.1.1.3	High Limit Shut-Off	Applicable	N	14	Hi limit shutoff temperatures not consistent with Table 6.3.1.1.3B on all air handling systems
6.3.1.1.4	Dampers	Applicable	Y	-	-
6.3.1.1.5	Relief of Excess Outdoor Air	Applicable	Y	-	-
6.3.1.2	Water Economizers	Not applicable	NA	-	Water-side economizers were not employed
6.3.1.3	Integrated Economizer Control	Applicable	Y	-	-
6.3.1.4	Economizer Heating System Impact	Applicable	N	8	Noncompliant on 8 of 14 systems
6.3.2	Simultaneous Heating and Cooling	Applicable	N	-	-
6.3.2.1	Zone Controls	Applicable	N	546	Reheat is permitted only by the exceptions to this rule. Air flow volumes not computed in accordance with requirements of 6.3.2.1(a)(1) and exceeded permissible limitations in 6.3.2.1(a)(2), (3), and (4).
6.3.2.2	Hydronic System Controls	Not applicable	NA	-	-
6.3.2.3	Dehumidification	Not applicable	NA	-	-
6.3.2.4	Humidification	Not applicable	NA	-	-
6.3.3	Air System Design and Control	Applicable	N	-	-
6.3.3.1	Fan Power Limitations	Applicable	N	12	System motor Horsepower exceeds permissible limits
6.3.3.2	Variable Air Volume Fan Control	Applicable	N	-	-
6.3.3.2.1	Part-Load Fan Power Limitations	Applicable	Y	-	-
6.3.3.2.2	Static Pressure Sensor Location	Applicable	N	-	Sensor location not determined.
6.3.3.2.3	Set-Point Reset	Applicable	N	8	No static pressure reset was provided
6.3.4	Hydronic System Design and Control	Applicable	N		
6.3.4.1	Hydronic Variable Flow Systems	Applicable	N	3	HW and CW sensor locations fail to meet requirements and no reset provisions provided.
6.3.4.2	Pump Isolation	Applicable	Y	-	-
6.3.4.3	Chilled and Hot Water Temperature Reset Controls	Applicable	Y	1	Exception is provided for for variable volume pumping.
6.3.5	Heat Rejection Equipment	Not applicable	NA	-	-
6.3.5.1	General	Not applicable	NA	-	-
6.3.5.2	Fan Speed Control	Not applicable	NA	-	-
6.3.6	Energy Recovery	Applicable	N	-	-
6.3.6.1	Exhaust Air Energy Recovery	Applicable	N	54	No exhaust air energy recovery is provided. Improper ventilation rates effect energy recovery requirements for 8 of 14 air handling systems, 42 of 45 exhaust fans.
6.3.6.2	Heat Recovery for Service Water Heating	Not applicable	NA	-	-
6.3.7	Exhaust Hoods	Not applicable	NA	-	-
6.3.7.1	Kitchen Hoods	Not applicable	NA	-	-
6.3.7.2	Fume Hoods	Not applicable	NA	-	-
6.3.8	Radiant Heating Systems	Not applicable	NA	-	-
6.3.8.1	Heating Unenclosed Spaces	Not applicable	NA	-	-
6.3.8.2	Heating Enclosed Spaces	Not applicable	NA	-	-
6.3.9	Hot Gas Bypass Limitations	Applicable	Y	-	-

Table 2 - Standard 62.1-1999 Compliance Check List

Section	Title	Applicability	Compliant (Y, N, NA)	Violations (EA)	Comment
1	Purpose	Applicable	N	1067	Total violations
4	Classification	Applicable	N	-	-
4.1	Ventilation Rate Procedure	Applicable	N	141	Required for LEED NC2.1 Compliance
4.2	Indoor Air Quality Procedure	Not Applicable	NA	-	-
5	Systems and Equipment	Applicable	N	-	-
5.1	Natural Ventilation	Not Applicable	NA	-	-
5.1.1	Location and Size of Openings	Not Applicable	NA	-	-
5.1.2	Control and Accessibility	Not Applicable	NA	-	-
5.2	Supply of Ventilation Air	Applicable	N	141	Determined non-compliant through validation computations. Access not granted to designer records.
5.3	Ventilation at Reduced Supply Rates	Applicable	N	141	Neither VAV air handling systems nor VAV air terminal units provided with controls required to deliver adequate outdoor air at reduced flows
5.4	Reintrainment of Exhaust	Applicable	Y	-	-
5.5	Airstream Surfaces	Applicable	N	-	-
5.5.1	Resistance to Mold Growth	Applicable	N	28	Fiberglass Duct not required to be UL-181or ASTM C1338 compliant for mold growth
5.5.2	Resistance to Erosion	Applicable	N	28	Fiberglass Duct not required to be UL-181compliant for erosion
5.6	Source Contaminant Control	Applicable	Y	-	-
5.7	Combustion Air	Applicable	Y	-	-
5.8	Particulate Contaminant Removal	Applicable	Y	-	Barely minimal compliance
5.9	Gasseous Contaminant Control	Not Applicable	NA	-	-
5.10	Humidity Control	Applicable	N	14	Air handling discharge temperature control strategy and lack of summer reheat availability prevents effective humidity control
5.11	Microbial Contaminant Control	Applicable	N	14	Use of duct liner in return ducts, fiberboard ducts and absence of active humidity control strategy makes microbial growth likely.
6	Procedures	Applicable	N	-	-
6.1	Ventilation Rate Procedure	Applicable	N	-	-
6.1.1	Acceptable Outdoor Air	Applicable	Y	-	-
6.1.2	Outdoor Air Treatment	Applicable	Y	-	-
6.1.3	Ventilation Requirements	Applicable	N	134	Compliance computations show Table 2 ventilation rates not used, less rigorous COMM 64.05 ventilation rates were employed
6.1.3.1	Multiple Spaces	Applicable	N	141	Compliance computaions show less rigorous COMM 64.05 method used in lieu of required ASHRAE Ventilation Rate Procedure
6.1.3.2	Recirculation Criteria	Applicable	N	141	Spaces unable to maintain Table 2 ourdoor air ventilation rates under all conditions of operation
6.1.3.3	Ventilation Effectiveness	Applicable	-	-	Not determined. Design documentation not made avaliable for independent review.
6.1.3.4	Intermittant or Variable Occupancy	Applicable	Y	-	Not employed
6.2	Indoor Air Quality Procedure	Not Applicable	NA	-	-

Table 2 - Standard 62.1-1999 Compliance Check List					
Section	Title	Applicability	Compliant (Y, N, NA)	Violations (EA)	Comment
6.3	Design Documentation Procedures	Applicable	N	141	Design documentation not made avaliable for independent review. Unlikely this documentation exists since compliance computations clearly shows that ventilation calculations were based on another methodology, ASHRAE Ventilation Rate Procedure was not used
7	Construction and System Start-Up	Applicable	N	-	-
7.1	Construction Phase	Applicable	N	-	-
7.1.1	Application	Applicable	-	-	-
7.1.2	Filters	Applicable	-	-	Not required in Construction Documents otherwise, could not be determined
7.1.3	Protection of Materials	Applicable	N	1	Not required in Construction Documents otherwise, could not be determined
7.1.4	Protection of Occupied Areas	Not Applicable	NA	-	Not applicable, new construction
7.1.4.1	Application	Not Applicable	NA	-	-
7.1.4.2	Protective Measures	Not Applicable	NA	-	-
7.2	System Start-Up	Applicable	N	-	-
7.2.1	Application	Applicable	-	-	-
7.2.2	Air Balancing	Applicable	Y	-	Air balance data was used to confirm that the facility did not comply with LEED prerequisites
7.2.3	Testing of Drain Pans	Applicable	-	-	Could not be determined
7.2.4	Ventilation System Start-up	Applicable	-	-	Could not be determined
7.2.5	Testing Damper Controls	Applicable	N	-	During site visit it was observed that the control of at least 2 air handling units were not as designed.
7.2.6	Documentation	Applicable	N	-	Design criteria were not observed to be a part of the O&M manuals
8	Operations and Maintenance	Applicable	N	-	-
8.1	General	Applicable	N	-	-
8.1.1	Application	Applicable	-	-	-
8.1.2	Operations and Maintenance	Applicable	-	-	Could not be determined
8.1.3	Building Alteration or Change-of-Use	Not Applicable	NA	-	-
8.2	Operations and Maintenance Manual	Applicable	Y	-	-
8.3	Ventilation System Operation	Applicable	N	2	During site visit it was observed that the control of at least 2 air handling units were not as designed.
8.4	Ventilation System Maintenance	Applicable	-	-	-
8.4.1	Ventilation System Components	Applicable	-	-	-
8.4.1.1	Filters and Air-Cleaning Devices	Applicable	-	-	Could not be determined
8.4.1.2	Outside Air Dampers	Applicable	-	-	Could not be determined
8.4.1.3	Humidifiers	Not Applicable	NA	-	Humidifiers not installed
8.4.1.4	Dehumidification Coils	Applicable	-	-	Could not be determined
8.4.1.5	Drain Pans	Applicable	-	-	Could not be determined
8.4.1.6	Outside Air Intake Louvers	Applicable	-	-	Could not be determined
8.4.1.7	Sensors	Not Applicable	NA	-	Outdoor air flow sensors not installed
8.4.1.8	Outdoor Air Flow Verification	Not Applicable	NA	-	-
8.4.1.9	Cooling Towers	Not Applicable	NA	-	Cooling towers not installed
8.4.1.10	Equipment/Component Accessibility	Applicable	Y	-	-
8.4.1.11	Floor Drains	Applicable	-	-	Could not be determined
8.4.2	Microbial Contamination	Applicable	-	-	Could not be determined
8.4.3	Moisture Intrusion	Applicable	-	-	Could not be determined

Chapter A–E 8

PROFESSIONAL CONDUCT

A–E 8.01	Authority.
A–E 8.02	Intent.
A–E 8.03	Definitions.
A–E 8.04	Offers to perform services shall be truthful.
A–E 8.05	Conflicts of interest.
A–E 8.06	Professional obligations.
A–E 8.07	Unauthorized practice.
A–E 8.08	Maintenance of professional standards.
A–E 8.09	Adherence to statutes and rules.
A–E 8.10	Plan stamping.
A–E 8.11	Suspension of registration; effect.

A–E 8.01 Authority. The rules of conduct in this chapter are adopted under authority of ss. 15.08 (5) (b), 227.11 and ch. 443, Stats.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87.

A–E 8.02 Intent. The intent of the examining board in adopting this chapter is to establish rules of professional conduct for the professions of architecture, landscape architecture, professional engineering, designing and land surveying. A violation of any standard specified in this chapter may result in disciplinary action under ss. 443.11 to 443.13, Stats.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. Register, June, 1995, No. 474, eff. 7–1–95**; am. Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.03 Definitions. In ch. 443, Stats., and chs. A–E 1 to 10:

(1) "Gross negligence in the practice of architecture, landscape architecture, professional engineering, designing or land surveying" means the performance of professional services by an architect, landscape architect, professional engineer, designer or land surveyor which does not comply with an acceptable standard of practice that has a significant relationship to the protection of health, safety or public welfare and is performed in a manner indicating that the professional knew or should have known, but acted with indifference to or disregard of, the accepted standard of practice.

(2) "Incompetency in the practice of architecture, landscape architecture, professional engineering, designing or land surveying" means conduct which demonstrates any of the following:

(a) Lack of ability or fitness to discharge the duty owed by an architect, landscape architect, professional engineer, designer or land surveyor to a client or employer or to the public.

(b) Lack of knowledge of the fundamental principles of the profession or an inability to apply fundamental principles of the profession.

(c) Failure to maintain competency in the current practices and methods applicable to the profession.

(3) "Misconduct in the practice of architecture, landscape architecture, professional engineering, designing or land surveying" means an act performed by an architect, landscape architect, professional engineer, designer or land surveyor in the course of the profession which jeopardizes the interest of the public, including any of the following:

(a) Violation of federal or state laws, local ordinances or administrative rules relating to the practice of architecture, landscape architecture, professional engineering, designing or land surveying.

(b) Preparation of deficient plans, drawings, maps, specifications or reports.

(c) Engaging in conduct which evidences a lack of trustworthiness to transact the business required by the profession.

(d) Misrepresentation of qualifications such as education, specialized training or experience.

(4) "Responsible supervision of construction" is defined in s. 443.01 (8), Stats.

(5) "Supervision," "direct supervision," "responsible charge," and "direction and control," mean direct, personal, active supervision and control of the preparation of plans, drawings, documents, specifications, reports, maps, plats and charts. The terms do not include any of the following:

(a) Indirect or casual supervision.

(b) Delegation of any decision requiring professional judgment.

(c) Casual review or inspection of prepared plans, drawings, specifications, maps, plats, charts, reports or other documents.

(d) Mere assumption by an architect, landscape architect, professional engineer, designer or land surveyor of responsibility for work without having control of the work.

(e) Assuming charge, control or direct supervision of work in which the architect, landscape architect, professional engineer, designer or land surveyor does not have technical proficiency.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. (intro.), (1), (2) (intro.), (a), (3) (intro.), (a), (5) (d) and (e), Register, June, 1995, No. 474, eff. 7–1–95; am. (2) (intro.) to (b), (3) (intro.) to (c), (5) (intro.) to (d), Register, January, 1999, No. 517, eff. 2–1–99; **am. (1), (2) (intro.) and (a), (3) (intro.), (a), (5) (d) and (e), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.04 Offers to perform services shall be truthful. When offering to perform professional services, an architect, landscape architect, professional engineer, designer or land surveyor:

(1) Shall accurately and truthfully represent to a prospective client or employer the capabilities and qualifications which the registrant has to perform the services to be rendered.

(2) Shall represent the costs and completion times of a proposed project to a client or prospective client as accurately and truthfully as is reasonably possible.

(3) May not offer to perform, nor perform, services which the registrant is not qualified to perform by education or experience without retaining the services of another who is qualified.

(4) May not use advertising or publicity which is fraudulent or deceptive.

(5) May not represent that he or she is engaged in a partnership or association with another unless there exists in fact a partnership or association.

(6) May not collect a fee for recommending the services of another unless written notice is first given to all parties concerned.

(7) May not practice under a firm name that misrepresents the identity of those practicing in the firm or misrepresents the type of services which the individuals, firm or partnership is authorized and qualified to perform.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. (intro.), Register, June, 1995, No. 474, eff. 7–1–95; am. (1) to (6), Register, January, 1999, No. 517, eff. 2–1–99; **am. (intro.), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.05 Conflicts of interest. (1) An architect, landscape architect, professional engineer, designer or land surveyor:

(a) Shall avoid conflicts of interest. If an unavoidable conflict of interest arises, the registrant shall immediately inform the client or employer of all the circumstances which may interfere with or impair the registrant's obligation to provide professional services. Under these circumstances a registrant may not proceed to provide professional services without the full approval and consent of the client or employer.

(b) Shall notify the employer or client and withdraw from employment at any time if it becomes apparent that it is not possible to faithfully discharge the responsibilities and duties owed to the client or employer.

(c) May not agree to perform professional services for a client or employer if the registrant has a significant financial or other interest which would impair or interfere with the registrant's responsibility to faithfully discharge professional services on behalf of the client or employer.

(d) May not accept payment from any party other than a client or employer for a particular project or may not have any direct or indirect financial interest in a service or phase of a service to be provided as part of a project unless the employer or client approves.

(e) May not solicit or accept anything of value from material or equipment suppliers in return for specifying or endorsing a product.

(f) May not violate the confidences of a client or employer, except as otherwise required by rules in this chapter.

(g) May not perform services for a client or employer while a full–time employe of another employer without notifying all parties concerned.

(2) Nothing in these rules limits a registrant's professional responsibility to an owner of a project when the registrant is employed by a person or firm under contract to construct and furnish design services for that project.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. (1) (intro.), Register, June, 1995, No. 474, eff. 7–1–95; am. (1) (a) to (f), Register, January, 1999, No. 517, eff. 2–1–99; **am. (1) (intro.), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.06 Professional obligations. An architect, landscape architect, professional engineer, designer or land surveyor:

(1) Shall use reasonable care and competence in providing professional services.

(2) May not evade the professional or contractual responsibility which the registrant has to a client or employer.

(3) May not enter into an agreement which provides that a person not legally and actually qualified to perform professional services has control over the registrant's judgment as related to public health, safety or welfare.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. (intro.), Register, June, 1995, No. 474, eff. 7–1–95; am. (1) and (2), Register, January, 1999, No. 517, eff. 2–1–99; **am. (intro.), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.07 Unauthorized practice. An architect, professional engineer, designer or land surveyor:

(1) Shall assist in enforcing laws which prohibit the unlicensed practice of architecture, professional engineering, designing and land surveying by reporting violations to the board.

(2) May not delegate professional responsibility to unlicensed persons and may not otherwise aid or abet the unlicensed practice of architecture, professional engineering, designing or land surveying.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. Register, June, 1995, No. 474, eff. 7–1–95; am. (1), Register, January, 1999, No. 517, eff. 2–1–99; **am. (intro.), (1) and (2), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.08 Maintenance of professional standards. An architect, landscape architect, professional engineer, designer or land surveyor:

(1) Shall furnish the board with information indicating that any person or firm has violated provisions in ch. 443, Stats., rules in this chapter or other legal standards applicable to the profession.

(2) May not discuss with any individual board member any disciplinary matter under investigation or in hearing.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. (intro.), Register, June, 1995, No. 474, eff. 7–1–95; am. (1), Register, January, 1999, No. 517, eff. 2–1–99; **am. (intro.), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.09 Adherence to statutes and rules. An architect, landscape architect, professional engineer, designer or land surveyor:

(1) Shall comply with the requirements in ch. 443, Stats., rules in this chapter and all other federal, state and local codes which relate to the practice of architecture, landscape architecture, professional engineering, designing and land surveying.

(2) May not engage in conduct that may adversely affect his or her fitness to practice architecture, landscape architecture, professional engineering, designing or land surveying.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. Register, June, 1995, No. 474, eff. 7–1–95; am. (1), Register, January, 1999, No. 517, eff. 2–1–99; **am. (intro.), (1) and (2), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.10 Plan stamping. (1) No architect, landscape architect, professional engineer or designer may sign, seal or stamp any plans, drawings, documents, specifications or reports for architectural, landscape architectural, professional engineering or design practice which are not prepared by the registrant or under his or her personal direction and control.

(2) No land surveyor may sign, seal or stamp any maps, plats, charts, or reports for land surveying practice which are not prepared by the land surveyor or under his or her personal direction and control.

(3) No architect, landscape architect, professional engineer, designer or land surveyor shall allow work performed by him or her or under his or her personal direction and control to be signed, sealed or stamped by another except that an architect, landscape architect, professional engineer, designer or land surveyor working under the personal direction and control of another registrant may allow that registrant to sign and seal or stamp the work.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. (1) and (3), Register, June, 1995, No. 474, eff. 7–1–95; **am. (1) and (3), Register, February, 2000, No. 530, eff. 3–1–00.**

A–E 8.11 Suspension of registration; effect. Any registrant whose registration has been suspended is prohibited during the term of the suspension from engaging in any of the following:

(1) Offering to perform any service which requires registration.

(2) Performing any professional service which requires registration.

(3) Signing or sealing plans, specifications, reports, maps, plats, or charts prepared for the practice of architecture, landscape architecture, professional engineering, designing or land surveying.

(4) Entering into contracts the performance of which require registration.

(5) Engaging in responsible supervision of construction as defined in s. 443.01 (8), Stats.

History: Cr. Register, February, 1987, No. 374, eff. 3–1–87; am. (3), Register, June, 1995, No. 474, eff. 7–1–95; am. (intro.) to (4), Register, January, 1999, No. 517, eff. 2–1–99; **am. (3), Register, February, 2000, No. 530, eff. 3–1–00.**

Chapter Comm 63

ENERGY CONSERVATION

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Comm 63.0002 Scope.
Comm 63.0003 Application.
Comm 63.0004 Compliance.

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Comm 63.0101 Scope and general requirements.
Comm 63.0102 Materials, systems and equipment.
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Comm 63.0105 Inspections.
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Comm 63.0402 System analysis.
Comm 63.0502 Building envelope.
Comm 63.0503 Building mechanical systems and equipment.
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Comm 63.0505 Lighting power budget.
Comm 63.0602 Building envelope.
Comm 63.0701 General scope and application.
Comm 63.0802 Building envelope requirements.
Comm 63.0803 Building mechanical systems.
Comm 63.0804 Service water heating.
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Part 7 — System Analysis Design
Comm 63.1070 System analysis design.

Note: Chapter Comm 63 as it existed on June 30, 2002 was repealed and a new chapter Comm 63 was created, Register December 2001 No. 552, effective July 1, 2002.

Subchapter I — Purpose, Scope, Application and Compliance

Comm 63.0001 Purpose. The purpose of this chapter is to regulate the design of building envelopes for adequate thermal resistance and low air leakage and the design and selection of mechanical, electrical, service water–heating and illumination systems and equipment which will enable effective use of energy in new building construction.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0002 Scope. (1) GENERAL. The scope of this chapter is as specified in s. Comm 61.02, except as exempted in sub. (2).

(2) EXEMPT BUILDINGS AND STRUCTURES. The following buildings or portions of buildings shall be exempt from this chapter.

(a) Buildings, or portions thereof, without space heating or cooling, service water heating, or illumination are exempt from the requirements of this chapter that apply to those systems.

(b) Buildings and structures, or portions thereof separated by building envelope assemblies from the remainder of the building, that have a peak design rate of energy usage less than 3.4 Btu/h·ft^2 of floor area for all purposes are exempt.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0003 Application. (1) GENERAL. This chapter shall be applied as specified in s. Comm 61.03 and as modified in subs. (2) to (5).

(2) ADDITIONS. (a) *Building Envelope.* Additions to existing buildings or structures may be made without the existing building or structure having to comply with the building envelope requirements of this chapter, but the addition envelope shall comply with this chapter.

(b) *HVAC systems.* Where an existing HVAC system serves both an existing building and a proposed addition, any portion of the HVAC system or equipment that is altered shall comply with this chapter.

(c) *Lighting systems.* Lighting systems installed in a new addition or in conjunction with an increase of floor area, such as the addition of a mezzanine, shall comply with this chapter.

(3) ALTERATIONS. (a) *Building envelope.* Alterations to the building envelope shall comply with one of the following:

1. The alteration shall not increase the rate of heat loss through the portion of the building envelope containing the alteration.

2. The alteration shall not increase the annual energy use from heat gain or loss through the entire building envelope.

3. The building envelope shall be brought into compliance with the requirements of this chapter.

(b) *HVAC systems.* Rooftop fan systems that replace existing fan systems shall be provided with economizers that comply with this chapter's requirements for new construction.

(c) *Lighting systems.* 1. When alterations to an existing lighting system increase the connected interior lighting load of the building or replace more than 50% of the lighting fixtures, the interior lighting system shall comply with ss. Comm 63.1044 to 63.1049.

2. When alterations to an existing lighting system increase the connected exterior lighting load or replace more than 50% of the lighting fixtures, the entire exterior lighting system shall comply with ss. Comm 63.1041 to 63.1043.

3. a. Except as specified in subpar. b., alterations to controls shall comply with ss. Comm 63.1050 and 63.1051.

b. Shut–off lighting controls in s. Comm 63.1050 (4) are not required in contiguous altered spaces of less than 5,000 square feet unless shut–off controls were required by the building code at the time of the original lighting design or if an exception to s. Comm 63.1050 (4) (b) is no longer applicable.

(4) CHANGE IN OCCUPANCY. (a) Any change in the occupancy classification of a building or structure that would increase the required minimum inside temperature as specified in Table 64.0403 shall comply with the requirements of this chapter.

(b) Any change in a building or structure that would result in an increase in demand for either fossil fuel or electrical energy supply shall comply with this chapter.

(5) MIXED RESIDENTIAL AND COMMERCIAL OCCUPANCY. (a) *General.* Except as specified in par. (b), when a building houses both a residential and a commercial occupancy, each portion of the building shall conform to the requirements for the occupancy, residential or commercial, housed therein. Where minor accessory uses do not occupy more than 10 percent of the area of any floor of a building, the major use shall determine whether the building is a residential or commercial building.

(b) *Exception.* All buildings with a height of four or more stories above grade shall be considered a commercial building for purposes of this chapter.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0004 Compliance. (1) GENERAL. All buildings shall comply with the International Energy Conservation Code (IECC), with the changes, additions or omissions specified in subch. II, and with the compliance approaches specified in sub. (2) for residential building and sub. (3) for commercial buildings.

(2) RESIDENTIAL BUILDINGS. (a) Except as specified in par. (b), for residential buildings one of the following approaches for compliance shall be used:

1. A systems approach for the entire building and its energy–using subsystems, which uses renewable sources as specified in IECC chapter 4.

2. An approach based on performance of individual components of the building envelope as specified in IECC chapter 5.

3. An approach based on performance of the total building envelope specified in IECC chapter 5.

4. An approach based on acceptable practice for each envelope component specified in IECC chapter 5.

5. An approach by prescriptive specification for individual components of the building envelope specified in IECC chapter 5.

6. An approach based on simplified, prescriptive specification specified in IECC chapter 6 when the glazing areas do not exceed 25 percent of the gross areas of exterior walls.

(b) This chapter does not apply to type A–1 residential buildings as defined in IECC section 202 as one and two family dwellings.

(3) COMMERCIAL BUILDINGS. For commercial buildings one of the following approaches for compliance shall be used:

(a) A prescriptive, system, or energy cost budget approach specified in subch. III.

(b) A prescriptive or performance option specified in IECC chapter 8.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Subchapter II — Changes, Additions or Omissions to the International Energy Conservation Code (IECC)

Comm 63.0100 Changes, additions or omissions to IECC. Changes, additions or omissions to the IECC are specified in this subchapter and are rules of the department and are not requirements of the IECC.

Note: This subchapter is numbered to correspond to the numbering used within the model code; i.e. s. Comm 63.0101 refers to section IECC 101. With a few exceptions, subchapter III of this chapter is numbered to correspond to the numbering in the previous energy requirements of Comm 63; i.e., s. Comm 63.1005 was previously Comm 63.05.

Note: Copies of the International Energy Conservation Code are on file in the offices of the department, the secretary of state and the revisor of statutes.

Note: Copies of the International Energy Conservation Code can be obtained from organizations as specified in s. Comm 61.05.

Note: Copies of department forms are available from the Safety and Buildings Division, P.O. Box 7162, Madison, WI 53707–7162; telephone (608) 266–3151 or TTY (608) 264–877; or on the Commerce webpage at: www.commerce.state.wi.us

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0101 Scope and general requirements. Substitute the following wording for the requirements in IECC section 101: Requirements relating to purpose, scope and application are contained in subch. I.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0102 Materials, systems and equipment. These are department rules in addition to the requirements in IECC section 102:

(1) PROHIBITION OF HEATED SIDEWALKS. The installation or use of heated sidewalks is prohibited as specified in s. 101.124, Stats.

Note: Section 101.124, Stats., reads as follows: “Heated Sidewalks Prohibited. In this section “exterior pedestrian traffic surface” means any sidewalk, ramp, stair, stoop, step, entrance way, plaza or pedestrian bridge not fully enclosed within a building and “heated” means heated by electricity or energy derived from the combustion of fossil fuels, but not including the use of waste thermal energy. “Exterior pedestrian traffic surface” does not include any means of ingress or egress by the physically disabled required under s. 101.13 (2). No person may construct a heated exterior pedestrian traffic surface. The department or any city, village, town or county is prohibited from approving any plan under s. 101.12 which includes such heated surface. The department shall order any existing heated exterior pedestrian traffic surface in operation to be shut off. This section does not apply to any inpatient health care facility as defined in s. 50.135 (1), or community–based residential facility, as defined in s. 50.01 (1g).”

(2) MATERIAL PROPERTIES. Thermal properties, performance of building envelope sections and components and heat transfer properties shall be determined in accordance with s. Comm 63.1018.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0103 Alternate materials–method of construction, design or insulating systems. The requirements in IECC section 103 are not included as part of this code.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0104 Construction documents. Substitute the following wording for the requirements in IECC section 104: Construction documents and other supporting documents shall be submitted in accordance with ch. Comm 61.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0105 Inspections. Substitute the following wording for the requirements in IECC section 105: Inspections shall be performed in accordance with ch. Comm 61.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0107 Conflicting requirements. Substitute the following wording for the requirements in IECC section 107.2: The process for dealing with conflicting rules shall be as specified in ch. Comm 61.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0202 General definitions. (1) This is a department definition in addition to the definitions in IECC section 202: "Circulating system" means service water heating system without a heat trap, or systems with circulating pump.

(2) Substitute the following wording for the definition specified in IECC section 202: "Approved" has the meaning given in s. Comm 62.0202 (2) (a).

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0302 Exterior design parameters. (1) WEATHER ADJUSTMENTS. Substitute the following wording for the requirements in IECC Table 302.1 footnote a: The outdoor design temperature shall be selected from the columns of 97–1/2 percent values for winter and 2–1/2 percent values for summer from tables in the ASHRAE *Handbook of Fundamentals*. Adjustments shall be permitted to reflect local climates, which differ from the tabulated temperatures, or local weather experience as determined by other weather resources.

(2) DEGREE–DAYS. Substitute the following wording for the requirements in IECC Table 302.1, footnote b: The degree days heating (base 65º F) and cooling (base 65º F) shall be selected from National Oceanic and Atmospheric Administration "Annual Degree Days to Selected Bases Derived from the 1961–1990 Normals," the ASHRAE *Handbook of Fundamentals*, data available from adjacent military installations, or other sources of local weather data.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0402 System analysis. Substitute the following wording for the requirements in IECC section 402.4.7: The same calculation tool shall be used to estimate the annual energy usage for space heating and cooling of the Standard design and the Proposed design. The calculation tool shall be approved by the department.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0502 Building envelope. (1) GENERAL. Substitute the following wording for the requirements and the exceptions in IECC section 502.1.1:

(a) *Moisture control.* Except as specified in sub. (2), the design shall not create conditions of accelerated deterioration from moisture condensation. Vapor retarders shall be provided on all warm–in winter sides of frame walls, floors and ceilings. The vapor retarder shall have a maximum permeance rating of 1.0 perm when tested in accordance with Procedure A of the ASTM E96. The vapor retarder shall be installed on the warm–in winter side of the thermal insulation.

(b) *Exceptions.* Where other approved means to avoid condensation in unventilated framed wall, floor, roof and ceiling cavities are provided.

(2) FLOORS OVER UNHEATED SPACES. Substitute the following wording for the requirements in IECC section 502.2.3.3: The floor section over an unheated space shall be selected from IECC Appendix Table 502.2.3.3 for the overall thermal transmittance factor (U_o) not exceeding the value specified for floors over unheated spaces in IECC Table 502.2. For floors over outdoor air, such as overhangs, U_o–factors for heating shall meet the same requirement as shown for floors over unheated spaces in IECC Table 502.2.

(3) FLOORS. Substitute the following wording for the requirements in IECC section 502.2.4.8: Floor R–values shall apply to floors over unconditioned spaces and floors over outside air.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0503 Building mechanical systems and equipment. (1) LOAD CALCULATIONS. Substitute the following wording for the requirements in IECC section 503.3.1: Heating load calculations shall be determined in accordance with s. Comm 63.1023.

(2) DISTRIBUTION, SYSTEM, CONSTRUCTION AND INSULATION. (a) *Hydronic piping insulation.* Substitute the following wording for the requirements and the exceptions in IECC section 503.3.3.1: All system piping shall be thermally insulated in accordance with s. Comm 63.1029 (1) and (2).

(b) *Duct and plenum insulation.* Substitute the following wording for the requirements and the exceptions in IECC section 503.3.3.3. Duct and plenum insulation shall be provided in accordance with s. Comm 63.0803 (2) (f).

(c) *Low–pressure duct systems.* Substitute the following wording for the requirements in IECC section 503.3.3.4.2: Low–pressure duct systems shall comply with all of the following:

1. Sections of supply and return ducts not located entirely within the conditioned space, and the unconditioned side of enclosed stud bays or joist cavities or spaces that are used to transport air shall be sealed.

2. Sealing shall be accomplished using welds, gaskets, mastics, mastic–plus–embedded–fabric systems or tapes installed in accordance with the manufacturer's instructions.

3. Insulation that provides a continuous air barrier may be used in lieu of sealing metal ducts.

4. Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled as complying with UL 181A.

5. Tapes and mastics used with flexible air ducts shall be listed and labeled as complying with UL 181B.

6. Tapes with rubber–based adhesives may not be used.

Note: Standard duct tape has a rubber–based adhesive and does not comply with the requirements under this section.

(d) *Sealing required.* Substitute the following wording for the requirements in IECC section 503.3.3.4.3: High– and medium–pressure ducts shall be sealed in accordance with s. Comm 63.1029 (4).

(e) *Mechanical ventilation.* Substitute the following wording for the requirements in IECC section 503.3.3.5: Each mechanical ventilation system (supply or exhaust, or both) shall be equipped with a readily accessible switch or other means for shutoff, or volume reduction and shutoff, when ventilation is not required. Automatic or gravity dampers that close when the system is not operating shall be provided for all outdoor air exhausts. Motorized dampers that close when the system is not operating shall be provided on all outdoor air intakes.

(f) *Balancing.* Substitute the following wording for the requirements in IECC section 503.3.3.7: Balancing and documentation of the HVAC system shall conform to the IMC.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **CR 01–139: renum. (2) (c) to (e) to be (2) (d) to (f), cr. (2) (c), r. and recr. (2) (d) Register June 2002 No. 558, eff. 7–1–02.**

Comm 63.0504 Service water heating. (1) COMBINATION SERVICE WATER–HEATING AND SPACE HEATING BOILERS. The requirements in IECC section 504.2.2, Exception 1. are not included as part of this code.

(2) PIPE INSULATION. Substitute the following wording for the requirements and the exception in IECC section 504.5: Pipe insulation shall be provided in accordance with s. Comm 63.1029 (1) and (2).

(3) SWIMMING POOLS. The requirements in IECC section 504.3, and IECC sections 504.3.1 to 504.3.3 are not included as part of this code.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0505 Lighting power budget. Substitute the following wording for the requirements and the exception in IECC section 505.2: Lighting systems shall comply with ss. Comm 63.1040 to 63.1053.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0602 Building envelope. (1) THERMAL PERFORMANCE CRITERIA, FLOORS OVER OUTSIDE AIR. Substitute the following wording for the requirements in IECC section 602.1.4: The required R–value in Tables 602.1 shall apply to all floors.

(2) CAULKING, SEALANTS AND GASKETING. This is a department rule in addition to the requirements in IECC section 602.1.10: When installed in the building envelope, recessed lighting fixtures shall comply with IECC section 502.1.3.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **CR 01–139: r. (2), renum. (3) to be (2) Register June 2002 No. 558, eff. 7–1–02**.

Comm 63.0701 General scope and application. Substitute the following wording for the requirements in IECC section 701.1: Commercial buildings shall meet the requirements of subch. III or they shall comply with the requirements specified in IECC chapter 8.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0802 Building envelope requirements. (1) GENERAL. These are department rules in addition to the requirements in IECC section 802.1: Glazed structures or glazed portions of buildings used for the production of plant life or for maintaining plant life as the primary purpose of the structure are exempt from the building envelope requirements. When the glazed areas are attached to a building with a different class of construction, these glazed areas shall be separated from the remainder of the building with construction material complying with the building envelope requirements.

(2) MOISTURE CONTROL. Substitute the following wording for the requirements and exceptions in IECC section 802.1.2:

(a) *Moisture control.* Except as specified in par. (b), vapor retarders shall be provided on all warm–in winter sides of frame walls, floors and ceilings. The vapor retarder shall have a maximum permeance rating of 1.0 perm when tested in accordance with Procedure A of the ASTM E 96, Standard Test Methods for Water Vapor Transmission of Materials.

(b) *Other approved means.* Where other approved means to avoid condensation in unventilated framed wall, floor, roof and ceiling cavities are provided.

(3) ROOF ASSEMBLY. This is a department rule in addition to the requirements in IECC section 802.2.4: The thermal transmittance value for ceilings next to unconditioned spaces shall comply with s. Comm 63.1015 (5).

(4) SEALING OF THE BUILDING ENVELOPE. This is a department rule in addition to the requirements in IECC section 802.3.2: When installed in the building envelope, recessed lighting fixtures shall comply with IECC section 502.1.3.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **CR 01–139: r. (3), renum. (4) and (5) to be (3) and (4) Register June 2002 No. 558, eff. 7–1–02**.

Comm 63.0803 Building mechanical systems. (1) GENERAL. This is a department rule in addition to the requirements in IECC section 803.1: Electrical motors shall comply with s. Comm 63.1032.

(2) SIMPLE HVAC SYSTEMS AND EQUIPMENT. (a) *Equipment and system sizing.* Substitute the following wording for the requirements in IECC section 803.2.1.1: Heating and cooling equipment and systems shall be sized to provide the minimum space and system loads calculated in accordance with IECC section 803.2.1.

(b) *Temperature controls.* Substitute the following wording for the requirements in IECC section 803.2.3.1: Each heating and cooling system shall have at least one temperature control device that complies with IECC sections 803.3.3.1.1, 803.3.3.2 and 803.3.3.3.

(c) *Humidity controls.* This is a department rule in addition to the requirements in IECC section 803.2.3.2: If a system is equipped with a means for adding moisture to maintain specific humidity levels in a zone, a humidistat shall be provided.

(d) *Cooling with outdoor air.* Substitute the following wording for the requirements in IECC section 803.2.6: Each fan system shall have economizer controls complying with s. Comm 63.1031.

(e) *Shutoff dampers.* Substitute the following wording for the requirements and the exceptions in IECC section 803.2.7:

1. 'Outdoor air supply and exhaust ducts.' Except as specified in subd. 2., automatic or gravity dampers that close when the system is not operating shall be provided for all outdoor air exhausts and motorized dampers that close when the system is not operating shall be provided on all outdoor air intakes.

2. 'Exceptions.' Outdoor air supply and exhaust ducts restricted by health and life safety requirements are exempt.

(f) *Duct and plenum insulation.* Substitute the following wording for the requirements and the exceptions in IECC section 803.2.8: 1. 'Supply and return air ducts and plenums.' Except as specified in subd. 2., all supply ducts and return air ducts and plenums shall be insulated with a minimum of R–4 insulation when located in unconditioned spaces and with a minimum of R–7.5 insulation when located outside the building envelope. When located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum of R–7.5 insulation. All supply ducts located in plenums within the building envelope shall be insulated to R–4.

2. 'Exceptions.' a. When located within equipment.

b. When the design temperature difference between the interior and exterior of the duct or plenum does not exceed 15ºF.

3. 'Joints, longitudinal and transverse seams, and connections.' Joints, longitudinal and transverse seams, and connections in ductwork shall be sealed in accordance with s. Comm 63.1029 (4).

(3) COMPLEX HVAC SYSTEMS AND EQUIPMENT. (a) *Equipment and system sizing.* Substitute the following wording for the requirements in IECC section 803.3.1.1: Heating and cooling equipment and system capacity shall be sized to provide the minimum space and system loads calculated in accordance with IECC section 803.2.1.

(b) *Shutoff damper controls.* Substitute the following wording for the requirements and the exception in IECC section 803.3.3.4:

1. Except as specified in subd. 2., automatic or gravity dampers that close when the system is not operating shall be provided for all outdoor air exhausts and motorized dampers that close when the system is not operating shall be provided on all outdoor air intakes.

2. Outdoor air supply and exhaust ducts restricted by health and life safety requirements are exempt.

(c) *Economizers.* Substitute the following wording for the requirements and the exception in IECC section 803.3.3.5: Each fan system shall have economizer controls complying with s. Comm 63.1031.

(d) *Piping insulation.* Substitute the following wording for the requirements and the exceptions in IECC section 803.3.7: All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with s. Comm 63.1029 (1) and (2).

(e) *HVAC system completion.* Substitute the following wording for the requirements in IECC sections 803.3.8, 803.3.8.1, 803.3.8.2, and 803.3.8.3: Balancing and documentation of HVAC systems shall conform to the IMC.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **CR 01–139: r. and recr. (2) (f) 3. Register June 2002 No. 558, eff. 7–1–02**.

Comm 63.0804 Service water heating. (1) TEMPERATURE CONTROLS. The requirements in IECC section 804.3 are not included as part of this code.

(2) HEAT TRAPS. Substitute the following wording for the requirements in IECC section 804.4: Plumbing piping systems, including those without an integral heat trap shall comply with s. Comm 63.1029 (1) and (2).

(3) PLUMBING PIPE INSULATION. Substitute the following wording for the requirements in IECC section 804.5: All system piping shall be thermally insulated in accordance with s. Comm 63.1029 (1) and (2).

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0805 Lighting systems. Substitute the following wording for the requirements in IECC section 805: Lighting systems shall comply with ss. Comm 63.1040 to 63.1053.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0900 Referenced standards. This is a department rule in addition to the requirements in IEEC chapter 9: The following standards are hereby incorporated by reference into this code:

(1) ASHRAE Standard 90.1–89, Energy Efficient Design of New Buildings, Except Low Rise Residential Buildings.

(2) ASTM C177–85, Test method for steady–state heat flux measurements and thermal transmission properties by means of the guarded–hot–plate apparatus.

(3) ASTM C335–84, Test method for steady state heat transfer properties of horizontal pipe insulation.

(4) National Concrete Masonry Association (NCMA) Evaluation Procedures of Integrally–Insulated Concrete Masonry Walls, January 1, 1999.

Note: ASHRAE standards may be purchased from the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329.

ASTM standards may be purchased from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

NCMA Evaluation Procedures may be obtained from the National Concrete Masonry Association, 2302 Horse Pen Road, Herndon, VA 20171–3499.

Copies of the standards adopted under this section are on file in the offices of the department, the secretary of state and the revisor of statutes.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.0901 Appendix. History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **CR 01–139: r. Register June 2002 No. 558, eff. 7–1–02**.

Subchapter III — Building Design for Commercial Buildings

Part 1 — Application

Comm 63.1001 Application. This subchapter shall be applied to all commercial buildings unless the building complies with IECC chapter 8.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Part 2 — Definitions

Comm 63.1005 Definitions. In this subchapter:

(1) "Ambient Lighting" is lighting designed to provide a substantially uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect. When designed for lower–than–task illuminance used in conjunction with other specific task lighting systems, it is also called "general" lighting.

(2) "Automatic" means self–acting, operating by its own mechanism when actuated by some impersonal influence, such as, a change in current strength, pressure, temperature, or mechanical configuration.

(3) "Automatic time switch control devices" means control devices that are capable of automatically turning loads off and on based on time schedules.

(4) "Building envelope" means the elements of a building that enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from unconditioned spaces.

(5) "Comfort cooling" or "comfort heating" means treating air to control one or more of the following: temperature, relative humidity, or distribution to meet the comfort requirements of the human occupants of the conditioned space.

(6) "Conditioned floor area" or "CFA" means the floor area in square feet of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space.

(7) "Commercial building" means a building as defined in IECC section 202.

(8) "Conditioned space" means a cooled space, heated space, or indirectly conditioned space.

(9) "Cooled space" means an enclosed space within a building that is conditioned by a cooling system with a sensible capacity that either exceeds 5 Btu/hr sq ft or is capable of maintaining a space dry–bulb temperature of 90°F or less at design conditions.

(10) "Daylighting control" means a device that automatically regulates the power input to electric lighting near the fenestration to maintain the desired workplace illumination, thus taking advantage of direct or indirect sunlight.

(11) "Daylit area" means the space on the floor that is the larger of par. (a) or (b) as follows:

(a) 1. For areas daylit by vertical glazing, the daylit area has the length of 15 feet, or the distance on the floor, perpendicular to the glazing, to the nearest 60–inch or higher opaque partition, whichever is less; and a width of the window plus either 2 feet on each side, the distance to an opaque partition, or one–half the distance to the closest skylight or vertical glazing, whichever is least.

2. For areas daylit by horizontal glazing, the daylit area is the footprint of the skylight plus, in each of the lateral and longitudinal dimensions of the skylight, the lesser of the floor–to–ceiling height, the distance to the nearest 60–inch or higher opaque partition, or one–half the horizontal distance to the edge of the closest skylight or vertical glazing.

(b) The daylit area calculated using a method acceptable to the department.

(12) "Deadband" means the range of values within which an input variable can be varied without initiating any noticeable change in the output variable.

(13) "Degree day" means a unit based upon temperature difference and time, used in estimating annual heating or cooling energy consumption. One degree day accrues for each degree of difference between the daily mean temperature and a reference temperature.

(14) "Display lighting" means lighting confined to the area of a display that provides a higher level of illuminance than the level of surrounding ambient illuminance.

(15) "Economizer, air" means a ducting arrangement and automatic control system that allows a cooling supply fan to supply outside air to reduce or eliminate the need for mechanical refrigeration during mild or cold weather.

(16) "Economizer, water" means a system by which the supply air of a cooling system is cooled directly or indirectly or both by evaporation of water or other appropriate fluid in order to reduce or eliminate the need for mechanical refrigeration during some time periods.

(17) "Effective aperture" or "EA" means for windows, the visible light transmittance times the window wall ratio per wall; and for sky lights, the well efficiency times the visible light transmittance times the sky light area times 0.85 divided by the gross exterior roof area.

(18) "Efficacy" means the ratio of light from a lamp to the electrical power consumed, including ballast losses, expressed in lumens per watt.

(19) "Emissivity" means the ratio of the rate of radiant heat energy emitted by a body at a given temperature to the rate of radiant heat energy emitted by a standard called a blackbody, at the same temperature in the same surroundings.

(20) "Exterior envelope" has the same meaning as "building envelope."

(21) "Exterior roof or ceiling" means an exterior partition, or partition separating a conditioned space from an enclosed unconditioned space, that has a slope less than 60 ° from horizontal, that has conditioned space below, and that is not an exterior door or skylight.

(22) "Exterior roof or ceiling area" means the area of the exterior surface of an exterior roof or ceiling.

(23) "Exterior wall" means an exterior partition that is not an exterior floor or soffit, exterior door, exterior roof or ceiling, window, or skylight.

(24) "Exterior wall area" means the area of the opaque exterior surface of exterior walls.

(25) "Fenestration" means any light–transmitting section in a building wall or roof. The fenestration includes glazing material, which may be glass or plastic, framing such as mullions, muntins, and dividers, external shading devices, internal shading devices, and integral or between glass shading devices.

(26) "Fenestration area" means the total area of fenestration measured using the rough opening and including the glazing material, sash, and frame.

(27) "General lighting" means lighting designed to provide a substantially uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect. When designed for lower–than– task illuminance used in conjunction with other specific task lighting systems, it is also called "ambient" lighting.

(28) "Gross exterior wall area" means the gross area of exterior walls separating a conditioned space from the outdoors or from unconditioned spaces as measured on the exterior above grade. It consists of the opaque wall, excluding vents and grills, including between floor spandrels, peripheral edges of flooring, window areas including sash, and door areas.

(29) "Gross floor area" means the sum of the floor areas of the conditioned spaces within the building including basements, mezzanine and intermediate–floored tiers, and penthouses of headroom height 7.5 ft or greater. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings, excluding covered walkways, open roofed–over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

(30) "Gross floor area over outside or unconditioned spaces" means the gross area of a floor assembly separating a conditioned space from the outdoors or from unconditioned spaces as measured from the exterior faces of exterior walls or from the centerline of walls separating buildings. The floor assembly shall be considered to include all floor components through which heat may flow between indoor and outdoor or unconditioned environments.

(31) "Gross lighted area" or "GLA" means the sum of the total lighted areas of a building measured from the inside of the perimeter walls for each floor of the building.

(32) "Gross roof area" means the gross area of a roof or ceiling assembly separating a conditioned space from the outdoors or from unconditioned spaces, measured from the exterior faces of exterior walls or from the centerline of walls separating buildings. The roof assembly shall be considered to include all roof or ceiling components through which heat may flow between indoor and outdoor environments including skylights but excluding service openings.

(33) "Gross exterior roof area" means the sum of the skylight area and the exterior roof/ceiling area.

(34) "Heat capacity" or "HC" means the amount of heat necessary to raise the temperature of a given mass one degree. Numerically, it is the mass multiplied by the specific heat.

(35) "Heated space" means an enclosed space within a building that is conditioned by a heating system with an output capacity either exceeding 10 Btu/h·ft^2 or capable of maintaining a space dry–bulb temperature of 50ºF or more at design conditions.

(36) "Heating, ventilating, and air conditioning system" or "HVAC system" means the equipment, distribution network, and terminals that provide either collectively or individually the process of heating, ventilating, or air conditioning to a building.

(37) "Indirectly conditioned space" means an enclosed space including, but not limited to, unconditioned volume in atria, that is not directly conditioned space; and either has an area–weighted heat transfer coefficient to directly conditioned space exceeding that to the outdoors or to unconditioned space, or is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.

(38) "Informational sign" means a sign used to give building or room identification direction or a warning for safety purposes in a building, but does not include advertising signs for product or merchandise displays.

(39) "Listed space area" or "LS" means any interior space with an identified area of activities for which a lighting power budget is calculated and listed in the lighting power allowance determination.

(40) "Lumen maintenance control device" means a device capable of automatically adjusting the light output of a lighting system throughout a continuous range to provide a preset level of illumination.

(41) "Luminaire" means a complete lighting unit consisting of at least one lamp and the parts designed to distribute the light, to position and protect the lamp, to connect the lamp to the power supply and ballasting, when applicable. Luminaires are commonly referred to as "lighting fixtures" or "instruments."

(42) "Manual" means capable of being operated by personal intervention.

(43) "Mass wall" means a wall assembly with a heat capacity (HC) greater than or equal to 5 Btu/ft^2 °F.

(44) "Mass wall insulation position" means:

(a) Exterior insulation position: a wall having all or nearly all of its mass exposed to the room air with the insulation on the exterior of that mass.

(b) Integral insulation position: a wall having mass exposed to both room and outside air with substantially equal amounts of mass on the inside and outside of the insulation layer.

(c) Interior insulation position: a wall not meeting either par. (a) or (b), particularly a wall having most of its mass external to an insulation layer.

(45) "Medical and clinical care" means the promotion of the condition of being sound in body or mind through medical, dental or psychological examination and treatment.

(46) "Multiscene dimming system" means a lighting control device that has the capability of setting light levels throughout a continuous range, and that has pre–established settings within the range.

(47) "Occupant–sensing device" means a device that automatically controls the lights based on occupancy.

(48) "Opaque areas" means all exposed areas of a building envelope which enclose conditioned space except fenestration areas and building service openings such as vents and grilles.

(49) "Ornamental chandeliers" means ceiling–mounted, close–to–ceiling, or suspended decorative luminaires that use glass, crystal, ornamental metals, or other decorative material and that typically are used in hotels, motels, restaurants, or churches as a significant element in the interior architecture.

(50) "Precision commercial or industrial work" means an art, craft, or manufacturing operation requiring a certain degree of refinement.

(51) "Private driveways, walkways, and parking lots" means exterior transit areas that are associated with a commercial or residential building and intended for use solely by the employees or tenants and not by the general public.

(52) "Public driveways, walkways, and parking lots" means exterior transit areas that are intended for use by the general public.

(53) "Recooling" means lowering the temperature of air that has been previously heated by a heating system.

(54) "Recovered energy" means energy utilized from an energy–using system which would otherwise be wasted or not contribute to a desired end use.

(55) "Reduced flicker operation" means the operation of a light, in which the light has a visual flicker less than 30% for frequency and modulation.

(56) "Reheating" means raising the temperature of air that has been previously cooled either by refrigeration or an economizer system.

Note: Introducing outdoor air necessary to meet ventilation requirements or to assure adequate indoor air quality is not considered to be cooling.

(57) "Reset" means adjustment of the controller set point to a higher or lower value automatically or manually.

(58) "Residential building" means a building as defined in IECC section 202.

(59) "Sconce" means a wall mounted decorative light fixture.

(60) "Shading coefficient" or "SCx " means the ratio of solar heat gain through a fenestration, with or without integral shading devices, to that occurring through unshaded 1/8–in. thick clear double strength glass.

(61) "Shell building" means a building for which the envelope is designed, constructed, or both prior to knowing the occupancy type.

Note: See also speculative building.

(62) "Speculative building" means a building for which the envelope is designed, constructed, or both prior to the design of the lighting, HVAC systems, or both. A speculative building differs from a shell building in that the intended occupancy is known for the speculative building.

Note: See also shell building.

(63) "Support area" means an area for functions that are different from but necessary to accomplish the main activity or purpose of other listed space areas.

(64) "Tandem wired" means pairs of luminaires operating with one lamp in each luminaire powered from a single two–lamp ballast contained in the other luminaires.

(65) "Task oriented lighting" means lighting that is designed specifically to illuminate a task location, and that is generally confined to the task location.

(66) "Thermal break" means an element of low thermal conductivity placed in an assembly to reduce the flow of heat between highly conductive materials.

(67) "Thermal conductance" or "C" means the constant time rate of heat flow through a unit area of a body induced by a unit temperature difference between the surfaces, expressed in Btu/h·ft^{2}·°F or equivalent units. It is the reciprocal of thermal resistance.

(68) "Thermal resistance" or "R" means the reciprocal of thermal conductance, 1/C expressed in h·ft^{2}·°F/Btu or equivalent units. The total thermal resistance of an assembly is $1/U_o$.

(69) "Thermal transmittance" or "U" means the overall coefficient of heat transfer from fluid to fluid. It is the time rate of heat flow per unit area under steady conditions from the fluid on the warm side of the barrier to the fluid on the cold side, per unit temperature difference between the 2 fluids, expressed in Btu/h·ft^{2}·°F or equivalent units.

(70) "Thermal transmittance, overall" or "U_o " means the gross overall (area weighted average) coefficient of heat transfer from air to air or fluid to fluid for a gross area of the building envelope, expressed in Btu/h·ft^{2}·°F or equivalent units. The U_o value applies to the combined effect of the time rate of heat flows through the various parallel paths such as windows, doors, and opaque construction areas comprising the gross area of one or more building envelope components such as walls, floors, and roof or ceiling.

(71) "Thermostat" means an automatic control device responsive to temperature.

(72) "Unconditioned space" means a space within a building that is not a conditioned space.

Note: See conditioned space.

(73) "Unlisted space" means the difference in area between the gross lighted area and the sum of all listed space areas.

(74) "Variable air volume HVAC system" or "VAV HVAC system" means HVAC systems that control the dry–bulb temperature within a space by varying the volume of air supply to the space.

(75) "Visible light transmittance" or "VLT" means the ratio, expressed as a decimal, of visible light that is transmitted through a glazing material to the light that strikes the material.

(76) "Wall heat capacity" or "HC" means the sum of products of the mass of each individual material in the wall per unit area of wall surface times its individual specific heat, Btu/(ft^{2}°F).

(77) "Well efficiency" means the ratio of the amount of visible light leaving a skylight well to the amount of visible light entering the skylight well and is calculated as follows:

(a) for rectangular wells:

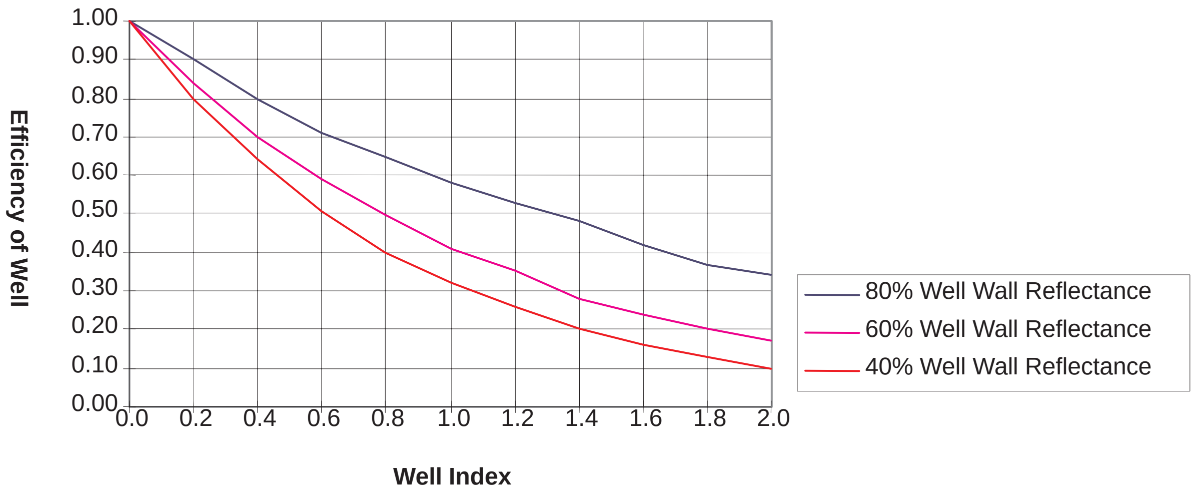
$$\frac{\text{Well height (well length + well width)}}{\text{2 x well length x well width}} = \text{the well index}$$

(b) for irregular shaped wells:

$$\frac{\text{Well height x well perimeter}}{\text{4 x well area}} = \text{the well index}$$

(c) The length, width, perimeter, and area expressed in pars. (a) and (b) are measured at the bottom of the well. The well index and the weighted average well wall reflectance are used in Figure 63.1005 to determine the well efficiency.

Figure 63.1005 Well Efficiency



Note: Reprinted from the IES Lighting Handbook, 1984, courtesy of the Illuminating Engineering Society of North America.

(78) "Window" means glazing that is not a skylight.

(79) "Window area" means the area of the surface of a window, plus the area of the frame, sash, and mullions.

(80) "Window wall ratio" means the ratio of the window area, including glazed areas of doors, to the gross exterior wall area.

(81) "Zone" means a space or group of spaces within a building with any combination of heating, cooling, or lighting requirements sufficiently similar so that desired conditions can be maintained throughout by a single controlling device.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Part 3 — Building Envelope

Comm 63.1010 Exempt buildings. This part applies to buildings or separately enclosed identifiable areas that have a mechanical space heating or air conditioning system.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1011 Air leakage and moisture migration. (1) GENERAL. The requirements of this section apply to those building components that separate interior building conditioned space from the outdoors or from unconditioned spaces or crawl spaces. Compliance with the criteria for air leakage through building components shall be determined by tests conducted in accordance with specified standards.

(2) AIR LEAKAGE FOR FACTORY MANUFACTURED WINDOWS, DOORS AND CURTAIN WALL ASSEMBLIES. Factory manufactured windows, doors and curtain wall assemblies shall comply with IECC section 802.3.1.

(3) AIR LEAKAGE REQUIREMENTS FOR EXTERIOR ENVELOPE. Openings and penetrations in the building envelope shall be sealed or gasketed in accordance with s. Comm 63.0802 (3).

(4) MOISTURE CONDENSATION. The design of buildings shall not create conditions of accelerated deterioration from moisture condensation and shall comply with s. Comm 63.0802 (2).

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **CR 01–139: am. (3) Register June 2002 No. 558, eff. 7–1–02**.

Comm 63.1012 Daylight credits for skylights. (1) COMMERCIAL BUILDINGS. Credits for skylights may be used in commercial buildings if the IECC section 802 requirements and any modifications or additions specified in subch. II are met.

(2) RESIDENTIAL BUILDINGS. Day light credits may be used in residential buildings if the IECC section 502 requirements are met.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1014 Building envelope thermal performance. (1) GENERAL. Except as provided in sub. (2), building envelopes shall comply with either the component standards of s. Comm 63.1015 or the system standards of s. Comm 63.1016. The calculation procedures of s. Comm 63.1019 shall be used to show compliance.

(2) EXCEPTIONS. (a) Buildings and areas of buildings that are used as factories and automatic car washes shall comply with s. Comm 63.1017.

(b) Buildings and areas of buildings that are used as warehouses that have documentation provided to verify that the HVAC system to be installed does not use energy primarily to provide human comfort shall comply with s. Comm 63.1017.

Note: See s. Comm 63.1010 for exempt buildings and spaces.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1015 Component standards option. (1) GENERAL. This section describes the component standards for building envelope thermal performance. Because component requirements consider the effect of solar gain as well as conductive heat transfer, the requirements for each component shall be met independently under this option. The wall and roof trade–off exception in sub. (4) may be used with this option. The system analysis design method specified in IECC section 806 shall be used to demonstrate the acceptability of trade–offs between component energy–conserving features. Separate occupancies in the same building shall meet the requirements of this section independently.

(2) DETERMINATION OF APPROPRIATE ACP TABLE. The appropriate alternate component package or ACP table shall be determined based on building location using Figures 63.1015–1 and 63.1015–4.

(3) MAXIMUM ALLOWABLE WINDOW WALL RATIO. In this subsection, the percentage of windows, including glazed areas of doors, relative to the gross exterior wall area of the building shall be less than or equal to the maximum allowable window wall ratio chosen from the appropriate ACP table for the glazing type of the building. The window wall ratio is the total area of window assemblies, including glazed areas of doors, divided by the total gross exterior wall area, considering all elevations of the building. The maximum allowable window wall ratio shall be determined using the following steps:

(a) Select the shading coefficient (SCx) range that is no less than the fenestration SCx including permanently installed internal, integral and external shading devices, but excluding the effect of external shading projections. Note that this includes curtains, shades, or blinds that are permanently installed. For a shell or speculative building for which the envelope is designed or constructed prior to the design of the lighting, HVAC systems, or both, only those shading devices that are part of the design when it is being evaluated for compliance shall be considered when determining compliance.

Note: Refer to ASHRAE Handbook, Fundamentals Volume, Chapter 27 for more information on shading coefficients. Shading coefficients for fenestration may be obtained from the manufacturer or from IECC Table 102.5.2 (3) when the conversion factor for solar heat gain coefficient (SHGC) to SCx given in IECC section 102.5.2 is applied. See also s. Comm 63.1019 (5).

(b) Select appropriate fenestration type. This is determined by the thermal transmittance value (U_{of}) of the fenestration assembly. The U_{of} of all assemblies must fall within the range, or lower, to determine the maximum window wall ratio, or an area–weighted average thermal transmittance value may be used.

(4) WALL AND ROOF TRADE–OFF. Trade–offs between the above grade exterior wall opaque areas and the gross roof area shall be allowed if either of the following conditions are met:

(a) 1. Except as specified in subd. 2., the thermal transmittance, overall value (U_o) for any above grade exterior opaque wall area or gross roof area may be increased or decreased, provided that the total annual energy use due to heat gain and loss for the building envelope is less than or equal to the total annual energy use due to heat gain and loss resulting from the use of the values in the appropriate ACP table given in Figures 63.1015–1 to 63.1015–4. Calculation of the total annual energy use of the building designs shall be done in accordance with IECC section 806.

2. The latest version of the ComCheck–EZ computer program or other programs subject to the approval of the department may be used to determine required thermal transmittance values in lieu of the ACP tables.

Note: ComCheck–EZ is a computer program that may be used only for determining building envelope compliance. The ComCheck–EZ computer program may be downloaded at: http://www.eren.doe.gov/buildings/codes_standards/buildings/com_download.html. The federal Department of Energy has issued a computer package called ComCheck–Plus, which establishes trade–offs between the building envelope, lighting, and HVAC equipment; however, this program has not been approved for use in Wisconsin since Wisconsin's lighting allowances are not the same as those included in the program.

(b) A submittal to the department for review and approval, incorporating recognized engineering practices, that the annual energy use due to heat gain and loss for the building envelope shall be less than or equal to that established in par (a).

(5) THERMAL TRANSMITTANCE VALUES FOR ROOFS, WALLS AND CEILINGS NEXT TO UNCONDITIONED SPACES, AND FLOORS OVER UNCONDITIONED SPACES. (a) The U–values for the building roofs, walls and ceilings next to unconditioned spaces, and floors over unconditioned spaces shall be less than or equal to those listed in the appropriate ACP table given in Figures 63.1015–1 to 63.1019–4.

(b) Skylights for which daylight credit cannot be taken in accordance with s. Comm 63.1012 shall be included in the calculation of the overall thermal transmittance value of the roof assembly (U_{or}).

(c) Unconditioned below–grade spaces that have floor or ceiling assemblies insulated as specified on the appropriate ACP table do not require below–grade wall insulation.

(6) THERMAL RESISTANCE VALUE FOR SLAB–ON–GRADE FLOORS. (a) Unheated slab–on–grade floors shall have insulation around the perimeter of the floor with the thermal resistance (R_u) of the insulation as listed in the appropriate ACP table given in Figures 63.1019–1 to 63.1019–4.

(b) For heated slabs–on–grade, the required minimum R–value shall be the R–value for the unheated slab–on–grade plus 2.0.

(c) The slab insulation specified shall extend either in a vertical plane downward from the top of the slab for the minimum distance given in the appropriate ACP table or downward to the bottom of the slab then in a horizontal plane beneath the slab or outward from the building for the minimum distance given in the ACP table. Vertical insulation shall not be required to extend below the foundation footing.

(d) The R–value and dimensions required for slabs refer only to the building insulation materials. Insulative continuity shall be maintained in the design of slab edge insulation systems. Continuity shall be maintained from the wall insulation through the intersection of the slab, wall and footing to the body of the slab edge insulation.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Figure 63.1015–1
Degree Day Regions for Use with AC Tables

Figure 63.1015–2
Alternate Component Package
ACP Table A

Part A1: Maximum Window Area / Gross Exterior Wall Area

Exterior Wall U_o	Shading Coefficient Range SC_x	U_{of} Range 0.60 to 0.56	0.55 to 0.51	0.50 to 0.46	0.45 to 0.41	≤ 0.40
≤ 0.06	0.80 – 0.71	0.20	0.21	0.23	0.25	0.27
	0.70 – 0.61	0.20	0.22	0.24	0.26	0.28
	0.60 – 0.51	0.21	0.22	0.25	0.27	0.30
	0.50 – 0.41	0.21	0.23	0.25	0.28	0.31
	≤ 0.40	0.21	0.23	0.26	0.29	0.33
0.061 to 0.070	0.80 – 0.71	0.18	0.20	0.21	0.23	0.25
	0.70 – 0.61	0.18	0.20	0.22	0.24	0.27
	0.60 – 0.51	0.19	0.21	0.23	0.25	0.28
	0.50 – 0.41	0.19	0.21	0.23	0.26	0.30
	≤ 0.40	0.19	0.21	0.24	0.27	0.31
0.071 to 0.080	0.80 – 0.71	0.16	0.18	0.20	0.22	0.24
	0.70 – 0.61	0.17	0.18	0.20	0.23	0.25
	0.60 – 0.51	0.17	0.19	0.21	0.23	0.26
	0.50 – 0.41	0.17	0.19	0.21	0.24	0.27
	≤ 0.40	0.18	0.19	0.22	0.25	0.28
0.081 to 0.090	0.80 –0.71	0.15	0.16	0.18	0.20	0.22
	0.70 – 0.61	0.15	0.17	0.18	0.21	0.23
	0.60 – 0.51	0.15	0.17	0.19	0.21	0.24
	0.50 – 0.41	0.16	0.17	0.19	0.22	0.25
	≤ 0.40	0.16	0.17	0.20	0.22	0.26

Part A2: Other Criteria
Roof Max U_o = 0.040
Wall and Ceiling Adjacent to Unconditioned Space Max U_o = 0.10
Floor Over Unconditioned Space Max U_o = 0.040
Wall Below Grade Min R–Value = 13

Part A3: Unheated Slab–On–Grade Minimum R–Value

Insulation	Length of Insulation		
Orientation	24″	36″	48″
Horizontal	R=18	R=15	R=11
Vertical	R=8	R=6	R=4

Figure 63.1015–3
Alternate Component Package
ACP Table B

Part B1: Maximum Window Area / Gross Exterior Wall Area						
Exterior Wall U_o	Shading Coefficient Range SC_x	U_{of} Range				
		0.60 to 0.56	0.55 to 0.51	0.50 to 0.46	0.45 to 0.41	≤ 0.40
≤ 0.06	0.80 – 0.71	0.20	0.21	0.22	0.23	0.24
	0.70 – 0.61	0.21	0.22	0.24	0.25	0.27
	0.60 – 0.51	0.22	0.24	0.25	0.27	0.29
	0.50 – 0.41	0.24	0.25	0.27	0.30	0.32
	≤ 0.40	0.25	0.27	0.29	0.32	0.35
0.061 to 0.070	0.80 – 0.71	0.19	0.20	0.21	0.22	0.23
	0.70 – 0.61	0.20	0.21	0.22	0.24	0.25
	0.60 – 0.51	0.21	0.23	0.24	0.26	0.28
	0.50 – 0.41	0.22	0.24	0.26	0.28	0.31
	≤ 0.04	0.24	0.26	0.28	0.31	0.34
0.071 to 0.080	0.80 – 0.71	0.18	0.19	0.20	0.21	0.23
	0.70 – 0.61	0.19	0.20	0.21	0.23	0.24
	0.60 – 0.51	0.20	0.21	0.23	0.25	0.27
	0.50 – 0.41	0.21	0.23	0.25	0.27	0.29
	≤ 0.40	0.22	0.24	0.27	0.29	0.32
0.081 to 0.090	0.80 –0.71	0.17	0.18	0.19	0.20	0.21
	0.70 – 0.61	0.18	0.19	0.20	0.21	0.23
	0.60 – 0.51	0.19	0.20	0.21	0.23	0.25
	0.50 – 0.41	0.20	0.21	0.23	0.25	0.28
	≤ 0.40	0.21	0.23	0.25	0.27	0.30

Part B2: Other Criteria
Roof Max U_o = 0.045
Wall and Ceiling Adjacent to Unconditioned Space Max U_o = 0.11
Floor Over Unconditioned Space Max U_o = 0.040
Wall Below Grade Min R–Value = 12

Part B3: Unheated Slab–On–Grade Minimum R–Value			
Insulation	Length of Insulation		
Orientation	24″	36″	48″
Horizontal	R=18	R=15	R=11
Vertical	R=8	R=6	R=4

Figure 63.1015–4
Alternate Component Package
ACP Table C

Part C1: Maximum Window Area / Gross Exterior Wall Area

Exterior Wall U_o	Shading Coefficient Range SC_x	U_{of} Range 0.60 to 0.56	0.55 to 0.51	0.50 to 0.46	0.45 to 0.41	≤ 0.40
≤ 0.06	0.80 – 0.71	0.20	0.21	0.22	0.22	0.23
	0.70 – 0.61	0.22	0.23	0.24	0.25	0.26
	0.60 – 0.51	0.23	0.25	0.26	0.27	0.29
	0.50 – 0.41	0.25	0.27	0.29	0.30	0.32
	≤ 0.40	0.27	0.29	0.32	0.34	0.37
0.061 to 0.070	0.80 – 0.71	0.19	0.20	0.21	0.22	0.23
	0.70 – 0.61	0.21	0.22	0.23	0.24	0.25
	0.60 – 0.51	0.22	0.24	0.25	0.26	0.28
	0.50 – 0.41	0.24	0.26	0.27	0.29	0.31
	≤ 0.40	0.26	0.28	0.30	0.33	0.35
0.071 to 0.080	0.80 – 0.71	0.18	0.19	0.20	0.21	0.22
	0.70 – 0.61	0.20	0.21	0.22	0.23	0.24
	0.60 – 0.51	0.21	0.23	0.25	0.26	0.27
	0.50 – 0.41	0.23	0.25	0.26	0.28	0.30
	≤ 0.40	0.25	0.27	0.29	0.31	0.34
0.081 to 0.090	0.80 –0.71	0.17	0.18	0.19	0.20	0.21
	0.70 – 0.61	0.19	0.20	0.21	0.22	0.23
	0.60 – 0.51	0.20	0.22	0.23	0.24	0.26
	0.50 – 0.41	0.22	0.23	0.25	0.27	0.29
	≤ 0.40	0.24	0.26	0.28	0.30	0.33

Part C2: Other Criteria
Roof Max U_o = 0.049
Wall and Ceiling Adjacent to Unconditioned Space Max U_o = 0.11
Floor Over Unconditioned Space Max U_o = 0.040
Wall Below Grade Min R–Value = 11

Part C3: Unheated Slab–On–Grade Minimum R–Value

Insulation Orientation	Length of Insulation 24″	36″	48″
Horizontal	R=18	R=15	R=11
Vertical	R=8	R=6	R=4

Comm 63.1016 System standards option. To comply with the system standards for building envelope thermal performance, the building shall comply with section 8.6 of ASHRAE standard 90.1 or with the system analysis design specified in IECC section 806 applied to the thermal envelope alone. Building site climate data shall be determined using Wisconsin division of state energy statistics or other source acceptable to the department.

Note: Section 8.6 of ASHRAE 90.1 Standard requires use of the latest version of the ENVSTD computer program, which is the computer program included in the ASHRAE 90.1 Standard to evaluate an envelope trade–off.

Note: ComCheck–EZ is a computer program that may be used only for determining building envelope compliance. The ComCheck–EZ computer program may be downloaded at: http://www.eren.doe.gov/buildings/codes_standards/buildings/com_download.html. The federal Department of Energy has issued a computer package called ComCheck–Plus, which establishes trade–offs between the building envelope, lighting, and HVAC equipment; however, this program has not been approved for use in Wisconsin since Wisconsin's lighting allowances are not the same as those included in the program.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1017 Design criteria. (1) THERMAL PERFORMANCE. (a) Except as provided in par. (b), the thermal performance values for the exterior envelope of buildings or areas of buildings that are warehouses that meet the criteria of s. Comm 63.1014 (2) (b), or that are factories shall not exceed the values in Table 63.1017–1. The calculation procedures of s. Comm 63.1019 shall be used to show compliance.

Table 63.1017–1
Thermal Performance Values

Number of Stories	Thermal Performance Values*
1–2	12
3–4	13
5–7	16
8–12	18
13–20	20
Over 20	21

* Expressed in Btu/hour/square foot of above–grade exterior envelope. See s. Comm 63.1023 (2) and (3) for design conditions.

(b) The thermal performance values specified in par. (a) may be increased or decreased provided the U–value for other components is decreased or increased so the total heat gain or loss for the entire building envelope and floor area does not exceed the total heat gain or loss resulting from conformance to the values specified in this section.

(2) FLOORS OVER UNCONDITIONED SPACES. The overall heat transmission coefficient (U–value) for floors of heated or mechanically cooled spaces over unconditioned spaces shall not exceed 0.08 Btu/h·ft^2·°F.

(3) SLAB–ON–GRADE PERIMETER INSULATION. For slab–on–grade floors with or without a grade beam, a foundation bearing wall or a foundation frost wall, the thermal resistance of the insulation around the perimeter of the floor shall not be less than the values shown in Table 63.1017–2. The insulation shall extend 48 inches in the vertical or horizontal direction or combination thereof with a total dimension of 48 inches. Slab–on grade perimeter insulation shall be moisture resistant.

Table 63.1017–2
Perimeter Insulation Requirements[1]

Slab–on–grade Perimeter Insulation		Zone 1	Zone 2	Zone 3	Zone 4
R = $\frac{°F \cdot ft^2 \cdot Hour}{Btu}$	Unheated Slabs	6.7	6.2	5.9	5.2
	Heated Slabs[2]	9.3	9.0	8.6	8.2

1 See Fig. 63.1023 for zone definitions.

2 Heated slabs have piping, duct work or other heat distribution system components embedded in or under them.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1018 Material properties. (1) ASHRAE FUNDAMENTAL DATA. Except as specified in sub. (2), when available, information on thermal properties, performance of building envelope sections, and components and heat transfer shall be obtained from ASHRAE *Handbook of Fundamentals*.

(2) EXCEPTIONS. (a) *Laboratory or field test measurements.* When the information is not available from ASHRAE *Handbook of Fundamentals*, the data may be obtained from laboratory or field–test measurements. If laboratory or field test measurements are used for envelope heat transmission, they shall be obtained using one of the following test methods:

1. ASTM C177, Test method by guarded hot plate apparatus.
2. ASTM C518, Test method by means of the heat flow meter apparatus.
3. ASTM C236, Standard test method by means of a guarded hot box.
4. ASTM C976, Standard test method by means of a calibrated hot box.
5. ASTM C335, Test method of horizontal pipe insulation.

(b) *Foam plastic insulation.* For foam plastic insulations that use a gas other than air as the insulating medium, laboratory or field tests shall be conducted on representative samples that have been aged for the equivalent of 5 years or until the R–Value has stabilized. The tests shall be conducted by an independent third party and shall be submitted for department product review and approval in accordance with ch. Comm 61.

(c) *Masonry or concrete units.* 1. Integrally insulated concrete masonry systems within the scope of the National Concrete Masonry Association (NCMA) shall be evaluated for the thermal performance of the masonry or concrete units in accordance with one of the following:

a. Use the NCMA Evaluation Procedures for the Integrally–Insulated Concrete Masonry Walls.

b. Use of default values as approved by the department may be used. No extrapolations or interpolations are allowed.

2. All other concrete or masonry units not within the scope of the NCMA Evaluation Procedures shall comply with one of the following methods for determining the thermal performance of the assembly or system:

a. Use default values as approved by the department. No extrapolations or interpolations are allowed.

b. Verify thermal performance through a laboratory or field test measurements specified in par. (a).

c. Use the department material approval process as specified in ch. Comm 61 to determine the U–factor.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1019 Required calculation procedures. **(1)** GENERAL. The following procedures shall be used to calculate the thermal performance of above– and below–grade envelope sections of any building that is heated or mechanically cooled.

(2) OVERALL THERMAL TRANSMITTANCE (U_O). The overall thermal transmittance of the building envelope assembly shall be calculated in accordance with the following equation:

$$U_o = \sum U_i A_i / A_o = (U_1 A_1 + U_2 A_2 + \bullet\bullet\bullet\bullet + U_n A_n)/A_o$$

where:

U_o = The area–weighted average thermal transmittance of the gross area of an envelope assembly; that is the exterior wall assembly including fenestration and doors, the roof and ceiling assembly, and the floor assembly, Btu/h·ft^2·°F.

A_o = The gross area of the envelope assembly, ft^2.

U_i = The thermal transmittance of each individual path of the envelope assembly, for example, the opaque portion of the wall assembly, Btu/h·ft^2·°F. U_i also equals $1/R_i$ where R_i is the total resistance to heat flow of an individual path through an envelope assembly.

A_i = The area of each individual element of the envelope assembly, ft^2.

(3) THERMAL TRANSMITTANCE (U_I) OF AN INDIVIDUAL PATH THROUGH AN ENVELOPE ASSEMBLY. The thermal transmittance of each envelope shall be determined with consideration of all major series and parallel heat flow paths through the elements of the assembly and film coefficients. Compression of insulation shall be considered in determining the thermal resistance.

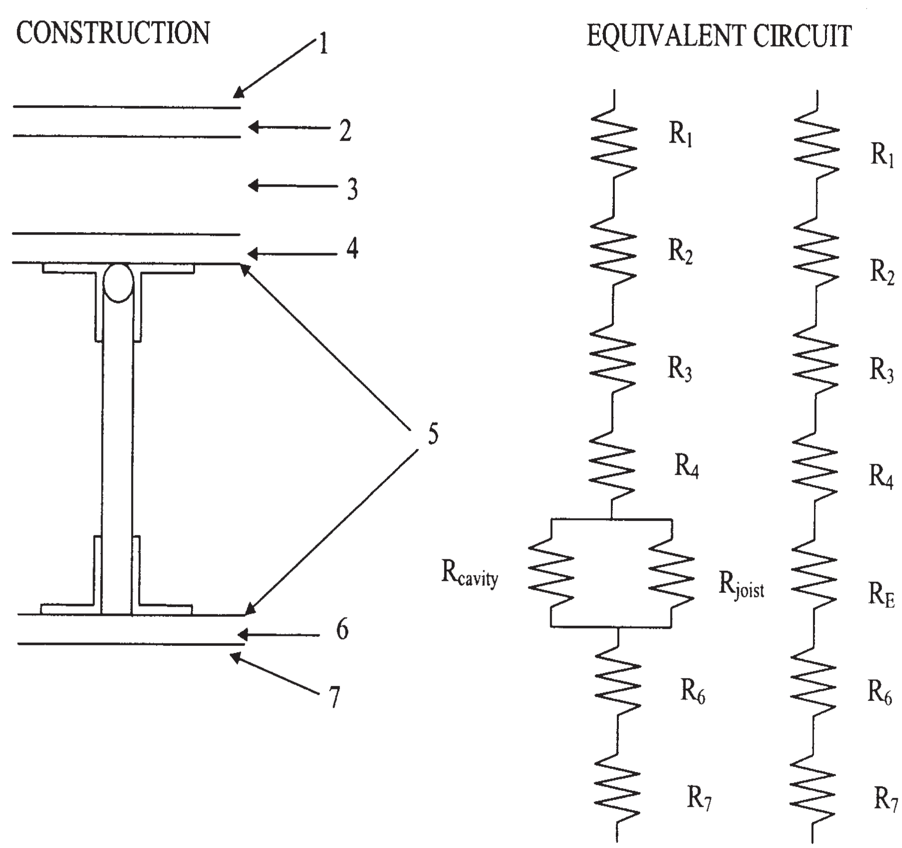
(a) *Thermal transmittance of opaque elements.* The thermal transmittance of opaque elements of assemblies shall be determined using a series path procedure with correction for the presence of parallel paths within an element of the envelope assembly such as wall cavities with parallel paths through insulation and studs. An acceptable procedure shall be used, as specified in Figure 63.1019–1. Figure 63.1019–2 illustrates a typical roof assembly.

Figure 63.1019–1
Calculation Procedures for Evaluating Major Series and Parallel Heat Flow Paths

Acceptable Procedures for Determining U_i for Opaque Elements

Sheathing	Framing	
	Metal	Nonmetal
Metal on One or Both Sides	Tests – s. Comm 63.1019 (3)(a) 1.a. Thermal Bridges – s. Comm 63.1019 (3)(a) 1.c.	Tests – s. Comm 63.1019 (3)(a) 1.a. Series or Parallel Path – s. Comm 63.1019 (3)(a) 2.
Nonmetal on Both Sides	Tests – s. Comm 63.1019 (3)(a) 1.a. Parallel Path Correction Factor – s. Comm 63.1019 (3)(a) 1.b. Zone Method – s. Comm 63.1019 (3)(a) 1.d.	Tests – s. Comm 63.1019 (3)(a) 1.a. Series or Parallel Path – s. Comm 63.1019 (3)(a) 2.

Figure 63.1019–2
Calculation Procedure for Thermal Resistance of a Typical Roof Assembly



$$\text{Where } 1/R_e = \frac{(1 - \%\ \text{joist})}{R\ \text{cavity}} + \frac{\%\ \text{Joist}}{R\ \text{joist}} \quad \text{or } R_e = R\ \text{cavity} \times F_c$$

R_e is the equivalent resistance of the element contacting the parallel path. F_c is the parallel path correction factor.

1. For envelope assemblies containing metal framing, the U_i shall be determined by using one of the following methods:

a. Using results from laboratory or field–test measurements where one of the procedures specified in s. Comm 63.1018 is used.

b. Using the thermal resistance of those roof and wall assemblies listed in Tables 63.1019–1 and 63.1019–2 shall be corrected using the following parallel path correction factor procedure:

Considering the total resistance of the series path:

$U_i = 1/R_t$

$R_t = R_i + R_e$

where:

R_t = The total resistance of the envelope assembly.

R_i = The resistance of the series elements (for i = 1 to n) excluding the parallel path element(s)

R_e = The equivalent resistance of the element containing the parallel path, the value of R_e is:

R_e = R–value of insulation x F_c

The Parallel Path Correction Factors (F_c) may be obtained from tests conducted using procedures listed in s. Comm 63.1018. Parallel Path Correction Factors for some envelope assemblies are listed in Tables 63.1019–1 and 63.1019–2.

c. For elements with internal metallic structures bonded on one or both sides to a metal skin or covering, the calculation procedure specified in the ASHRAE *Handbook of Fundamentals,* or specified in ASHRAE standard 90.1, or other procedure acceptable to the department shall be used to include the effects of thermal bridges in metal construction.

d. For elements other than those covered above, the zone method described in the ASHRAE *Handbook of Fundamentals* shall be used for calculation.

Table 63.1019–1
Roofs
Parallel Path Correction Factors[a]

Bridged R–Value	0	5	10	15	20	25	30	35	40	45	50	55
Correction Factor	1.0	0.96	0.92	0.88	0.85	0.81	0.79	0.76	0.73	0.71	0.69	0.67

[a] Table values are based upon metal trusses with 4–foot spacing that penetrate the insulation, and 0.66–inch diameter cross members every 1 foot.

Table 63.1019–2
Wall Sections with Metal Studs
Parallel Path Correction Factors

Size of Members	Gauge of Stud[a]	Spacing of Framing, in.	Cavity Insulation R–Value	Correction Factor	Effective Framing/Cavity R–Values
2 x 4	18–16	16 o.c.	R–11 R–13 R–15	0.50 0.46 0.43	R–5.5 R–6.0 R–6.4
2 x 4	18–16	24 o.c.	R–11 R–13 R–15	0.60 0.55 0.52	R–6.6 R–7.2 R–7.8
2 x 6	18–16	16 o.c.	R–19 R–21	0.37 0.35	R–7.1 R–7.4
2 x 6	18–16	24 o.c.	R–19 R–21	0.45 0.43	R–8.6 R–9.0
2 x 8	18–16	16 o.c.	R–25	0.31	R–7.8
2 x 8	18–16	24 o.c.	R–25	0.38	R–9.6

[a] These factors can be applied to metal studs of this gauge or thinner.

2. For assemblies containing nonmetal framing, the U_i shall be determined from one of the laboratory or field test measurements specified in s. Comm 63.1018 or from the ASHRAE series–parallel method. Formulas in the ASHRAE *Handbook of Fundamentals*, shall be used for these calculations.

3. The opaque portions of doors shall be considered to be a part of the opaque wall assembly in the calculation of the average thermal transmittance. The thermal transmittance of the entire opaque door assembly including the frame shall be included in the calculation.

(b) *Thermal transmittance of fenestration.* Values of U_{of} shall be determined using one of the following methods:

1. The National Fenestration Rating Council (NFRC) 100 Procedure for Determining Fenestration Product U–Factors. The thermal performance values shall be certified through the NFRC Fenestration Thermal Performance Rating Certification and Labeling Program as described in the NFRC Product Certification Program LAP 1, PCP 1, and CAP 1.

2. The values for the appropriate product type given in IECC Table 102.5.2 (1) may be used.

Note: In order to use the component standards option of s. Comm 63.1015, the U–value of fenestration must be 0.60 or less.

(4) GROSS AREA OF ENVELOPE COMPONENTS. (a) *Roof assembly.* The gross area of a roof assembly consists of the total surface of the roof assembly exposed to outside air or unconditioned spaces. The roof assembly shall be considered to include all roof or ceiling components through which heat may flow between indoor and outdoor environments including skylight surfaces but excluding service openings. For thermal transmittance purposes when return air ceiling plenums are employed, the roof or ceiling assembly shall not include the resistance of the ceiling or the plenum space as part of the total resistance of the assembly.

(b) *Floor assembly.* The gross area of a floor assembly over outside or unconditioned spaces consists of the total surface of the floor assembly exposed to outside air or unconditioned space. The floor assembly shall include all floor components through which heat may flow between indoor and outdoor or unconditioned space environments.

(c) *Exterior walls.* The gross area of exterior walls enclosing a heated or cooled space is measured on the exterior and consists of the opaque wall including between floor spandrels, peripheral edges of flooring, window areas including sash, and door areas, but excluding vents, grilles, and pipes.

(5) SHADING COEFFICIENTS. The shading coefficient (SC_x) for fenestration shall be obtained from the ASHRAE *Handbook of Fundamentals* or from manufacturer's test data or from IECC section 102.5.2. SC_x is the shading coefficient of the fenestration including permanently installed internal and external shading devices but excluding the effect of external shading projections, which is calculated separately. The shading coefficient used for louvered shade screens shall be determined using a profile angle of 30º as found in the ASHRAE *Handbook of Fundamentals*.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Part 4 — Equipment and Systems

Comm 63.1020 Minimum equipment efficiencies. **(1)** Space heating or cooling equipment that is not covered by 10 CFR Part 430, Energy Conservation Program for Consumer Products, shall have a minimum efficiency at the specified rating conditions not less than the values given in ASHRAE 90.1, section 10.4.1.

(2) Equipment ratings shall be certified under a nationally recognized certification program or rating procedure or by data furnished by the equipment manufacturer to show compliance with the minimum efficiency requirements.

Note: The following certification programs are accepted by the department: Gas Appliance and Manufacturers Association (GAMA) and Air–Conditioning and Refrigeration Institute (ARI).

(3) Compliance with minimum efficiency requirements specified for HVAC equipment shall include compliance with part–load requirements where indicated as well as standards for full–load requirements. The part–load efficiency shall be determined as specified in ASHRAE 90.1.

(4) Space heating or cooling equipment used to provide additional functions, such as water heating for plumbing, as part of a combination or integrated system shall comply with minimum performance requirements for the appropriate space heating or cooling equipment category.

(5) Equipment providing water heating for plumbing that is used to provide additional functions, such as space heating, as part of a combination or integrated system shall comply with minimum performance requirements for water heating equipment as specified in s. Comm 84.20 (5) (n).

(6) Combination space and plumbing water heating equipment shall comply with IECC section 504.2.2 and s. Comm 63.0504 (1).

Note: See ch. Comm 64 for additional requirements for combined systems.

(7) Equipment that is not used for comfort cooling or comfort heating is exempt from the energy efficiency requirements of this chapter.

Note: Omission of minimum performance requirements for certain classes of HVAC equipment does not preclude use of that equipment.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1021 Field–assembled equipment and components. When components, such as indoor or outdoor coils, from more than one manufacturer are used as parts of air–conditioning or heating equipment, component efficiencies shall

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be specified based on data provided by the component manufacturers.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1022 Heat pump equipment controls. Controls for heat pumps equipped with supplementary heaters that are installed in residential buildings shall comply with IECC section 503.3.2.3, and controls for equipment installed in commercial buildings shall comply with IECC sections 803.3.3.1.1.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1023 Load calculations for sizing. **(1)** CALCULATION PROCEDURES. Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with the procedures described in the ASHRAE *Handbook of Fundamentals*, or a similar computation procedure approved by the department. For those design parameters addressed in subs. (2) to (6), the values specified shall be used.

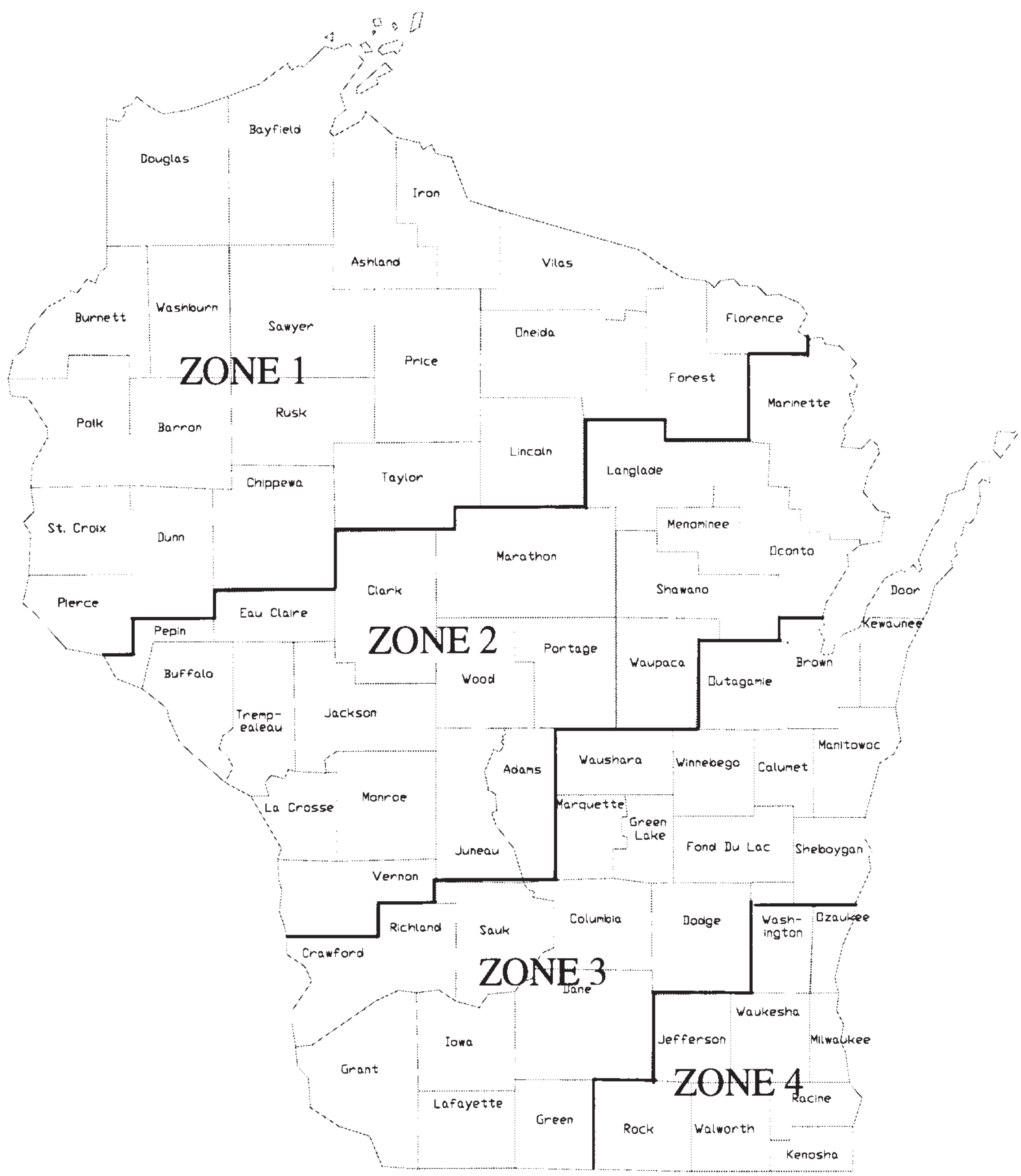
Note: This section does not require the installation of cooling equipment.

(2) INDOOR DESIGN CONDITIONS. The winter indoor design temperature is specified in Table 64.0403. When air conditioning is provided in accordance with ch. Comm 64, the summer indoor design temperature is 78ºF or lower.

(3) OUTDOOR DESIGN CONDITIONS. Winter maximum and summer minimum for outdoor design temperatures shall be taken from Figure 63.1023.

Note: Systems may be designed for colder winter temperatures or for warmer summer temperatures.

Figure 63.1023
Outdoor Design Conditions



Zone	Winter Design Temp. (°F)	Summer Dry Bulb (°F)	Summer Wet Bulb (°F)
1	–25	86	75*
2	–20	87	75
3	–15	87	75
4	–10	89	77

*Exception: For Douglas, Bayfield, Ashland and Iron Counties, use 70°F summer wet bulb design temperature.

(4) VENTILATION. Outdoor air ventilation loads shall be based on ventilation rates specified in ch. Comm 64.

(5) ENVELOPE. Envelope heating and cooling loads shall be based on envelope characteristics such as thermal conductance, shading coefficient, and air leakage consistent with the values used to demonstrate compliance with this subchapter, Part 3, building envelope.

(6) LIGHTING. Lighting loads shall be based on actual design lighting levels or power budgets consistent with subch. III, Part 5. Lighting loads may not be included for the purpose of calculating design heating loads.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1024 System and equipment sizing. HVAC systems and equipment shall be sized to provide the minimum space and system loads calculated in accordance with s. Comm 63.1023. Heating and cooling equipment and systems shall meet the minimum efficiencies in IECC Table 803.2.2 (1).

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1026 Temperature controls. (1) SYSTEM CONTROL. Each HVAC system shall include at least one temperature control device.

(2) ZONE CONTROLS. (a) *Individual thermostatic controls.* 1. 'General.' Except as provided in subd. 2., the supply of heating and cooling energy to each zone shall be controlled by individual thermostatic controls responding to temperature within the zone.

2. 'Exceptions.' Independent perimeter systems that are designed to offset only envelope heat losses or gains, or both, may serve one or more zones also served by an interior system with the following limitations:

a. The perimeter system shall include at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation for 50 contiguous feet or more; and

b. The perimeter system heating and cooling supply shall be controlled by thermostats located within the zones served by the system.

(b) *Zone controls for comfort heating.* Where used to control comfort heating, zone thermostatic controls shall be capable of being set locally or remotely by adjustment or selection of sensors down to 50ºF or lower.

(c) *Zone controls for comfort cooling.* Where used to control comfort cooling, zone thermostatic controls shall be capable of being set locally or remotely by adjustment or selection of sensors up to 85ºF or higher.

(d) *Zone controls for both heating and cooling.* 1. 'General.' Except as provided in subd. 2., zone thermostatic controls used to control both comfort heating and cooling shall be capable of providing a temperature range, or deadband, of at least 5ºF within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

2. 'Exceptions.' a. Deadbands are not required for special occupancy, special usage, or required systems where deadband controls are not appropriate.

b. Deadbands are not required for buildings complying with the ASHRAE energy cost budget method under subch. III, Part 5, if, in the proposed building energy analysis, heating and cooling thermostat set–points are set to the same value between 70ºF and 75ºF inclusive and assumed to be constant throughout the year.

c. Deadbands may be omitted for thermostats that have manual changeover between heating and cooling modes.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1027 Zone controls. (1) THERMOSTATIC AND HUMIDISTATIC CONTROLS. Except as provided in sub. (2), zone thermostatic and humidistatic controls shall be capable of operating in sequence to supply heating and cooling energy to the zone. Such controls shall prevent any of the following:

(a) Reheating.

(b) Recooling.

(c) Mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled, either by mechanical refrigeration or by economizer systems.

(d) Other simultaneous operation of heating and cooling systems to the same zone.

(2) EXCEPTIONS. All of the following systems and zones are exempt from this section:

(a) Variable air volume (VAV) systems which, during periods of occupancy, are designed to reduce the air supply to each zone to a minimum before reheating, recooling, or mixing takes place. This minimum volume shall be no greater than the largest of the following:

1. 30% of the peak supply volume.

2. The minimum required to meet ventilation requirements of ch. Comm 64.

3. 0.4 cfm/square foot of zone conditioned floor area.

(b) Zones where special pressurization relationships or cross–contamination requirements are such that VAV systems are impractical, such as isolation rooms, operating areas of hospitals, and laboratories.

(c) Where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site–recovered or site–solar energy source.

(d) Zones where specified humidity levels are required to satisfy process needs, such as computer rooms and museums.

(e) Zones with a peak supply air quantity of 150 cfm or less.

(f) Multiple reheat systems serving multiple zones, other than those employing variable air volume for temperature control, that are provided with controls that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the coolest air. In the case of direct expansion cooling systems, cooling may be cycled based on the zone requiring the coolest air or average room temperature for all zones.

(g) Dual duct and multizone systems that are provided with controls that will automatically reset all of the following:

1. The cold duct air supply to the highest temperature that will satisfy the zone requiring the coolest air.

2. The hot duct air supply to the lowest temperature that will satisfy the zone requiring the warmest air.

(h) Systems in which heated air is recooled, directly or indirectly, to maintain space temperature that are provided with controls that will automatically reset the temperature to which the supply air is heated to the lowest level that will satisfy the zone requiring the warmest air.

(i) A multiple zone heating, ventilating and air–conditioning system that employs reheating or recooling for control of not more than 5,000 cfm or 20% of the total supply air of the system, whichever is less.

(3) OFF–HOUR CONTROLS. Except as provided in pars. (a) to (c), mechanical HVAC systems shall be equipped with automatic controls capable of accomplishing a reduction of energy use through control setback or equipment shutdown during periods of nonuse or alternate use of the zones served by the system. The following systems are exempt from this subsection:

(a) Systems serving areas expected to operate continuously.

(b) Where it can be shown that setback or shutdown will not result in a decrease in overall building energy costs.

(c) Equipment with full load demands of 2 kW or 6826 Btu/h or less that is controlled by readily accessible manual off–hour controls.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1028 Humidity control. If a system is equipped with a means for adding moisture to maintain specific humidity levels in a zone or zones, a humidistat shall be provided in accordance with IECC section 503.3.2.4 for residential buildings and IECC section 803.2.3.2 for commercial buildings.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1029 Insulation, materials and construction. (1) GENERAL. Insulation required by subs. (2) and (3) shall be suitably protected from damage. Insulation shall be installed in accordance with practices acceptable to the department. The department accepts MICA Commercial and Industrial Insulation Standards as an insulation installation practice.

(2) PIPING INSULATION. Except as provided in pars. (a) to (c), recirculating plumbing system piping, plumbing piping in the first 8 feet from storage tanks for noncirculating systems, any piping served by a self–regulating electric heating cable, HVAC system piping, and related HVAC fluid conveying conduit, such as heat exchanger bodies, shall be thermally insulated in accordance with Table 63.1029 or equivalent. The following piping or conduit is exempted from this subsection:

(a) Factory–installed piping or conduit within HVAC equipment tested and rated in accordance with s. Comm 63.1020;

(b) Piping or conduit for which no insulation is specified in Table 63.1029.

(c) Where it can be shown that the heat gain or heat loss to or from piping or conduit without insulation will not increase building energy use.

Table 63.1029
Plumbing and HVAC Piping Minimum Insulation [in. [a] (R–Value)]

	Insulation Conductivity[a]		**Nominal Pipe Diameter [in. (R–value)]**					
Fluid Design Operating Temp. Range, °F	Conductivity Range Btu·in./–(h·ft^2·°F)	Mean Rating Temp. °F	Runouts[b] up to 2	1 and less	1–1/4 to 2	2–1/2 to 4	5 & 6	8 & up
Heating systems (Steam, Steam Condensate, and Hot Water)								
Above 350	0.32–0.34	250	1.5(R–4.4)	1.5(R–4.4)	2.5(R–7.4)	3.0(R–8.8)	3.5(R–10.3)	3.5(R–10.3)
251–350	0.29–0.31	200	1.5(R–4.8)	1.5(R–4.8)	2.5(R–8.1)	2.5(R–8.1)	3.5(R–11.3)	3.5(R–11.3)
201–250	0.27–0.30	150	1.0(R–3.3)	1.0(R–3.3)	1.5(R–5.0)	2.0(R–6.7)	2.0(R–6.7)	3.5(R–11.7)
141–200	0.25–0.29	125	0.5(R–1.8)	0.5(R–1.8)	1.5(R–5.2)	1.5(R–5.2)	1.5(R–5.2)	1.5(R–5.2)
105–140	0.24–0.28	100	0.5(R–1.8)	0.5(R–1.8)	1.0(R–3.6)	1.0(R–3.6)	1.0(R–3.6)	1.5(R–5.4)
Domestic and Service Hot Water systems[c]								
105 and greater	0.24–0.28	100	0.5(R–1.8)	1.0(R–3.6)	1.0(R–3.6)	1.5(R–5.4)	1.5(R–5.4)	1.5(R–5.4)
Cooling systems (Chilled water, brine, and refrigerant)[d]								
40–55	0.23–0.27	75	0.5(R–1.9)	0.5(R–1.9)	0.75(R–2.8)	1.0(R–3.7)	1.0(R–3.7)	1.0(R–3.7)
Below 40	0.23–0.27	75	1.0(R–3.7)	1.0(R–3.7)	1.5(R–5.6)	1.5(R–5.6)	1.5(R–5.6)	1.5(R–5.6)

a For insulation outside the state conductivity range, the minimum thickness (T) shall be determined as follows: $T=PR\,[(1+t/PR)^{K/k}-1]$, where T = minimum insulation thickness for material with conductivity K, in.; PR = actual outside radius of pipe, in.; t = insulation thickness, in.; K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature; and k = the lower value of the conductivity range listed for the applicable fluid temperature.

b Runouts to individual terminal units not exceeding 12 ft. in length.

c Applies to recirculating sections of service or domestic hot water systems and first 8 ft. from storage tank for nonrecirculating systems.

d The required minimum thickness does not consider water vapor transmission and condensation.

(3) AIR–HANDLING SYSTEM INSULATION. All air–handling ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with s. Comm 63.0803 (2) (f).

(4) ADDITIONAL DUCT SEALING. (a) *General.* Except as specified in par. (b), ductwork and plenums shall be sealed in accordance with Table 63.1029–1, and shall meet the duct seal classes specified in Table 63.1029–2.

(b) *Exception.* Ductwork and plenums confined within individual dwelling units shall comply with s. Comm 63.0503 (2) (c).

Table 63.1029–1

Minimum Duct Seal Level[a]

Duct Location	Duct Type			
	Supply			
	≤ 2 in. w.c[b] (500 Pa)	> 2 in. w.c.[b] (500 Pa)	Exhaust	Return
Outdoors[c]	A	A	C	A
Unconditioned Spaces	B	A	C	B
Conditioned Spaces	C	B	B	C

[a] See Table Comm 63.0803–2 definition of Seal Class.
[b] Duct design static pressure classification.
[c] Includes indirectly conditioned spaces, such as return air plenums.

Table 63.1029–2

Duct Seal Classes

Duct Seal Class	Sealing Requirements[a]
A	All transverse joints, longitudinal seams, and duct wall penetrations. Pressure sensitive tape shall not be used as the primary sealant.
B	All transverse joints and longitudinal seams. Pressure sensitive tape shall not be used as the primary sealant.
C	Transverse joints only.

[a] Longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections and are oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw fastener, pipe, rod or wire. Spiral lock seams in round and flat oval duct need not be sealed. All other connections are considered transverse joints, including but not limited to spin–ins, taps and other branch connections, access door frames and jambs, and duct connections to equipment.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **CR 01–139: r. and recr. (4) Register June 2002 No. 558, eff. 7–1–02**.

Comm 63.1030 Hydronic system controls. Hydronic system controls shall comply with IECC section 803.3.3.7.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1031 Economizer controls. **(1)** FAN SYSTEM. Except as provided in sub. (2), each fan system shall be designed and capable of being controlled to take advantage of favorable weather conditions to reduce mechanical cooling requirements. The system shall include either of the following:

(a) A temperature or enthalpy air economizer system which is capable of automatically modulating outside air and return air dampers to provide 100% of the design supply air quantity as outside air for cooling;

(b) A water economizer system, which is capable of cooling supply air by direct evaporation, indirect evaporation, or both. Such a system shall be designed and capable of being controlled to provide 100% of the expected system cooling load at outside air temperatures of 50ºF dry–bulb/40ºF wet–bulb and below.

(2) EXCEPTIONS. All of the following systems are exempt from this subsection:

(a) Individual fan–cooling units with a supply capacity of less than 2,000 cfm or a total system cooling capacity of less than 62,000 Btu/hour for split systems or less than 36,000 Btu/hour for all other types. The total capacity of all such units complying by use of this exception shall not exceed 600,000 Btu/hour per building or 10% of the total installed cooling capacity, whichever is larger;

(b) Systems with air or evaporatively cooled condensers for which it can be shown that the use of outdoor air cooling affects the operation of other systems, such as humidification, dehumidification, or supermarket refrigeration systems, so as to increase overall building energy costs;

Note: Other areas that may use controlled humidification or dehumidification are computer rooms, museums, library stacks and drafting rooms.

(c) Where the overall building energy use resulting from alternative designs, such as internal to external zone heat recovery systems, can be shown to be less than those resulting from an economizer system.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1032 Electrical motors. **(1)** PERMANENTLY WIRED MOTORS. Any permanently wired motor that meets all of the criteria specified in pars. (a) through (g) shall meet the efficiency requirements specified in Table 63.1032 and the requirements of this section:

(a) The motor is used in a HVAC fan or pumping system.

(b) The motor is polyphase.

(c) The motor is one horsepower or more.

(d) The motor is a design A or B squirrel–cage, foot–mounted, T–frame induction motor that has synchronous speeds of 3600, 1800, 1200, and 900 rpm.

(e) The motor is expected to operate more than 1000 hours per year.

(f) The motor is not a multispeed motor used in a system designed to use more than one speed.

(g) The motor is not a component of equipment that meets the efficiency requirements of s. Comm 63.1020 where motor input is included in the determination of the equipment efficiency.

(2) MOTOR NAMEPLATE. The motor nameplate shall list the minimum nominal full–load motor efficiency.

Note: Motors that are classified as “energy efficient” under the National Electric Manufacturer’s Association Standard MG 12.55, dated 3–14–91, are acceptable to the department as meeting the efficiency requirements of this section.

Table 63.1032
Minimum Acceptable Nominal Full–Load Motor Efficiency for Single–Speed Polyphase Squirrel–Cage Induction Motors Having Synchronous Speeds of 3600, 1800, 1200 and 900 rpm

Full–Load Efficiencies—Open Motors								
HP	2–Pole		4–Pole		6–Pole		8–Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	—	—	82.5	81.5	80.0	78.5	74.0	72.0
1.5	82.5	81.5	84.0	82.5	84.0	82.5	75.5	74.0
2.0	84.0	82.5	84.0	82.5	85.5	84.0	85.5	84.0
3.0	84.0	82.5	86.5	85.5	86.5	85.5	86.5	85.5
5.0	85.5	84.0	87.5	86.5	87.5	86.5	87.5	86.0
7.5	87.5	86.5	88.5	87.5	88.5	87.5	88.5	87.5
10.0	88.5	87.5	89.5	88.5	90.2	89.5	89.5	88.5
15.0	89.5	88.5	91.0	90.2	90.2	89.5	89.5	88.5
20.0	90.5	89.5	91.0	90.2	91.0	90.2	90.2	89.5
25.0	91.0	90.2	91.7	91.0	91.7	91.0	90.2	89.5
30.0	91.0	90.2	92.4	91.7	92.4	91.7	91.0	90.2
40.0	91.7	91.0	93.0	92.4	93.0	92.4	91.0	90.2
50.0	92.4	91.7	93.0	92.4	93.0	92.4	91.7	91.0
60.0	93.0	92.4	93.6	93.0	93.6	93.0	92.4	91.7
75.0	93.0	92.4	94.1	93.6	93.6	93.0	93.6	93.0
100.0	93.0	92.4	94.1	93.6	94.1	93.6	93.6	93.0
125.0	93.6	93.0	94.5	94.1	94.1	93.6	93.6	93.0
150.0	93.6	93.0	95.0	94.5	94.5	94.1	93.6	93.0
200.0	94.5	94.1	95.0	94.5	94.5	94.1	93.6	93.0
Full–Load Efficiencies—Enclosed Motors								
HP	2–Pole		4–Pole		6–Pole		8–Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	75.5	74.0	82.5	81.5	80.0	78.5	74.0	72.0
1.5	82.5	81.5	84.0	82.5	85.5	84.0	77.0	75.5
2.0	84.0	82.5	84.0	82.5	86.5	85.5	82.5	81.5
3.0	85.5	84.0	87.5	86.5	87.5	86.5	84.0	82.5
5.0	87.5	86.5	87.5	86.5	87.5	86.5	85.5	84.0
7.5	88.5	87.5	89.5	88.5	89.5	88.5	85.5	84.0
10.0	89.5	88.5	89.5	88.5	89.5	88.5	88.5	87.5
15.0	90.2	89.5	91.0	90.2	90.2	89.5	88.5	87.5
20.0	90.2	89.5	91.0	90.2	90.2	89.5	89.5	88.5
25.0	91.0	90.2	92.4	91.7	91.7	91.0	89.5	88.5
30.0	91.0	90.2	92.4	91.7	91.7	91.0	91.0	90.2
40.0	91.7	91.0	93.0	92.4	93.0	92.4	91.0	90.2
50.0	92.4	91.7	93.0	92.4	93.0	92.4	91.7	91.0
60.0	93.0	92.4	93.6	93.0	93.6	93.0	91.7	91.0
75.0	93.0	92.4	94.1	93.6	93.6	93.0	93.0	92.4
100.0	93.6	93.0	94.5	94.1	94.1	93.6	93.0	92.4
125.0	94.5	94.1	94.5	94.1	94.1	93.6	93.6	93.0
150.0	94.5	94.1	95.0	94.5	95.0	94.5	93.6	93.0
200.0	95.0	94.5	95.0	94.5	95.0	94.5	94.1	93.6

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Part 5 — Lighting Power

Comm 63.1040 Scope. (1) GENERAL. Except as specified in sub. (2), ss. Comm 63.1041 to 63.1051 shall apply to all of the following rooms, spaces and areas:

(a) Interior spaces of buildings.

(b) Building exteriors and exterior areas such as entrances, exits, and loading docks.

(c) Roads, grounds, parking, and other exterior areas where lighting is energized through the building electrical service.

(2) EXCEPTIONS. Lighting that is specifically designated as required by a health or life safety regulation is exempt.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1041 Exterior lighting power requirement. The exterior lighting power of a building or a group of buildings in a multibuilding facility calculated in accordance with s. Comm 63.1042 shall be no greater than the lighting power allowance calculated in accordance with s. Comm 63.1043.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1042 Calculation of exterior lighting power. The calculated exterior lighting power is the sum of the power for all exterior luminaires that are included in s. Comm 63.1040, minus the power for exempted exterior lighting as specified in subs. (1) to (5).

(1) Task lighting for outdoor activities such as manufacturing and processing facilities.

(2) Lighting power for theatrical productions.

(3) Lighting for outdoor sporting facilities, including playing and seating areas.

(4) Lighting for dwelling units that is controlled within the dwelling unit.

(5) Exit way or egress lighting required by IBC section 1003.2.11 that has switching regulated by Article 700 of the National Electrical Code.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; **correction in (5) made under s. 13.93 (2m) (b) 7., Stats**.

Comm 63.1043 Exterior lighting power allowance. (1) CALCULATION METHOD. The exterior lighting power allowance for a building or a multibuilding facility is the sum of all the allowed lighting powers for all exterior areas. The lighting power for each area is calculated by multiplying the unit power allowance from Table 63.1043 by the applicable length or area.

(2) APPLICABLE AREAS AND LENGTHS. The applicable areas and lengths used with Table 63.1043 to calculate the exterior lighting power allowance are described in pars. (a) to (d).

(a) Horizontal areas of grounds, driveways, lots, gardens or parks may be calculated as if they were flat, or the actual area of the surfaces of contours may be used.

(b) Canopied areas are the area of the horizontal surface under the canopy. A canopy includes an exterior awning, soffit or ornamental or functional structure signifying a main entrance to a building.

(c) The linear length of door openings is measured in plan view and includes the door opening only. Sidelights and other portions of the door, which do not open, are not included.

(d) The applicable area of the building facade includes all vertical and horizontal areas that are intended to be illuminated.

Table 63.1043
Exterior Lighting Unit Power Allowances

Area Description	Allowances
Canopies (not associated with an entrance)	4 W/ft^2
Commerce or merchandizing areas	4 W/ft^2
Exit (with or without canopy)	16 W/lin ft of door opening
Entrance (without canopy)	20 W/lin ft of door opening
Entrance (with canopy)	
High traffic (retail, hotel, airport, theater, etc.)	6.6 W/ft^2 of canopied area
Light traffic (hospital, office, school, etc.)	2.6 W/ft^2 of canopied area
Loading area	0.26 W/ft^2
Loading door	13 W/lin ft of door opening
Building exterior surfaces/ facades	0.16 W/ft^2 of surface area to be illuminated
Storage and nonmanufacturing work areas	0.13 W/ft^2
Other activity areas for casual use such as picnic grounds, gardens, parks and other landscaped areas.	0.06 W/ft^2
Private driveways/walkways	0.06 W/ft^2
Public driveways/walkways	0.10 W/ft^2
Private parking lots	0.08 W/ft^2
Public parking lots	0.12 W/ft^2
Pump island canopies	4 W/ft^2

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1044 Interior lighting power requirement. The interior lighting power of a building calculated in accordance with s. Comm 63.1045 shall be no greater than the interior lighting power allowance calculated in accordance with s. Comm 63.1046.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1045 Calculation of interior lighting power. The calculated interior lighting power of a building is the total watts of all interior luminares including, but not limited to, track and flexible lighting systems, lighting that is integral with modular furniture, movable displays and cabinets, and internally illuminated case work for task or display purposes, minus any adjustments allowed under subs. (1) through (4).

(1) MULTIPLE INTERLOCKED LIGHTING SYSTEMS SERVING A SPACE. When multiple interlocked lighting systems serve a space, the watts of all systems except the system with the highest wattage may be excluded from the calculated lighting power if:

(a) The lighting systems are interlocked to prevent simultaneous operation; or

(b) The lighting systems are controlled by a preset dimming system or other device that prevents simultaneous operation of more than one lighting system, except under the direct control of authorized personnel.

(2) REDUCTION OF WATTAGE THROUGH CONTROLS. The watts of any luminaire that is controlled may be reduced by the number of watts times the applicable power adjustment factor from Table 63.1045 if all of the following are met:

(a) The control complies with s. Comm 63.1051.

(b) At least 50% of the light output of the luminaire is within the applicable space listed in Table 63.1045.

(c) Except as noted in Table 63.1045, only one power adjustment factor is used for the luminaire.

(d) For daylighting control credits, the luminaire is controlled by the daylighting control, and the luminaire is located within the daylit area.

(e) For automatic time switch control devices, a timed manual override is provided at each switch location required by s. Comm 63.1050. The override device shall control only the lights in the surrounding area enclosed by ceiling–height partitions.

Table 63.1045
Lighting Power Adjustment Factors

Type of Control	Type of Space	Factor
Automatic daylighting controls	Daylit areas	
Continuous dimming		0.30
Multiple step dimming		0.20
On/off		0.10
Automatic time switch control device in conjunction with automatic daylighting controls	Daylit areas ≤ 250 square feet	
Continuous dimming		0.35
Multiple step dimming		0.25
On/off		0.15
Automatic time switch control device in conjunction with lumen maintenance and automatic daylighting controls	Daylit areas ≤ 250 square feet	
Continuous dimming		0.40
Multiple step dimming		0.30
On/off		0.20
Lumen maintenance	Any space	0.10
Lumen maintenance in conjunction with an automatic time switch control device	Space ≤ 250 square feet	0.15
Automatic time switch control device	Spaces ≤ 250 square feet	0.15
Occupant–sensing device with a separate sensor for each space	Spaces ≤ 250 square feet enclosed by opaque floor–to–ceiling partitions; any size classroom, corridor, conference or waiting room	0.30*
Occupant–sensing device with separate sensor for each space	Rooms of any size that are used exclusively for storage	0.60*
Occupant–sensing device with separate sensor for each space	Spaces > 250 square feet	0.10*
Occupant–sensing device with a separate sensor for each space used in conjunction with daylighting controls and separate sensor for each space	Spaces ≤ 250 square feet within a daylit area and enclosed by opaque floor–to–ceiling partitions	
Continuous dimming		0.40*
Multiple step dimming		0.35*
On/off		0.35*
Occupant–sensing device with a separate sensor for each space used in conjunction with daylighting controls and separate sensor for each space and lumen maintenance	Spaces ≤ 250 square feet within a daylit area and enclosed by opaque floor–to–ceiling partitions	0.35*
Continuous dimming		0.45*
Multiple step dimming		0.40*
On/off		0.35*
Occupant–sensing device with a separate sensor for each space used with lumen maintenance	Spaces ≤ 250 square feet and enclosed by opaque floor–to–ceiling partitions	0.35*
Occupant–sensing device with a separate sensor for each space used in conjunction with an automatic time switch control device	Spaces ≤ 250 square feet enclosed by opaque floor to ceiling partitions	0.35*
Manual dimming system	Hotels, motels, restaurants, auditoriums, theaters	0.10
Multiscene programmable dimming system	Hotels, motels, restaurants, auditoriums, theaters	0.20
Occupant–sensing device with programmable multiscene dimming system	Hotels, motels, restaurants, auditoriums, theaters	0.35

***Note to Table 63.1045:** Adjustment factors for occupant–sensing devices are for devices with on–off operation. If devices are used that turn lights down, rather than off, the adjustment factor shall be multiplied by the percent of energy savings that occur while the lights are turned down.

(3) LIGHTING WATTAGE EXCLUDED. The watts of the following lighting applications may be excluded from the calculated interior lighting power of the building.

(a) Lighting for theatrical productions and other live performances, television broadcasting, audio–visual presentations, and those portions of entertainment facilities such as stage areas in hotel ballrooms, night clubs, dance floors, churches, and casinos where lighting is an essential technical element for the function performed, if the lighting is an addition to a general lighting system, and if the lighting is separately controlled and accessible only to authorized operators.

(b) Lighting for television, video and film production.

(c) Lighting for photographic processes.

(d) Lighting for the amusement and attraction areas in theme parks.

(e) Lighting for exhibits in areas such as exhibit, convention, and hotel function areas, if the lighting is an addition to a general lighting system, and if the lighting is separately controlled and accessible only to authorized operators.

(f) Specialized local lighting installed in nonlighting process equipment by its manufacturer used to illuminate process related tasks only.

(g) In buildings for medical and clinical care, examination and surgical lights, low–level night lights, and lighting integral to medical equipment.

(h) Lighting fixtures that are an integral part of refrigeration equipment.

(i) Nonretail display lighting required for art exhibits or displays in galleries, museums and monuments.

(j) Special lighting needed for research.

(k) Task lighting for plant growth or maintenance, if it is equipped with an automatic 24–hour time switch that has program back–up capabilities that prevent the loss of the switch's program and time setting for at least 10 hours if power is interrupted.

(L) Exit way or egress illumination that is normally off.

(m) Task lighting specifically designed for primary use by visually impaired, for lip reading, and by senior citizens.

(n) Lighting for informational signs and exit signs, but excluding commercial displays.

Note: See s. Comm 63.1005 (38) for definition of informational sign and s. Comm 63.1052 for exit sign requirements.

(o) Display window lighting in retail facilities provided the display area is separated from the store sales area by opaque ceiling–height partitions.

(p) Lighting in dwelling units that provides complete independent living facilities for one or more persons including permanent provisions for living, sleeping, eating, cooking, and sanitation.

(q) In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.

(r) Lighting equipment that is for sale.

(s) Lighting demonstration equipment in lighting education facilities.

(4) LIGHTING FIXTURES THAT ALLOW SUBSTITUTION OF SOURCES. The watts of track and other lighting fixtures that allow the substitution of low efficacy sources for high efficacy sources without altering the wiring of the fixture shall be determined by this subsection or other method approved by the department.

(a) *Track and busway line–voltage lighting.* The wattage of line–voltage lighting track and plug–in busway that allow the addition and relocation, or both, of luminaries without altering the wiring of the system shall be the specified wattage of the luminaries included in the system with a minimum of 30 W/lin ft.

(b) *Low–voltage lighting systems.* The wattage of low–voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow the addition or relocation, or both, without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.

(c) *Incandescent medium base sockets.* The wattage for medium base fixtures shall be the listed lighting power capacity, in watts, of the fixture.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1046 Calculation of interior lighting power allowance. The interior lighting power allowance shall be calculated using one of the methods in s. Comm 63.1047, 63.1048 or 63.1049 as applicable.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1047 Complete building method. The complete building method may be used only on projects involving entire buildings where at least 80 percent of the areas of the building are the same type of use. Under this approach, the interior lighting power allowance is the lighting power density value in Table 63.1047 times the floor area of the entire building. Hotel, motel and residential buildings shall not use this method. Building uses that are not listed in Table 63.1047 shall be assigned the allowed lighting power density given under "All Others."

Table 63.1047
Complete Building Method
Lighting Power Density Values (Watts/ft^2)

Type of Use	Allowed Lighting Power Density
Banks and Financial Institutions	1.7
Correctional Housing	1.4
General Commercial and Industrial Work Buildings	1.2
Grocery Store	1.8
Industrial and Commercial Storage Buildings	0.8
Medical Buildings and Clinics	1.5
Office Building	1.5
Religious Worship, Auditorium, and Convention Centers	2.0
Restaurants	1.5
Retail and Wholesale Store	2.6
Schools	1.8
Theaters	1.5
All others	0.8

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1048 Area category method. Under the area category method, the interior lighting power allowance for the building is the sum of all allowed lighting powers for all areas in the building. The allowed lighting power for an area is the lighting power density in Table 63.1048 times the area. For purposes of the Area Category Method, an "Area" means all contiguous spaces that accommodate or are associated with a single one of the primary functions listed in Table 63.1048. Buildings with primary functions not listed in Table 63.1048 shall not use this method. Where areas are bounded or separated by interior partitions, the floor space occupied by those interior partitions shall not be included in any area. The area shall not include enclosed retail display windows with exempted lighting as described in s. Comm 63.1045 (3) (o). When the Area Category Method is used to calculate the interior lighting power allowance for an entire building, main entry lobbies, corridors, rest rooms, and support functions shall be treated as separate areas.

Table 63.1048
Area Category Method – Lighting Power Density Values (Watts/ft^2)

Primary Function	Allowed Lighting Power Density
Auditorium	2.0
Auto Repair	2.0
Bank/Financial Institution	1.8
Classrooms	2.0
Convention, Conference and Meeting Centers	1.6
Corridors, Rest Rooms and Support Areas	0.8
Detention Facilities	1.6
Dining	1.2
Exhibit	2.3
Storage Garage	0.2
General Commercial and Industrial Work	1.3
Grocery	2.0
Guest Room or Dorm Room	1.4
Hotel Function	2.3*
Industrial and Commercial Storage	0.6
Kitchen	2.2
Laboratory	3.3
Lobbies:	
Hotel Lobby	2.3*
Main Entry Lobby	1.6*
Malls, Arcades, and Atria	1.2*
Medical and Clinical Care	1.8
Office	1.6
Precision Commercial and/or Industrial Work	2.0
Religious Worship	2.2*
Retail Sales, Wholesale Showrooms	2.8
Theaters:	
Motion Picture	1.0
Performance	1.5*

*** Note to Table 63.1048:** The smallest of the following values may be added to the allowed lighting power listed in Table 63.1048 for ornamental chandeliers and sconces that are switched or dimmed on circuits different from the circuits for general lighting:

a. 1 watt per square foot times the area of the space in which the chandelier or sconce is used; or

b. The actual design wattage of the chandelier or sconce.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1049 Activity method. Under the activity method, the interior lighting power allowance for a building is determined by calculating a lighting power budget for each space in accordance with subs. (1) to (4) and summing them in accordance with sub. (5).

(1) The lighting power budget of each interior space shall be determined in accordance with the following equation:

LPB = A x UPD x AF

Where:

LPB = lighting power budget of the space, W

A = area of the space, ft^2

UPD = unit power density, W/ft^2 [Table 63.1049]

AF = area factor of the room [Figure 63.1049]

(a) The UPD shall be selected from Table 63.1049. For applications to areas or activities other than those given, select values for the most similar areas or activities. The UPD for a multifunctional space shall be based on the lowest UPD of any of the activities of the space.

(b) The area factor (AF) shall be determined from Figure 63.1049 based on the room area (Ar) and ceiling height. The room area shall be calculated from the inside dimensions of the room. Rooms of identical ceiling height and activities may be evaluated as a group. The AF of a group of rooms shall be determined from the average area of these rooms.

The following equation gives the formula used in developing Fig. 63.1049.

$$AF = 0.2 + 0.8(1/0.9^n)$$

Where:

$$n = \left[\frac{10.21(CH - 2.5)}{\sqrt{A_r}}\right] - 1$$

AF= Area factor

CH= Average ceiling height, ft.

A_r= Room area, ft^2

If AF < 1.0, then AF = 1.0

If AF > 1.8, then AF = 1.8

(2) For rooms serving multiple functions such as hotel banquet or meeting rooms and office conference or presentation rooms; an adjustment factor of 1.5 times the UPD may be used if a supplementary system is actually installed and meets all of the following conditions:

(a) The installed power for the supplementary system shall not be greater than 33 percent of the adjusted lighting power budget calculated for that space.

(b) Independent controls shall be installed for the supplementary system.

(3) In rooms containing multiple simultaneous activities, such as a large general office having separate accounting and drafting areas within the same room, the lighting power budget for the rooms shall be the weighted average of the activities in proportion to the areas being served.

(4) The activity of indoor sports areas shall be considered as an area 10 feet beyond the playing boundaries of the sport, not to exceed the total floor area of the indoor sports space less the spectator seating area.

(5) The interior lighting power allowance shall be calculated in accordance with the following equation. The interior lighting power allowance shall include a 0.20 W/ft^2 allowance for unlisted spaces.

$$ILPA = (LPB_1 + LPB_2 + ... + LPB_n) + (0.20\ W/ft^2 \times \text{unlisted space area})$$

Where:

ILPA= interior lighting power allowance, W

Unlisted space area = GLA – Σ(LS), ft^2

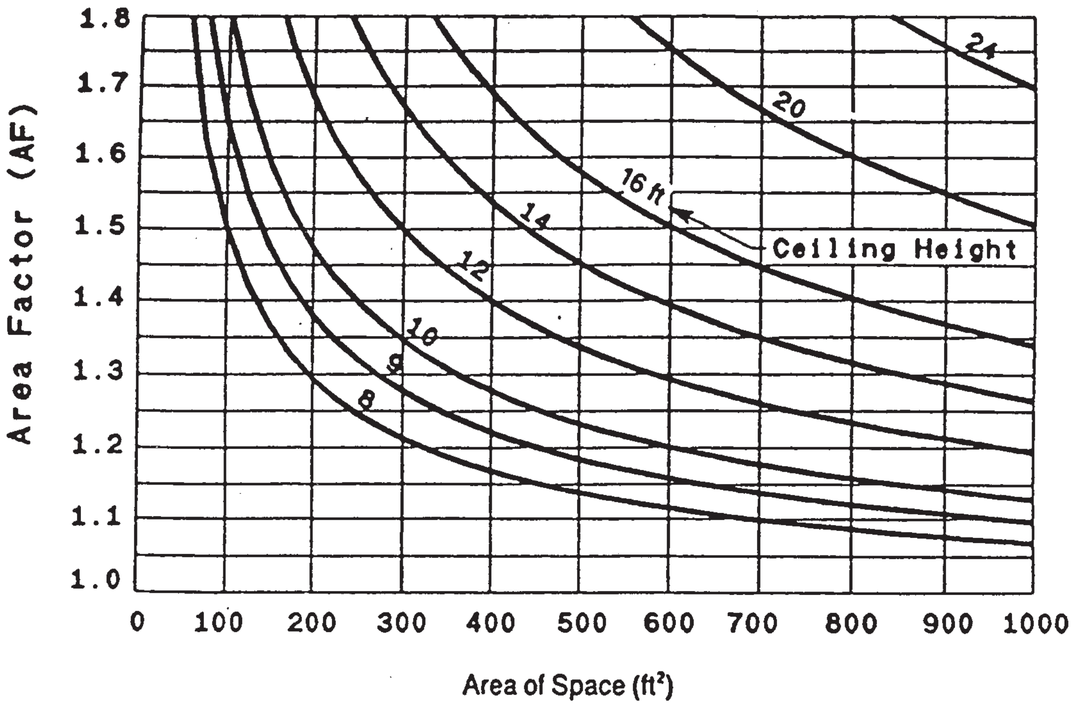
GLA= gross lighted area, ft^2

LPB= lighting power budget, W

LS= listed space

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Figure 63.1049 Area Factor



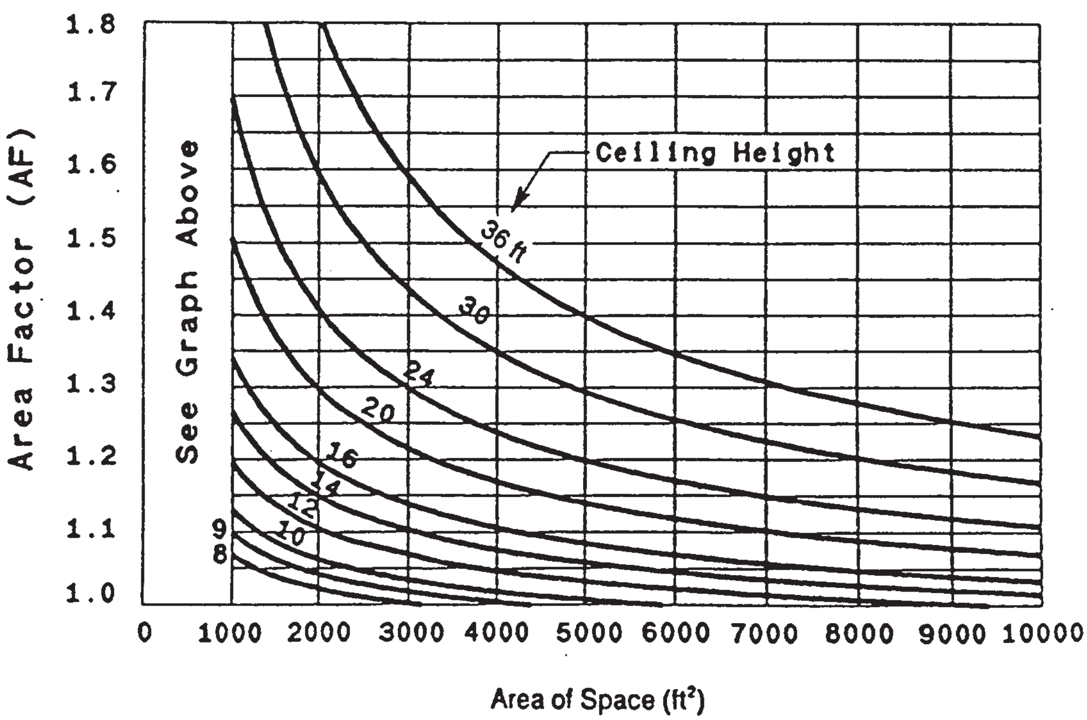


Table 63.1049
Unit Power Densities

Part a – Common Activity Areas

Activity/Area	UPD W/ft^2	Note
Auditorium	1.6	a
Corridor	0.8	b
Classroom/Lecture Hall	2.0	
Electrical/Mechanical Equipment Room		
General	0.7	b
Control Rooms	1.5	b
Food Service		
Fast Food/Cafeteria	1.3	
Leisure Dining	2.5	c
Bar Lounge	2.5	c
Kitchen	1.4	
Recreation/Lounge	0.7	
Stair		
Active Traffic	0.6	
Emergency Exit	0.4	
Toilet and Washroom	0.8	
Garage		
Auto and Pedestrian Circulation Area	0.3	
Parking Area	0.2	
Laboratory	3.0	
Library		
Audio/Visual	1.1	
Stack Area	1.5	
Card File and Cataloging	1.6	
Reading Area	1.9	
Lobby (General)		
Reception and Waiting	1.0	
Elevator Lobbies	0.8	
Atrium (Multistory)		
First Three Floors	0.7	
Each Additional Floor	0.2	
Locker Room and Shower	0.8	
Office Category 1 (*Enclosed offices, all open plan offices without partitions or with partitions* lower than 4.5 feet below the ceiling)*		
Reading, Typing and Filing	1.8	d
Drafting	2.6	d
Accounting	2.1	d
Office Category 2 (*Open plan offices 900 square feet or larger with partitions* 3.5 to 4.5 feet below the ceiling. Offices less than 900 square feet shall use Category 1)*		
Reading, Typing and Filing	1.9	b
Drafting	2.9	b
Accounting	2.4	b
Office Category 3 *(Open plan offices 900 square feet or larger with partitions* higher than 3.5 feet below the ceiling. Offices less than 900 square feet shall use Category 1)*		
Reading, Typing and Filing	2.2	b
Drafting	3.4	b
Accounting	2.7	b
Common Activity Areas		
Conference Meeting Room	1.8	a
Computer Office Equipment	2.1	
Filing, Inactive	1.0	
Mail Room	1.8	
Shop		
Machinery	2.5	
Electrical/Electronic	2.5	
Painting	1.6	
Carpentry	2.3	
Welding	1.2	
Storage and Warehouse		
Inactive Storage	0.3	
Active Storage, Bulky	0.3	
Active Storage, Fine	1.0	
Material Handling	1.0	
Unlisted Space	0.2	

* Not less than 90 percent of all work stations shall be individually enclosed with partitions of at least the height described.

Part b – Specific Buildings

Activity/Area	UPD W/ft^2	Note
Airport, Bus and Rail Station		
Baggage Area	1.0	
Concourse/Main Thruway	0.9	
Ticket Counter	2.5	
Waiting and Lounge Area	1.2	
Bank		
Customer Area	1.1	
Banking Activity Area	2.8	
Barber and Beauty Parlor	2.0	
Church, Synagogue, Chapel		
Worship/Congregational	2.5	
Preaching and Sermon	2.7	
Dormitory		
Bedroom	1.1	
Bedroom With Study	1.4	
Study Hall	1.8	

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Part b – Specific Buildings (Continued)

Activity/Area	UPD W/ft²	Note
Fire and Police Department		
Fire Engine Room	0.7	
Detention Dayroom	1.5	
Jail Cell	1.2	
Hospital/Nursing Home		
Corridor	1.3	b
Dental Suite/Examination/Treatment	1.6	
Emergency	2.3	
Laboratory	3.0	
Lounge/Waiting Room	0.9	
Medical Supplies	2.4	
Nursery	2.0	
Nurse Station	2.1	
Occupational Therapy/Physical Therapy	1.6	
Patient Room	1.4	
Pharmacy	1.7	
Radiology	2.1	
Surgical and O.B. Suites		
General Area	2.1	
Operating Room	7.0	
Recovery	2.3	
Hotel/Conference Center		
Banquet Room/Multipurpose	2.4	a
Bathroom/Powder Room	1.2	
Guest Room	1.4	
Public Area	1.2	
Exhibition Hall	2.6	
Conference/Meeting	1.8	a
Lobby	1.9	
Reception Desk	2.4	
Laundry		
Washing	0.9	
Ironing and Sorting	1.3	
Museum and Gallery		
General Exhibition	1.9	
Inspection/Restoration	3.9	
Storage (Artifacts)		
Inactive	0.6	
Active	0.7	
Post Office		
Lobby	1.1	
Sorting and Mailing	2.1	
Service Station/Auto Repair	1.0	
Theater		
Performance Arts	1.5	
Motion Picture	1.0	
Lobby	.1.5	
Retail Establishments		
Merchandising and Circulation Area – Applicable to all lighting, including accent and display lighting, installed in merchandising and circulation areas	2.2	g
Mall Concourse	1.4	
Retail Support Areas		
Tailoring	2.1	
Dressing/Fitting Rooms	1.4	

Part c – Indoor Athletic Areas[e,f]

Activity/Area	UPD W/ft²
Seating Area, All Sports	0.4
Badminton	
Club	0.5
Tournament	0.8
Basketball/Volleyball	
Intramural	0.8
College	1.3
Professional	1.9
Bowling	
Approach Area	0.5
Lanes	1.1
Boxing or Wrestling (platform)	
Amateur	2.4
Professional	4.8
Gymnasium	
General Exercising and Recreation Only	1.0
Handball/Raquetball/Squash	
Club	1.3
Tournament	2.6
Hockey, Ice	
Amateur	1.3
College or Professional	2.6
Skating Rink	
Recreational	0.9
Exhibition/Professional	2.6
Swimming	
Recreational	0.9
Exhibition	1.5
Under Water	1.0
Tennis	
Recreational (Class III)	1.3
Club/College (Class II	1.9
Professional (Class I)	2.6
Tennis, Table	
Club	1.0
Tournament	1.6

Notes for Table 63.1049:

a A 1.5 power adjustment factor is applicable for multifunctional spaces.

b Area factor of 1.0 shall be used for these spaces.

c UPD includes lighting power required for clean–up purpose.

d Area factor shall not exceed 1.55.

e Area factor of 1.0 shall be used for all indoor athletic spaces.

f Facilities that are used for more than one level of play shall have appropriate switching between the different levels specified in Table 63.1049. Dimming shall not be used to accomplish the reduction in illumination. The illumination at all levels shall be uniform.

g Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or 0.8 W/ft^2 times the floor area of the display area shall be added to the interior lighting power determined in accordance with this line item.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1050 Lighting controls that must be installed. (1) AREA CONTROLS. (a) Except as provided in pars. (c) and (d), each interior area enclosed by ceiling–height partitions shall have an independent switching or control device. This switching or control device shall comply with all of the following:

1. Be readily accessible.

2. Located so that a person using the device can see the lights or area controlled by that switch, or so that the area being lit is annunciated.

3. Be manually operated, or automatically controlled by an occupant–sensing device that meets the requirements of s. Comm 63.1051 (4).

(b) Other devices may be installed in conjunction with the switching or control device required by par. (a) provided that they:

1. Permit the required switching or control device to override the action of the other devices; and

2. Reset the mode of any automatic system to normal operation without further action.

(c) Up to one–half watt per square foot of lighting in any area within a building that must be continuously illuminated for reasons of building security or emergency egress are exempt from par. (a) if:

1. The area is designated a security or emergency egress area on the plans and specifications submitted to the department; and

2. The area is controlled by switches accessible only to authorized personnel.

(d) Public areas with switches that are accessible only to authorized personnel are exempt from the area control requirements of par. (a).

(2) CONTROLS TO REDUCE LIGHTING. (a) Except as provided in par. (b), the general lighting of any enclosed interior space 100 square feet or larger in which the connected lighting load exceeds 1.2 watts per square foot for the space as a whole, and that has more than one light source or luminaire, shall be controlled so that the load for the lights may be reduced by at least one–half while maintaining a reasonably uniform level of illuminance throughout the area. A reasonably uniform reduction of illuminance shall be achieved by one of the following:

1. Controlling all lamps or luminaires with dimmers.

2. Dual switching of alternate rows of luminaires, alternate luminaires, or alternate lamps.

3. Switching the middle lamps of three lamp luminaires independently of the outer lamps.

4. Switching each luminaire or each lamp.

5. Other methods approved by the department.

(b) The requirements of par. (a) do not apply to any of the following:

1. Lights in areas that are controlled by an occupant–sensing device that meets the requirements of s. Comm 63.1051 (4).

2. Lights in corridors.

3. Lights in areas that are controlled by an automatic time switch control device that has a timed manual override available at each switch location required by sub. (1), and that controls only the lights in that area enclosed by ceiling height partitions.

(3) DAYLIT AREAS. (a) Except as provided in par. (b), daylit areas in any interior enclosed space greater than 250 square feet and a lighting density more than 1.2 W/ft^2 shall meet the requirements of subds. 1. and 2.

1. Such areas shall have at least one control that complies with all of the following:

a. Controls only luminaires in the daylit area.

b. Controls at least 50% of the lamps or luminaires in the daylit area, in a manner described in sub. (2) (a) 1. to 5., independently of all other lamps or luminaires in the enclosed space. The other luminaires in the enclosed space may be controlled in any manner allowed by sub. (2) (a) 1. to 5.

2. Such areas shall have controls that control the luminaires in each vertically daylit area separately from the luminaires in each horizontally daylit area.

(b) The requirements of this subsection do not apply to any of the following:

1. Daylit areas where the effective aperture of glazing is equal or less than 0.1 for vertical glazing and 0.01 for horizontal glazing.

2. Daylit areas where existing adjacent structures or natural objects obstruct daylight to the extent that effective use of daylighting is not feasible.

(4) SHUT–OFF CONTROLS. (a) Except as provided in par. (b), for every floor or metered space, all interior lighting systems shall be equipped with at least one separate automatic control to shut off the lighting. This automatic control shall meet the requirements of s. Comm 63.1051 and may be an occupancy sensor, automatic time switch, or other device capable of automatically shutting off the lighting.

(b) The requirements of par. (a) do not apply to any of the following:

1. Buildings or separately metered spaces of less than 5,000 square feet of space.

2. Where the system is serving an area that must be continuously lit, or where the use of the space prohibits the use of a preestablished lighting program.

Note: Service equipment rooms as specified in NEC 110–26 (3) (d) are covered by this exception.

3. In residential buildings, hotels and motels, lighting of corridors, guest rooms, and lodging quarters.

4. Up to one–half watt per square foot of lighting in any area within a building that must be continuously illuminated for reasons of building security or emergency egress, if:

a. The area is designated a security or emergency egress area on the plans and specifications submitted to the department; or

b. The area is controlled by switches accessible only to authorized personnel.

(c) If an automatic time switch control device is installed to comply with par. (a), it shall incorporate an override switching device that complies with all of the following:

1. Is readily accessible.

2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.

3. Is manually operated.

4. Allows the lighting to remain on for no more than two hours when an override is initiated.

5. Controls an area not exceeding 20,000 square feet in malls, auditoriums, gymnasiums, single tenant retail spaces, factories, warehouses and arenas, and not exceeding 5,000 square feet for other uses.

6. Two overrides may be provided for a maximum of 10,000 square feet if the lighting is dual level controlled in accordance with sub. (2) (a) 2. or 3.

(5) DISPLAY LIGHTING CONTROLS. Display lighting shall be separately switched on circuits that are 20 amps or less.

(6) EXTERIOR LIGHTING CONTROLS. Except in lighting in parking garages, tunnels, and large covered areas that require illumination during daylight hours, exterior lighting shall be controlled by a directional photocell or astronomical time switch that automatically turns off the exterior lighting when daylight is available. Time switches shall be equipped with back–up provisions to keep time during a power outage of 10 hours or more.

(7) HOTEL AND MOTEL GUEST ROOM CONTROLS. Hotel and motel guest rooms or suites excluding bathrooms shall have one or more master switches at the main entry door or at the entry door of each room that turn off all permanently wired lighting fixtures and switched receptacles in the room or suite.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1051 Requirements for lighting control devices. Automatic time switch control devices, occupant–sensing devices, automatic daylighting control devices, lumen maintenance control devices, or interior photocell sensor devices that are used to justify a wattage reduction factor in the calculation of the actual internal lighting power in s. Comm 63.1045 (2) shall be approved for compliance with all of the applicable requirements of subs. (1) to (7) and shall be installed in compliance with sub. (8). Approval of devices shall be obtained via the material approval program in accordance with ch. Comm 61 or via manufacturer certification to the California Energy Commission.

Note: Information on California Energy Commission Certification may be obtained from the California Energy Commission, Energy Efficiency and Demand Analysis Division, 1516 9th Street, MS–25, Sacramento, CA 95814, (916) 654–4080. A list of approved control devices is available on the internet at ftp://38.144.192.166/pub/efftech/appliance/.

(1) ALL DEVICES: INSTRUCTIONS FOR INSTALLATION AND CALIBRATION. The manufacturer shall provide step–by–step instructions for installation and start–up calibration of the device.

(2) ALL DEVICES: STATUS SIGNAL. The device shall have an indicator that visibly or audibly informs the device operator that it is operating properly, or that it has failed or malfunctioned, except for photocell sensors or other devices where a status signal is infeasible because of inadequate power.

(3) AUTOMATIC TIME SWITCH CONTROL DEVICES. Automatic time switch control devices shall comply with all of the following:

(a) Be capable of programming different schedules for weekdays and weekends.

(b) Incorporate an automatic "holiday shut–off" feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation.

(c) Have program backup capabilities that prevent the loss of the device's program and time setting for at least 10 hours if power is interrupted.

(4) OCCUPANT–SENSING DEVICES. Occupant–sensing devices shall be capable of automatically controlling all the lights in an area no more than 30 minutes after the area has been vacated. In addition, ultrasonic and microwave devices shall have a built–in mechanism that allows calibration of the sensitivity of the device to room movement in order to reduce the false sensing of occupants and shall comply with either par. (a) or (b), as applicable:

(a) If the device emits ultrasonic radiation as a signal for sensing occupants within an area, the device shall comply with all of the following:

1. Have had an Initial Report submitted to the Bureau of Radiological Health, Federal Food and Drug Administration, under 21 CFR 1002.10.

2. Emit no audible sound.

3. Not emit ultrasound in excess of the decibel (dB) values given in Table 63.1051 measured no more than 5 feet from the source on axis.

Table 63.1051
Maximum Ultrasound Emissions

Midfrequency of Sound Pressure Third–Octave Bank (in kHz)	Maximum dB Level within Third–Octave B and (in dB reference 20 micropascals)
less than 20	80
20 or more to less than 25	105
25 or more to less than 31.5	110
31.5 or more	115

(b) If the device emits microwave radiation as a signal for sensing occupants within area, the device shall comply with all of the following:

1. Comply with all applicable provisions in 47 CFR Part 5, and have an approved Federal Communications Commission identification number that appears on all units of the device and that has been submitted to the department.

2. Not emit radiation in excess of 1 milliwatt per square centimeter measured at no more than 5 centimeters from the emission surface of the device.

3. Have permanently affixed to it installation instructions recommending that it be installed at least 12 inches from any area normally used by room occupants.

(5) AUTOMATIC DAYLIGHTING CONTROL DEVICES. Automatic daylighting control devices shall comply with all of the following:

(a) Be capable of reducing the light output of the general lighting of the controlled area by at least one–half while maintaining a uniform level of illuminance throughout the area.

(b) If the device is a dimmer, provide electrical outputs to lamps for reduced flicker operation through the dimming range and without causing premature lamp failure.

(c) If the device is a stepped dimming system, incorporate time delay circuits to prevent cycling of light level changes of less than three minutes.

(d) If the device uses step switching with separate "on" and "off" settings for the steps, have sufficient separation or deadband of "on" and "off" points to prevent cycling.

(e) Have provided by the manufacturer step–by–step instructions for installation and start–up calibration to design foot–candle levels.

(6) LUMEN MAINTENANCE CONTROL DEVICES. Lumen maintenance control devices shall comply with all of the following:

(a) Be capable of reducing the light output of the general lighting of the controlled area by at least 30% while maintaining a uniform illuminance throughout the area.

(b) Provide electrical outputs to lamps for reduced flicker operation through the dimming range and without causing premature lamp failure.

(c) Incorporate an alarm, either audible or visible, to announce when a specified setpoint of lumens or watts has been reached.

(d) Have provided by the manufacturer step–by–step instructions for installation and start up calibration to design foot–candle levels.

(7) INTERIOR PHOTOCELL SENSOR DEVICES. Interior photocell sensors shall not have a mechanical slide cover or other device that permits easy unauthorized disabling of the control, and shall not be incorporated into a wall–mounted occupant–sensing device.

(8) INSTALLATION IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. If an automatic time switch control device, occupant–sensing device, automatic daylighting control device, lumen maintenance control device, or interior photocell sensor device is installed, it shall comply with both pars. (a) and (b).

(a) The device shall be installed in accordance with the manufacturer's instructions.

(b) Automatic daylighting control devices and lumen maintenance control devices shall:

1. Be installed so that automatic daylighting control devices control only luminaries within the daylit area; and

2. Have photocell sensors that are either ceiling mounted or located so that they are accessible only to authorized personnel, and that are located so that they maintain adequate illumination in the area according to the designer's or manufacturer's instructions.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1052 Exit signs. Exit signs shall have an installed wattage of 20 watts or less.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 63.1053 Reduction of single lamp ballasts. The following luminaries located within the same room shall be tandem wired or provided with three–lamp ballasts:

(1) One–lamp or three–lamp fluorescent luminaries recess–mounted within 10 feet center–to–center of each other.

(2) One–lamp or three–lamp fluorescent luminaries pendant–or surface–mounted within one foot edge–to–edge of each other.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Part 6 — Nondepletable Energy Source

Comm 63.1060 Buildings utilizing solar, geothermal, wind or other nondepletable energy source. Any building, or portion thereof, utilizing any nondepletable energy source shall meet all the requirements in IECC section 806.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Part 7 — System Analysis Design

Comm 63.1070 System analysis design. A building designed using system analysis design shall comply with IECC section 806.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Appendix 6

Larry Spielvogel

From: "Mark Lentz" <mlentz@lentzengineering.com>
To: "Dahmen, Randy" <rdahmen@commerce.state.wi.us>
Sent: Monday, November 21, 2005 9:32 PM
Subject: Re: ASHRAE Standard 901 enforcement by Safety & Buildings

Dear Randy,

We may not always agree, and I still think you are wrong, but I do appreciate and respect your perspective. I didn't raise the question to antagonize you, I really wanted to know.

As always, thank you very much for taking the time to respond.

Mark Lentz

Dahmen, Randy wrote:

>However, ASHRAE 90.1, specifically ONLY those portions that have been
>"incorporated" into the WI Commercial Bldg Code are clearly defined in all
>sections of the code, as already delineated in my previous email. As
>stated in the code The following standards are hereby incorporated by
>reference into this code: The sections I've indicated in my earlier email
>clearly reference ASHRAE 90.1. We both know there are multiple versions of
>ASHRAE 90.1, just as there are many versions of ASHRAE Fundamentals (ie.
>every 4 yrs). This section defines which of the many updates of the
>standard the code basis its requirements. Comm 63.0900 specifically states
>ASHRAE 90.-1989. This is to differentiate it from versions in say 2001,
>2004, etc. Randy Dahmen
>
>
>
>
>From: Mark Lentz [mailto:mlentz@lentzengineering.com]
>Sent: Monday, November 21, 2005 4:39 PM
>To: Dahmen, Randy
>Subject: Re: ASHRAE Standard 901 enforcement by Safety & Buildings
>
>
>Dear Randy,
>
>I'm having a problem with your interpretation. The code states the
>following, verbatim.
>
>"COMM 63.0900 Referenced Standards. This is a department rule in addition to
>the requirements in IEEC chapter 9: The following standards are hereby
>incorporated by reference into this code:
>(1) ASHRAE Standard 90.1-89, Energy efficient Design of New Buildings Except
>Low Rise Residential Buildings."
>

>I understand how the code is organized, and I recognize the points you made.
>However, this provision of the code is short, sweet, and completely
>unambiguous. By incorporating the Standard by reference, the code is
>clearly and specifically adopting all of the requirements of ASHRAE Standard
>90.1. Since IECC and COMM 63 are derived from ASHRAE Standard 90.1, in
>doing so, it is stating that everything not specifically covered by the IECC
>or COMM 63 is referred back to the requirements of ASHRAE Standard 90.1-89
>(recognizing that the standard reference is 15 years out of date, too).
>
>In COMM 63, this provision is not a part of any sub-element requirement. As
>a requirement, it stands by itself. It does not indicate than only portions
>of the Standard are adopted. The way I read it, this makes ASHRAE Standard
>90.1-89 enforceable in full, with only those elements which are specifically
>modified within the code permitting deviation. And there, I would
>anticipate that that the most rigorous requirements to govern.
>
>I don't see any other way to interpret it.
>
>Mark Lentz
>
>Dahmen, Randy wrote:
>
>
>Please note the context that ASHRAE 90.1 is NOT adopted in its entirety for
>
>use with the WI Code. Only specific portions were incorporated, and their
>
>adoption did not make the code any more restrictive, which you seem to
>
>imply. For your reference, yes, you are reading a portion of the code and
>
>attempting to incorporate it to all requirements, when clearly that is NOT
>
>how the WI Commercial Building Code reads or is to be applied.
>
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>
>Comm 63.1016 System standards option. To comply with the system standards
>
>for building envelope thermal performance, the building shall comply with
>
>section 8.6 of ASHRAE standard 90.1 or with the system analysis design
>
>specified in IECC section 806 applied to the thermal envelope alone.
>

>Building site climate data shall be determined using Wisconsin division of
>
>state energy statistics or other source acceptable to the department.
>
>
>
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>
>
>
>Note that this had nothing to do with the project which you reference.
>
>Building Envelope compliance was shown using Comcheck-EZ not IECC 806.
>
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>
>Comm 63.1019(3)(a)1.c. For elements with internal metallic structures
>
>bonded on one or both sides to a metal skin or covering, the calculation
>
>procedure specified in the ASHRAE Handbook of Fundamentals, or specified in
>
>ASHRAE standard 90.1, or other procedure acceptable to the department shall
>
>be used to include the effects of thermal bridges in metal construction.
>
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>
>Note that this was fully addressed with the project which you reference via
>
>Comcheck-EZ.
>
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>
>Comm 63.1020 Minimum equipment efficiencies. (1) Space heating or cooling
>
>equipment that is not covered by 10 CFR Part 430, Energy Conservation
>
>Program for Consumer Products, shall have a minimum efficiency at the

>
>specified rating conditions not less than the values given in ASHRAE 90.1,
>
>section 10.4.1.
>
>
>
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>
>Note that these are manufacturing requirements for the minimum efficiency of
>
>HVAC equipment as defined. Note that this was fully addressed with the
>
>project.
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>
>Comm 63.1020(3) Compliance with minimum efficiency requirements specified
>
>for HVAC equipment shall include compliance with part-load requirements
>
>where indicated as well as standards for full-load requirements. The
>
>part-load efficiency shall be determined as specified in ASHRAE 90.1.
>
>
>
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>
>Note that application of ASHRAE 90.1 was used for the determination of part
>
>load efficiencies ONLY. Note that this was fully addressed with the project.
>
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>
>Comm 63.0900 Referenced standards. This is a department rule in addition to
>
>the requirements in IECC chapter 9: The following standards are hereby
>

>incorporated by reference into this code:
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>
>   (1) ASTM C177-85, Test method for steady-state heat flux
>
>measurements and thermal transmission properties by means of the
>
>guarded-hot-plate apparatus.
>
>
>
>
>
>
>
>   (2) ASTM C335-84, Test method for steady state heat transfer
>
>properties of horizontal pipe insulation.
>
>
>
>
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>
>
>   (3) ASHRAE Standard 90.1-89, Energy Efficient Design of New
>
>Buildings, Except Low Rise Residential Buildings.
>
>
>
>   (4) National Concrete Masonry Association (NCMA) Evaluation
>
>Procedures of Integrally-Insulated Concrete Masonry Walls, January 1, 1999.
>
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>
>By no means did I exaggerate in any way or form. You can see for yourself
>
>that WI Commercial Building Code adopts specific portions of the ASHRAE 90.1
>
>Standard. The WI Commercial Building Code does NOT adopt ASHRAE 90.1, in

>
>its entirety, which is what I believe you seem to be implying with your
>
>discovery of a "gem".
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>
>Randall R. Dahmen, PE
>
>Commercial Building Inspector, Code Consultant
>
> & Plan Reviewer
>
>WI Dept. of Commerce, Safety & Buildings Division
>
>201 W. Washington Av. 4th Floor
>
>P.O. Box 7162
>
>Madison, WI 53707-7162
>
>Ph: 608-266-3162
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>From: Mark Lentz [mailto:mlentz@lentzengineering.com
><mailto:mlentz@lentzengineering.com>]
>
>Sent: Monday, November 21, 2005 12:58 PM
>
>To: Dahmen, Randy
>
>Subject: ASHRAE Standard 901 enforcement by Safety & Buildings
>
>
>
>Dear Randy,
>
>A while back, when you were looking at the Northland Pines High School

>
>design documents, you advised me that it is not B&S's responsibility to
>
>enforce the requirements of ASHRAE Standard 90.1. I took you at your word.
>
>
>
>However, I ran into a little jewel while looking at the code for another
>
>reference. You might want to review COMM 63.0900. It states, "The
>
>following Standards are hereby incorporated by reference into this code:
>
>(1) ASHRAE Standard 90.1-1989....."
>
>
>
>I know that Standard 90.1 compliance was required at the state level by
>
>federal statute. It does appear to me that Wisconsin is in compliance with
>
>that federal statute and that ASHRAE Standard 90.1 compliance and
>
>enforcement ARE BOTH required by the Wisconsin code.
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>
>Am I reading this incorrectly?
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>
>Mark Lentz
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Chapter Comm 64

HEATING, VENTILATING AND AIR CONDITIONING

Subchapter I — Purpose, Scope, Application and Compliance
Comm 64.0001 Purpose and scope.
Comm 64.0002 Application.
Comm 64.0003 Compliance.
Comm 64.0004 Approval of drawings and specifications.

Subchapter II — Changes, Additions or Omissions to the International Mechanical Code (IMC)
Comm 64.0100 Changes, additions or omission to the International Mechanical Code® (IMC).
Comm 64.0101 General.
Comm 64.0102 Applicability.
Comm 64.0202 Definitions.
Comm 64.0300 Specific criteria for operating rooms and autopsy rooms.
Comm 64.0301 General regulations.
Comm 64.0304 Installation.
Comm 64.0306 Access and service space.
Comm 64.0309 Temperature control.
Comm 64.0312 Heating and cooling load calculations.
Comm 64.0313 Other requirements.
Comm 64.0401 Ventilation.
Comm 64.0402 Natural ventilation.
Comm 64.0403 Mechanical ventilation.
Comm 64.0404 Enclosed parking garages.
Comm 64.0501 Required systems.
Comm 64.0502 Required systems.
Comm 64.0506 Commercial kitchen grease ducts and exhaust equipment.
Comm 64.0507 Capacity of hoods.
Comm 64.0603 Duct construction and insulation.
Comm 64.0604 Insulation.
Comm 64.0605 General.
Comm 64.0606 Smoke detection system control.
Comm 64.0702 Inside air.
Comm 64.0710 Opening location and protection.
Comm 64.0801 Chimneys and vents.
Comm 64.0900 Specific criteria for duct humidifiers.
Comm 64.0918 Forced–air warm–air furnaces.
Comm 64.1001 Boilers, water heaters and pressure vessels.
Comm 64.1101 Refrigeration.
Comm 64.1201 Hydronic piping.
Comm 64.1300 Fuel oil piping and storage.
Comm 64.1500 Referenced standards.
Comm 64.1600 Appendices.

Note: Chapter Comm 64 as it existed on June 30, 2002 was repealed and a new chapter Comm 64 was created, Register December 2001 No. 552, effective July 1, 2002.

Note: Chapter ILHR 64 was renumbered to be Chapter Comm 64 under s. 13.93 (2m) (b) 1., Stats., and corrections made under s. 13.93 (2m) (b) 7., Stats., Register, September, 1998, No. 513.

Note: Chapter ILHR 64 was revised in December, 1995 effective April 1, 1996. On April 6, 1996 the department of industry, labor and human relations published an emergency rule stating that the effective date of the December, 1995 rule version was delayed. A permanent rule was adopted in December, 1996 stating that the revised text of ch. ILHR 64, as published, would be effective April 1, 1997.

Note: Chapter Ind 59 as it existed on December 31, 1975 was repealed and a new chapter Ind 64 was created effective January 1, 1976. Chapter Ind 64 was renumbered to be chapter Comm 64 effective January 1, 1984. Chapter ILHR 64 as it existed on March 31, 1997 was repealed and a new chapter ILHR 64 was created effective April 1, 1997. Corrections made under s. 13.93 (2m) (b) 1. and 7., Stats., Register, March, 1997, No. 495.

Subchapter I — Purpose, Scope, Application and Compliance

Comm 64.0001 Purpose and scope. (1) PURPOSE. (a) The purpose of this chapter is to regulate the design, installation, operation and maintenance of heating, ventilating and air conditioning systems in buildings and structures as specified in ch. Comm 61.

(b) The installation of fuel gas distribution piping and equipment, fuel gas–fired appliances and fuel gas–fired appliance venting systems shall be regulated by ch. Comm 65.

(c) Fixed electric space heating equipment shall comply with ch. Comm 16.

(2) SCOPE. The scope of this chapter is as specified in s. Comm 61.02.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0002 Application. (1) GENERAL. The application of this chapter is as specified in s. Comm 61.03 and as modified in this section.

(2) APPLICABILITY. All heating, ventilating and air conditioning systems shall be designed, installed, maintained and operated so as to provide the service and results required within the provisions of this chapter. The minimum requirements established in each part of this chapter shall be complied with as they apply to the structures and facilities covered in the IBC.

Note: The administrative rules pertaining to energy conservation, ch. Comm 63, may be applied retroactively to existing buildings and structures.

(3) EXISTING SYSTEMS. The provisions for existing systems shall be as specified in pars. (a) and (b).

(a) *Additions.* 1. The provisions of this chapter shall apply to all additions to existing buildings and structures as specified in s. Comm 61.03.

2. Except when an existing heating, ventilating and air conditioning system is extended to serve an addition, existing system components are not required to be replaced if the provisions in this chapter are met within the addition.

(b) *Alterations.* 1. The provisions of this chapter shall apply to all alterations in any building or structure which affect the replacement of major equipment as specified in s. Comm 61.03.

2. When an existing heating, ventilating and air conditioning system serves a remodeled or altered space that has not undergone a change in occupancy classification, the existing system components are not required to be replaced if the provisions in this chapter that applied to the original construction of the space are met.

Note: "Occupancy classification" refers to the entries in Table 64.0403.

Note: Compliance with this chapter shall not constitute assurance of proper installation or operation of the heating, ventilating and air conditioning system. This chapter is not to be used as a design manual, but it is established as a minimum standard for safety, health and general welfare of the public.

Note: Maintenance and repair to existing equipment when there is no change to the building or occupancy, is considered an alteration.

(4) RETROACTIVITY. Retroactivity shall apply as specified in s. Comm 61.03.

(5) CONFLICTS. Conflicts between rules and other requirements shall apply as specified in s. Comm 61.03.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0003 Compliance. All buildings and structures shall comply with the IMC and the changes, additions or omissions under subch. II.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0004 Approval of drawings and specifications. All drawings and specifications shall be submitted to the department in accordance with the provisions of subch. III of ch. Comm 61.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Subchapter II — Changes, Additions or Omissions to the International Mechanical Code (IMC)

Comm 64.0100 Changes, additions or omission to the International Mechanical Code® (IMC). Changes, additions or omission to the international mechanical code are specified in this subchapter and are rules of the department and are not requirements of the IMC.

Note: This code subchapter is numbered to correspond to the numbering used within the model code; i.e., s. Comm 64.0102 refers to section IMC 102.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0101 General. (1) ADMINISTRATION. (a) The requirements in IMC section 101 are not included as part of this chapter.

(b) The requirements in IMC sections 102.1, 102.2, 102.4 to 102.7 and 102.9 are not included as part of this chapter.

(2) SCOPE. The requirements of IMC sections 103 to 107, 108.1 to 108.6 and 109 are not included as part of this chapter.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0102 Applicability. This is a department rule in addition to the requirements in IMC section 102.3:

(1) The designer or installer shall provide the owner with written instructions for the operation and maintenance of the system and equipment. An operating and maintenance manual shall be provided to the building owner or operator. The manual shall include basic data relating to the operation and maintenance of heating, ventilating and air conditioning (HVAC) systems and equipment.

(2) Required routine maintenance actions shall be clearly identified. Where applicable, HVAC controls information such as diagrams, schematics, control sequence descriptions, and maintenance and calibration information shall be included.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0202 Definitions. (1) ADDITIONS. These are department definitions in addition to the definitions in IMC section 202:

(a) "Air change" means the introduction of new, cleaned or recirculated air to a space.

(b) "Air change rate" means airflow in volume units per hour divided by the building space volume in identical volume units.

(c) "DHFS" means the department of health and family services.

(d) "Spot heating" means to provide heat to raise the air temperature to the required minimum in the immediate area of the occupants.

(2) SUBSTITUTIONS. Substitute the following meanings for the corresponding definitions in IMC section 202:

(a) "Approved" means acceptable to the department.

(b) "Unusually tight construction" has the meaning given in s. Comm 65.0201.

Note: Section Comm 65.0201 reads: ' "Unusually tight construction" means the total area of outdoor openings is less than 3% of the floor area of the space in which equipment is located.'

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–139: r. (2) (b), renum. (2) (c) to be (2) (b) Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0300 Specific criteria for operating rooms and autopsy rooms. This is a department rule in addition to the requirements in IMC chapter 3: In operating rooms of hospitals and ambulatory surgery centers rooms and autopsy rooms, the bottoms of ventilation supply and return openings shall be at least 3 inches above the floor.

History: CR 01–135: cr. Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0301 General regulations. (1) ENERGY UTILIZATION. This is a department informational note to be used under IMC section 301.2:

Note: See ch. Comm 63 for additional requirements.

(2) LISTED AND LABELED. Substitute the following wording for the requirements in IMC section 301.4:

(a) *General.* All appliances regulated by this chapter shall be listed and labeled as specified in this chapter, unless approved by the department in accordance with par. (b) or the product approval criteria in s. Comm 61.60.

(b) *Unlisted equipment.* The department may approve an installation of unlisted equipment after receipt of all of the following:

1. A statement from the equipment manufacturer indicating the national standard with which the equipment complies.

2. The results of a test conducted by a Wisconsin registered engineer on the output and safety controls in accordance with the national standard used by the manufacturer.

(3) ELECTRICAL. Substitute the following wording for the requirements in IMC section 301.7: Electrical wiring, controls and connections to equipment and appliances regulated by this chapter shall be in accordance with ch. Comm 16.

(4) PLUMBING CONNECTIONS. Substitute the following wording for the requirements in IMC section 301.8: Potable water supply and building drainage system connections to equipment and appliances regulated by this chapter shall be in accordance with chs. Comm 81 to 87.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–139: r. and recr. (2) (a) and (b) Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0304 Installation. This is a department informational note to be used under IMC section 304.2:

Note: See s. Comm 61.03 (2) for clarification on the application of different requirements and where the most restrictive requirements apply.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0306 Access and service space. This is a department exception to the requirements in IMC section 306.6: These provisions do not apply when the installation consists of fans only.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0309 Temperature control. Substitute the following wording for the requirements and exception in IMC section 309:

(1) HEATING SYSTEM DESIGN. Except as provided in sub. (2) or (3), the heating system shall be designed and operated to maintain a temperature of not less than that shown in Table 64.0403 at 3 feet above the floor within the occupied space during occupied periods.

(2) SPOT HEATING. Spot heating may be used to heat individual fixed work stations in industrial buildings in lieu of heating the entire space as specified in sub. (1), provided the inside design temperature at the fixed work station is at least 60°F.

(3) SEASONAL OCCUPANCIES. When approved by the department, heating requirements may be waived, but not ventilation required by this chapter, during the period of May 15 through September 15 for the following or similar occupancies: drive–in eating places, club houses, outdoor toilets, camp lodge buildings, canning factories and migrant labor camps.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–135: am. (1) Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0312 Heating and cooling load calculations. This is a department informational note to be used under IMC section 312:

Note: For design parameters in the IECC refer to ch. Comm 63 or IECC section 803.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0313 Other requirements. These are department rules in addition to the requirements in IMC chapter 3:

(1) BALANCING, FINAL TEST REQUIRED. Every heating, ventilating and air conditioning system shall be balanced upon installation. The person or agency responsible for balancing of the ventilating system shall document in writing the amount of outdoor air being provided and distributed for the building occupants and any other specialty ventilation. The document shall be retained at the site and shall be made available to the department upon request.

(a) Air systems shall be balanced in a manner to minimize losses from damper throttling by first adjusting fan speed then adjusting dampers to meet design flow conditions. Balancing procedures shall be acceptable to the department. Damper throttling alone may be used for air system balancing with fan motors of 1 hp or less, or if throttling results in no greater than 1/3 hp fan horsepower draw above that required if the fan speed were adjusted.

(b) Either of the following test methods shall be used:

1. Hydronic systems shall be balanced in a manner to minimize valve throttling losses by first trimming the pump impeller or adjusting the pump speed then adjusting the valves to meet design flow conditions.

2. Valve throttling alone may be used for hydronic system balancing under any of the following conditions as specified in subd. 2. a. to d.

a. Pumps with pump motors of 10 hp or less.

b. If throttling results in no greater than 3 hp pump horsepower draw for pumps of 60 hp or less, or no greater than 5% of pump horsepower draw for pumps greater than 60 hp, above that required if the impeller were trimmed.

c. To reserve additional pump pressure capability in open circuit piping systems subject to fouling. Valve throttling pressure drop shall not exceed that expected for future fouling.

d. Where it can be shown that throttling will not increase overall building energy costs.

Note: National Environmental Balancing Bureau (NEBB) Procedural Standards, the Associated Air Balance Council (AABC) National Standards, the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), or equivalent balancing procedures are acceptable to the department.

(2) BALANCING, PROPER WORKING CONDITION. HVAC control systems shall be tested to assure that control elements are calibrated, adjusted and in proper working condition.

(3) BALANCING, OPERATING AND MAINTENANCE MANUAL. An operating and maintenance manual shall be provided to the building owner or operator. The manual shall include basic data relating to the operation and maintenance of HVAC systems and equipment. Required routine maintenance actions shall be clearly identified. Where applicable, HVAC controls information such as diagrams, schematics, control sequence descriptions, and maintenance and calibration information shall be included.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0401 Ventilation. (1) VENTILATION REQUIRED. Substitute the following wording for the requirements in IMC section 401.2: Every occupied space shall be ventilated by natural means in accordance with IMC section 402 or by mechanical means in accordance with IMC section 403 and as specified in Table 64.0403.

(2) WHEN REQUIRED. Substitute the following wording for the requirements in IMC section 401.3:

(a) *Outside air.* Mechanical ventilation systems shall be operated to provide a continuous source of outside air to all areas while people are present.

(b) *Operation.* 1. Except as provided in subd. 2., the required building exhaust ventilating systems shall operate continuously when people are in the building to provide the amount of exhaust specified in Table 64.0403.

Note: Chapter Comm 32 may require continuous operation of some exhaust systems, such as purging systems, chloride storage exhaust or industrial exhaust.

2. Subdivision 1. does not apply to all of the following:

a. Toilet rooms with 2 or fewer total water closets or urinals if the required ventilation is provided when the room is occupied.

b. Shower rooms with 2 or fewer showerheads if the required ventilation is provided when the room is occupied.

c. Common residential laundry rooms with a total of 4 or fewer washers and dryers if the required ventilation is provided when the room is occupied.

d. Mechanical exhaust systems for natatoriums even when the building is not occupied.

(3) EXITS. Substitute the following wording for the requirements in IMC section 401.4: Vestibule ventilation for smokeproof enclosures shall be in accordance with the IBC.

(4) INTAKE OPENINGS. (a) Substitute the following wording for the requirements in IMC section 401.5.1:

1. Mechanical and required gravity outside air intake openings shall be located a minimum of 10 feet from any hazardous or noxious contaminant such as vents, chimneys, plumbing vents, streets, alleys, parking lots and locating docks, except as otherwise specified in this chapter. Where a source of contaminant is located within 10 feet of an intake opening, such opening shall be located a minimum of 2 feet below the contaminant source.

2. The lowest side of outside air intake required openings shall be located at least 12 inches vertically from the adjoining grade level, above adjoining roof surfaces, or above the bottom of an areaway.

3. If an outside air intake is located in an areaway, the areaway shall have a horizontal cross section equal to or greater than the free area of the outside air intake opening.

4. For health care facilities all of the following shall apply:

a. Except as provided under subd. 4. b., outdoor air intakes shall be located at least 25 feet from exhaust outlets of ventilating systems, combustion equipment stacks, medical–surgical vacuum systems, plumbing vents or areas that may collect vehicular exhaust or other noxious fumes.

b. Plumbing and vacuum vents that terminate at a level above the top of the air intake may be located as close as 10 feet to an outdoor air intake.

c. The bottom of outdoor air intakes serving central systems shall be located at least 6 feet above ground level or, when installed above the roof, at least 3 feet above roof level.

d. Exhaust outlets from areas that may be contaminated shall be located above roof level and arranged to minimize recirculation of exhaust air into the building.

(b) These are department exceptions in addition to the requirements in IMC section 401.5.1:

1. The setback distances as specified in IMC section 401.5.1 shall not apply to the combustion air intake of a direct vent appliance.

2. Unless a greater distance is specified by the manufacturer, exhaust openings for 100 cfm or less discharge shall be located at least 12 inches, measured in any direction, from doors or openable windows.

3. The 10–foot minimum separation does not apply to the intake and exhaust of a factory–packaged rooftop unit or other listed outdoor appliance provided nothing restricts air flow around the unit. The exhaust and intake of the unit shall be located to minimize contamination of outside air.

4. Unless a greater distance is specified by the manufacturer, product of combustion outlets of direct vent appliance vents shall terminate at least 12 inches measured in any direction from doors or openable windows.

5. Where it can be demonstrated that an engineered system design will prevent the maximum concentration of contaminants brought in through the outside air intake from exceeding the maximum contaminant concentration obtainable by providing the separation distances in accordance with sub. (4) (a), the outdoor air intakes may be located in accordance with such engineered system design.

Note: See ch. Comm 82 for plumbing vent setbacks. That rule requires plumbing vents to be 10 feet from air intakes and 10 feet horizontally from or 2 feet above roof scuttles, doors or openable windows.

Note: See NFPA standard 45, Fire Protection for Laboratories Using Chemicals, adopted under ch. Comm 10, for chemical fume hood exhaust location. Health care and related facilities may have additional requirements.

(5) EXHAUST OPENINGS. These are department rules in addition to the requirements in IMC section 401.5.2:

(a) *Gravity ventilation ducts.* Gravity ventilation ducts shall extend not less than 2 feet above the highest portion of the building within a 10–foot radius of the duct and shall be provided with a siphon roof ventilator.

(b) *Barometric relief vents.* Where barometric relief vents are installed on the roof, the discharge openings shall be no less than 2 feet above the roof surface where the vent pierces the roof.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–135: r. and recr. (4) (a) (intro.), cr. (4) (a) 4. and (b) 5., CR 01–139: r. and recr. (4) (a) 3., am. (4) (b) 2. Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0402 Natural ventilation. This is a department rule in addition to the requirements in IMC section 402: Natural ventilation shall be permitted only in areas specified in Table 64.0403.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0403 Mechanical ventilation. (1) VENTILATION SYSTEMS. Substitute the following wording for the requirements in IMC section 403.1:

(a) Mechanical ventilation shall be provided by a method of supply air and exhaust air. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey ventilation air shall be designed and installed in accordance with IMC chapter 6.

(b) Ventilation supply systems shall be designed to deliver the required rate of supply air into the occupied zone within an occupied space.

(2) OUTDOOR AIR REQUIRED. (a) This is a department exception to the requirements in IMC section 403.2: Where it can be demonstrated that an engineered ventilation system design will prevent the maximum concentration of contaminants from exceeding the maximum obtainable by providing the rate of outdoor air ventilation determined in accordance with IMC section 403.3, the minimum required rate of outdoor air may be reduced in accordance with such engineered system design.

(b) This is a department rule in addition to the requirements in IMC section 403.2: The outdoor air shall be free from contamination of any kind in proportions detrimental to the health and comfort of the general population exposed to it.

(3) RECIRCULATION PROHIBITED. Substitute the following wording for exception 3 in IMC section 403.2.1: Where mechanical exhaust is required by Table 64.0403, recirculation of air from such spaces is prohibited. All air supplied to such spaces shall be exhausted, including any air in excess of that required by Table 64.0403.

(4) RECIRCULATION OF AIR. (a) These are department rules in addition to the requirements in IMC section 403.2:

1. In hospitals and ambulatory surgery centers, air supply for operating rooms and delivery rooms that are designed for cesarean–section deliveries shall be provided from ceiling outlets located near the center of the work area. Return–air inlets shall be located near the floor level. Each operating room and delivery room designed for cesarean–section deliveries shall have at least 2 return–air inlets located as remotely from each other as practical.

2. In hospitals and ambulatory surgery centers, air supply outlets for rooms used for invasive procedures shall be located at or near the ceiling. Return or exhaust air inlets shall be located near the floor level. Exhaust grills for anesthesia evacuation and other special applications may be installed in the ceiling.

(b) This is a department informational note to be used under IMC section 403.2.1:

Note: The following are examples where the department will accept air transferred from: corridor to toilet room; corridor to cloak room or janitor closet; dining room to kitchen; locker room to toilet room; gymnasium to locker room; showroom to garage; and corridor to school vocational shops.

(5) TRANSFER AIR. Substitute the following wording for the requirements in IMC section 403.2.2: Except where recirculation from such spaces is prohibited by Table 64.0403, air transferred from occupied spaces is not prohibited from serving as makeup air for required exhaust systems in such spaces as kitchens, baths, toilet rooms, elevators and smoking lounges. The amount of transfer air and exhaust air shall be sufficient to provide the flow rates as specified in IMC sections 403.3 and 403.3.1. The required outdoor air rates specified in Table 64.0403 shall be introduced directly into such spaces or into the occupied spaces from which air is transferred or a combination of both.

(6) VENTILATION RATE. Substitute the following wording for the requirements and exceptions in IMC section 403.3:

(a) *Ventilation rate determination.* 1. Except as provided in pars. (c) and (d), ventilation systems shall be designed to have the capacity to supply the minimum outdoor airflow rate determined in accordance with Table 64.0403 based on the occupancy of the space, the occupant load and a minimum of 7.5 cfm of outside air per person, or other parameters stated in Table 64.0403.

2. a. Except as provided in subpars. b. to d., the occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in Table 64.0403.

b. The estimated maximum occupant load rate may be determined using other means with justification acceptable to the department to show that a different number of occupants is reasonable.

c. Where there is no value indicated for the net square feet per person in Table 64.0403, the actual number of occupants shall be used to determine the required amount of outside air.

d. Ventilation rates for occupancies not represented in Table 64.0403 shall be determined by an approved engineering analysis, or by using the most similar occupancy in the table.

3. The ventilation system shall be designed to supply the required rate of ventilation air continuously during the period the building is occupied, except as otherwise stated in other provisions of this chapter.

Note: See Table 64.0403 for specific occupancies.

(b) *Adjacent spaces with differing ventilation requirements.* 1. Except as provided in subd. 2., spaces with different ventilation requirements shall be provided with a complete solid separation, or the most stringent ventilation requirement shall apply to all unseparated areas.

2. The separation as specified in subd. 1. is not required where an engineered ventilation design system will prevent the concentration of contaminants from exceeding that obtainable by providing a physical separation.

(c) *Exceptions for certain occupancies.* 1.'Toilet rooms.' A toilet room that has only one water closet or urinal and no bathtub or shower may be provided with either natural ventilation via a window or louvered opening with at least 2 square feet of area openable directly to the outside or mechanical exhaust ventilation as specified in Table 64.0403.

2. 'Janitor closets.' A janitor closet that has only one service sink may be provided with either natural ventilation via a window or louvered opening with at least 2 square feet of area openable directly to the outside or mechanical exhaust ventilation as specified in Table 64.0403.

3. 'Locker and shower rooms.' An adjoining locker room, shower room and toilet room shall be exhausted at the rate specified in Table 64.0403 based on the largest amount of exhaust required for any of the three rooms. A negative pressure relation-

ship shall be maintained in the shower and toilet rooms with respect to the locker room.

4. 'Chemical or septic toilets.' Chemical or septic toilets and composting privies are prohibited in spaces under negative pressure. Toilet rooms with chemical or septic toilets shall be provided with natural ventilation via a window, louver or skylight with at least 2 square feet of area openable directly to the outside. The opening shall be provided with a screen to limit the passage of insects and vermin.

5. 'Pool ventilation.' In a natatorium, the volume of supply air and exhaust air may be reduced to a minimum of 1 cfm per square foot of pool surface provided automatic humidity controls perform so as not to create accelerated building material deterioration from moisture condensation.

6. 'Health care facilities.' Recirculation and flow of air in health care facilities shall comply with the requirements in Table 2 or Table 6, as applicable, of AIA Guidelines for Design and Construction of Hospital and Health Care Facilities.

(d) *Outside air requirements waived.* 1. If a mechanical air supply system is provided and the requirement for outdoor air determined in accordance with Table 64.0403 is less than 5% of the minimum required air changes per hour, the requirement for outside air may be eliminated.

2. The requirement for outside air or percent of openings specified in Table 64.0403 may be omitted in large volume spaces containing 5,000 or more cubic feet per occupant. Required exhaust ventilation and makeup air shall not be omitted.

(7) SYSTEM OPERATION. Substitute the following wording for the requirements in IMC section 403.3.1: The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation may be based on the rate per person indicated in Table 64.0403 and the actual number of occupants present.

(8) COMMON VENTILATION SYSTEM. These are department alternatives to the requirements in IMC section 403.3.2:

(a) *General.* Except as specified in par. (d), each room served by a common mechanical ventilation system shall be provided with the minimum outdoor airflow rate determined individually for each room, or the minimum amount of outside air may be supplied to the system if a minimum air change rate for each room is either provided in accordance with this section or waived in accordance with par. (c).

(b) *Minimum air change.* 1. 'Application.' a. The required air change shall be provided while people are present.

b. The air-change rate may be based on actual room height or up to 10 feet from the floor level of the room in question. The volume above 10 feet, in rooms that are more than 10 feet in height, need not be considered in the air change requirement if the required air change is designed to occur in the lower 10 feet of the occupied space.

c. The required minimum air change volume shall be transferred through the air handling equipment where it is diluted or replaced with outside air, and supplied back to the space.

2. 'Six air changes per hour.' Except as specified in subd. 3. and unless mechanical exhaust is required by Table 64.0403, the total air change rate for each room shall be at least 6 air changes per hour.

3. 'Less than 6 air changes per hour.' An air change rate of less than 6 air changes per hour will be permitted where mechanical cooling (air conditioning) is provided to maintain an interior design temperature of 78°F or lower and the heat gain requirement for the space has been satisfied. The air change rate may not be less than the minimum air changes per hour if specified in Table 64.0403.

Note: As specified in s. Comm 64.0403, the amount of outside air required must be maintained even if the air change rate is reduced.

(c) *Air change requirement waived.* The air change requirement for 6 air changes per hour may be omitted in any of the following applications:

1. Buildings or rooms utilizing spot heating as the only source of heat.

2. Buildings where the requirement for outside air is waived in accordance with sub. (6) (d).

3. Buildings utilizing natural ventilation as specified in IMC section 402.

(d) *Air change rates in health care facilities.* Air change rates in health care facilities shall comply with the requirements in Table 2 or Table 6, as applicable, of AIA Guidelines for Design and Construction of Hospital and Health Care Facilities.

(9) REQUIRED OUTDOOR VENTILATION AIR. (a) Substitute the following table for IMC Table 403.3:

Table 64.0403

Required Minimum Inside Temperature And Outdoor Ventilation Air

		Ventilation Requirements			
		Basis of Capacity			
Occupancy Classification[i]	**Minimum Inside Temperature (degrees F)**	**Estimated Maximum Occupant Load (persons per 1,000 sq. ft.)[a]**	**Natural Ventilation Allowed**	**Exhaust [e] (cfm/net sq. ft. floor area)**	**Air Change Rate [k] (minimum air change per hour with A/C)**
Correctional facilities					
Sleeping rooms [j]	68	20	yes	—	—
Dining halls	68	100	no	—	2.0
Guard stations	68	40	yes	—	—
Dry cleaners, laundries					
Coin–operated dry cleaners	68	8	yes	—	1.0
Coin–operated laundries	68	8	yes	—	1.0
Commercial dry cleaners	60	—	no	2.0	—
Commercial laundries	60	—	no	2.0	—
Storage, pick up	60	8	yes	—	1.0
Apartment laundry rooms	60	—	no	0.5	—
Education					
Auditoriums	68	150	no	—	2.0
Classrooms	68	50	no	—	2.0
Day care facilities	68	30	yes only if ≤ 20 children	—	2.0
Laboratories (science)	68	30	no	—	2.0
Corridors with lockers	68	—	—	—	10 cfm/lineal ft. of length
Music rooms	68	50	no	—	2.0
Smoking lounges [b,g]	68	—	no	2.0	—
Special education	68	35	no	—	2.0
Training shops	60	30	no	—	—
Food and beverage service					
Bars and cocktail lounges	68	100	no	—	2.0
Cafeterias, fast food	68	100	no	—	2.0
Dining rooms	68	70	no	—	2.0
Kitchens (cooking) [f,g]	60	20	yes	—	1.0

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Table 64.0403 – Continued

Required Minimum Inside Temperature And Outdoor Ventilation Air

Occupancy Classification[i]	Minimum Inside Temperature (degrees F)	Ventilation Requirements			
		Basis of Capacity			
		Estimated Maximum Occupant Load (persons per 1,000 sq. ft.)[a]	Natural Ventilation Allowed	Exhaust [e] (cfm/net sq. ft. floor area)	Air Change Rate [k] (minimum air change per hour with A/C)
Health care facilities Hospitals Nursing homes Ambulatory surgery centers	footnote m	footnote m	no	footnote m	footnote m
Hotels, motels, resorts and dorms					
Assembly rooms	68	120	no	—	2.0
Bathrooms [b,g]	68	—	no	35 cfm/room	—
Bedrooms	68	footnote n	yes	—	—
Conference rooms	68	50	no	—	2.0
Dormitory sleeping areas	68	20	yes	—	—
Casinos	68	—	no	2.0	—
Living rooms	68	footnote n	yes	—	—
Lobbies	68	30	no	—	—
Industrial/Factory					
Factories and machine shops	60	13	yes	—	—
Foundries	NMR	13	yes	—	—
Sawmills	NMR	—	yes	—	—
Offices					
Conference rooms	68	50	no	—	1.5
Office spaces	68	7	no	—	1.5
Reception areas	68	60	no	—	1.5
Telecommunication centers and data entry	68	60	no	—	1.5
Places of worship, entertainment and recreation which accommodate less than 100 persons	footnote h	—	yes	footnote h	—
Private dwellings, single and multiple					
Living areas	68	2 people for first bedroom plus one person for each additional bedroom	yes	—	—

Table 64.0403 – Continued

Required Minimum Inside Temperature And Outdoor Ventilation Air

		Ventilation Requirements			
		Basis of Capacity			
Occupancy Classification[i]	**Minimum Inside Temperature (degrees F)**	**Estimated Maximum Occupant Load (persons per 1,000 sq. ft.)[a]**	**Natural Ventilation Allowed**	**Exhaust [e] (cfm/net sq. ft. floor area)**	**Air Change Rate [k] (minimum air change per hour with A/C)**
Kitchens [g]	68	—	yes	100 cfm intermittent or 20 cfm continuous	—
Toilet rooms and bathrooms [g, l]	68	—	no	Mechanical exhaust capacity 50 cfm intermittent or 20 cfm continuous	—
Garages, separated by a solid wall for each dwelling	NMR	—	yes	100 cfm/ vehicle	—
Garages, common for multiple units [b]	NMR	—	no	0.5	—
Retail stores, sales floors and showroom floors	68	8	yes	—	1.0
Seasonal occupancies, camps and lodges					
Dining and recreational areas	NMR	15	yes	—	—
Living and sleeping areas	NMR	—	yes	—	—
Club houses	NMR	15	yes	—	—
Drive–ins	NMR	15	yes	—	—
Specialty shops					
Automotive service and repair garages	60	—	no	0.5	—
Barber shops	68	25	no	—	—
Beauty salons [c]	68	—	no	0.5	—
Clothier, furniture specialty shops	68	8	yes	—	1.0
Florist shops	68	8	yes	—	1.0
Hardware, drugs, fabrics stores	68	8	yes	—	1.0
Supermarkets	68	8	yes	—	1.0

Table 64.0403 – Continued

Required Minimum Inside Temperature And Outdoor Ventilation Air

Occupancy Classification[i]	Minimum Inside Temperature (degrees F)	Ventilation Requirements — Basis of Capacity: Estimated Maximum Occupant Load (persons per 1,000 sq. ft.)[a]	Natural Ventilation Allowed	Exhaust [e] (cfm/net sq. ft. floor area)	Air Change Rate [k] (minimum air change per hour with A/C)
Sports and amusement					
Ballrooms and discos	68	100	no	—	2.0
Bleacher areas	68	363 or 18 in./person	no	—	2.0
Bowling centers (seating areas)	68	70	no	—	2.0
Game rooms	68	70	no	—	2.0
Natatoriums	76	—	—	2.0 cfm/ sq. ft. pool area	—
Ice skating rinks (indoor)	NMR	5	no	—	—
Playing floor (gymnasiums)	68	30	no	—	2.0
Roller skating rinks (indoor)	60	30	no	—	2.0
Spectator areas (non–bleacher)	68	150	no	—	2.0
Storage					
Chlorine storage and handling rooms	NMR	—	no	2.0	—
Enclosed parking garages [d]	NMR	—	no	0.5	—
Warehouses	NMR	—	—	—	—
Theaters					
Auditoriums	68	150	no	—	2.0
Lobbies	68	150	no	—	—
Stages, studios	68	70	no	—	2.0
Ticket booths	68	60	no	—	2.0
Transportation					
Platforms	NMR	100	no	—	2.0
Waiting rooms	68	100	no	—	2.0
Utility and public spaces					
Elevators [g]	NMR	—	no	1.0	—
Janitor closets [l]	NMR	—	no	2.0 or 75 cfm/ sink	—
Locker and dressing rooms [b]	70	—	no	0.5	—
Shower rooms	70	—	no	2.0	—
Toilet rooms [b, g, l]	68	—	no	75 cfm/TF	—
Smoking lounges [b, g]	68	—	no	2.0	—

Table 64.0403 – Continued

Required Minimum Inside Temperature And Outdoor Ventilation Air

Occupancy Classification[i]	Minimum Inside Temperature (degrees F)	Ventilation Requirements — Basis of Capacity: Estimated Maximum Occupant Load (persons per 1,000 sq. ft.)[a]	Natural Ventilation Allowed	Exhaust[e] (cfm/net sq. ft. floor area)	Air Change Rate[k] (minimum air change per hour with A/C)
Workrooms					
Bank vault	68	5	no	—	—
Meat processing	NMR	10	yes	—	—
Pharmacy	68	20	yes	—	1.5
Photo studio	68	10	yes	—	1.0
Printing	60	13	yes	footnote[o]	—

CFM = Cubic feet per minute; LF = Lineal foot; NMR = No minimum requirement; TF = Toilet fixtures (water closets and urinals); A/C =Air conditioning

a Based upon net floor area.

b Mechanical exhaust is required and the recirculation of air from these spaces that would otherwise be allowed by IMC section 403.2.1 is prohibited.

c The classification of a 'beauty' shop depends on the types of services provided. Only beauty salons routinely provide chemical processing of hair to produce texture or color changes, or manicures or other services with a similar need for air–borne contaminant and odor control.

d Enclosed parking garages are parking garages with less than 30% open areas in the total wall area enclosing the garage. Ventilation systems in enclosed parking garages shall comply with IMC section 404. A mechanical ventilation system shall not be required in garages having a floor area of 850 square feet or less and used for the storage of 5 or fewer motorized vehicles. Requirements for parking garages shall apply to all buildings, or parts of buildings, into which motor vehicles are driven for loading or unloading or are stored.

e The ventilation rate is based upon cubic feet per minute per square foot of the floor area being ventilated.

f The sum of the outdoor and transfer air from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 cfm/sf.

g Transfer air permitted in accordance with IMC section 403.2.2.

h See specific occupancy classification table entries for inside design temperature and cfm per net square feet floor area requirements.

i This table is intended as a reference guide with generic Use types listed under those Occupancy types most often associated with the use. When Use types are mixed between Occupancy types and the Use type is unlisted within the specific Occupancy type, the use shall be ventilated as required by the same Use type listed in the other Occupancy type. Unlisted occupancies or uses shall be ventilated as required for the most similar listed occupancy classification acceptable to the department. Rooms that are used for different purposes at different times shall be designed for the greatest amount of ventilation required for any of the uses.

j When unseparated toilet fixtures are included in sleeping areas (such as cells), the room shall be ventilated as required for toilet rooms.

k See sub. (8) for specific requirements and exceptions. Units listed as minimum air change per hour with air conditioning unless otherwise specified.

l Natural ventilation may be allowed under this section.

m For air ventilation requirements in healthcare facilities, use American Institute of Architects (AIA) guidelines (AIA Guidelines for Design and Construction of Hospital and Health Care Facilities).

n The minimum mechanical ventilation rate is 15 cfm/room of outside air.

o Refer to IMC chapter 5 for requirements.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–135: renum. (3) to be (3) (b), cr. (3) (a), (4) (a) 6. and (5) (d), am. (5) (a), (b) 1. a., (c) 1. and (6) Table; CR 01–139: renum. (3) to (6) to be (4), (6), (8) and (9), cr. (3), (5) and (7), am. (6) Table, r. and recr. (6) Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0404 Enclosed parking garages. **(1)** ENCLOSED PARKING GARAGES. Substitute the following wording for the requirements in IMC section 404.1: Mechanical ventilation systems for enclosed parking garages are not required to operate continuously where the system meets all of the following:

(a) The system is arranged to operate automatically upon detection of carbon monoxide at a level of 35 parts per million (ppm) by automatic detection devices.

(b) If diesel fuel vehicles are stored, the system is arranged to operate automatically upon detection of nitrogen dioxide at a level of one part per million (ppm) by automatic detection devices.

(c) The system includes automatic controls for providing exhaust ventilation at a rate of 1/2 cfm per square foot for at least five hours in each 24–hour period.

(d) The system maintains the garage at negative or neutral pressure relative to other spaces.

(2) MINIMUM VENTILATION. Substitute the following wording for the requirements in IMC section 404.2: Automatic operation of the system shall not reduce the ventilation rate below 7.5 cfm per person and the system shall be capable of producing an exhaust rate of 0.5 cfm per square foot of floor area.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–139: r. and recr. (1) Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0501 Required systems. This is a department exception to the requirements in IMC section 501.4: A mechanically exhausted room or space that is within a dwelling unit which is served by an independent heating, ventilating and air conditioning system is not required to be maintained with negative or neutral pressure.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0502 Required systems. Substitute the following wording for the requirements in IMC section 502.1: An exhaust system shall be provided, maintained and operated as specifically required by this section and for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders and other appliances, equipment and processes in such areas produce or throw off dust particles sufficiently light to float in the air or which emit heat, odors, fumes, spray, gas or smoke, in such quantities to be injurious to health or safety.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0506 Commercial kitchen grease ducts and exhaust equipment. (1) GENERAL. This is an informational note to be used under IMC section 506.1:

Note: See Table 64.0403 for modifications regarding required cfm/person.

(2) EXHAUST FANS. (a) This is a department alternative to the requirements, but not the exceptions, in IMC section 506.3.3: Joints may be made with any other means that provide a liquid–tight seal at 1500ºF.

(b) Substitute the following wording for the requirements in IMC section 506.3.3.1:

1. Duct joints shall be butt joints or overlapping duct joints of either the telescoping bell type or flanged. Overlapping joints shall be installed to prevent ledges and obstructions from collecting grease or interfering with gravity drainage to the intended collection point.

2. The difference between the inside cross–sectional dimensions of overlapping sections of duct shall not exceed 0.25 inch.

3. The length of overlap for overlapping duct joints shall not exceed 2 inches.

(c) This is a department rule in addition to the requirements in IMC section 506.3.8: Fans serving commercial kitchen hoods shall be listed for use with grease–laden air.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0507 Capacity of hoods. Substitute the following wording for the introductory paragraph in IMC section 507.13: A kitchen exhaust hood shall be provided with a capture velocity to capture the grease vapors effectively and may be designed through engineering analysis, or based on this section and the requirements in IMC sections 507.13.1 through 507.13.4. where:

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–139: am. Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0603 Duct construction and insulation. This is a department informational note to be used under IMC sections 603.3 and 603.4:

Note: For DHFS licensed healthcare facilities as specified in chs. HFS 124, 131, 132, and 134, also refer to the following standards: Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), HVAC Duct Construction Standards— Metal and Flexible, 1995 edition.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0604 Insulation. (1) These are department rules in addition to the requirements in IMC sections 604 and 604.8:

(a) 1. Except as provided under subd. 2., in hospitals and ambulatory surgery centers, duct linings exposed to air movement shall not be used in ducts serving operating rooms, delivery rooms, labor, delivery and recovery rooms, nurseries, protective environment rooms and critical care units.

2. In hospitals and ambulatory surgery centers, the requirement in subd. 1. does not apply to mixing boxes and acoustical traps that have special coverings over such lining to mitigate fungal and microbial growth.

(b) In hospitals and ambulatory surgery centers, duct lining shall not be installed within 15 feet downstream of humidifiers or as necessary to prevent moisture accumulation in the lining.

(2) This is a department exception to the requirements in IMC section 604.8: The distances from a listed duct lining to a heater may be reduced in accordance with the duct lining listing.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–135: renum. (1) to be (3), cr. (1) Register June 2002 No. 558, eff. 7–1–02; correction to renum. (3) to be (2) made under s. 13.93 (2m) (b) 1., Stats., Register June 2002 No. 558.

Comm 64.0605 General. These are department exceptions to the requirements in IMC section 605.1:

(1) Central air handling systems in hospitals, nursing homes and ambulatory surgery centers shall comply with the applicable filtration requirements specified in section 7.31.D8, 8.31.D5, 9.31.D8 or 11.31.D4 of the AIA Guidelines for Design and Construction of Hospitals and Health Care Facilities.

(2) Non–central air handling systems in hospitals, nursing homes and ambulatory surgery centers shall be equipped with permanent cleanable or replaceable filters with a minimum efficiency of 68 percent weight arrestance.

(3) In hospitals and ambulatory surgery centers, non–central air handling systems shall be used as recirculating units only. All outdoor air requirements shall be met by a separate central air handling system with the filtration as provided in sub. (1).

(4) Preheat coils for snow melting that are single row, have a maximum 8 fins per inch, are accessible for pressure washing and have ductwork that is designed for drainage need not be provided with air filters.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–135: am. (1), renum. (2) to be (4), cr. (2) and (3) Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0606 Smoke detection system control. (1) This is a department informational note to be used under IMC section 606.2.1:

Note: For DHFS licensed healthcare facilities as specified in chs. HFS 124, 131, 132, and 134, also refer to NFPA standard 90A section 4–4.2A for air handling units between 2,000 cfm and 15,000 cfm.

(2) This is a department informational note to be used under IMC section 606.4:

Note: For DHFS licensed healthcare facilities as specified in chs. HFS 124, 131, 132, and 134, also refer to NFPA standard 90A section 4–3.2 for smoke dampers isolating air handling units.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0702 Inside air. (1) This is a department rule in addition to the requirements in IMC section 702.1: When the space providing air for combustion, ventilation and dilution of flue gases has a minimum volume of 250 cubic feet per 1,000 Btu per hour combined input rating of all appliances, the use of inside air for combustion shall be allowed.

(2) This is a department informational note to be used under IMC section 702.1:

Note: When applying the provisions of this section, refer to IFGC section 201 as adopted and modified in s. Comm 65.0210 for the definition of "unusually tight construction".

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0710 Opening location and protection. Substitute the following wording for the requirements in IMC section 710.1: Mounting height of the combustion air intakes shall have the lowest side of outside air intake openings located at least 12 inches vertical from the adjoining grade level.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0801 Chimneys and vents. (1) This is a department informational note to be used under IMC chapter 8:

Note: For DHFS licensed healthcare facilities as specified in chs. HFS 124, 132, and 134, also refer to NFPA 211 as adopted in these chapters.

(2) These are department rules in addition to the requirements in IMC section 801.2: Permanently installed and portable unvented fuel–fired space heaters are prohibited.

Note: See ch. Comm 65, subch. II, Part 6 for the prohibition of unvented gas–fired space heaters.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.0900 Specific criteria for duct humidifiers. These are department rules in addition to the requirements in IMC chapter 9:

(1) For duct humidifiers located upstream of final filters in a hospital or ambulatory surgery center all of the following shall apply:

(a) The duct humidifier shall be located at least 15 feet upstream of the final filters.

(b) The ductwork with duct–mounted humidifiers shall have a means of water removal.

(c) An adjustable high–limit humidistat shall be located downstream of the humidifier to reduce the potential of condensation inside the duct.

(d) All duct takeoffs shall be sufficiently downstream of the humidifier to ensure complete moisture absorption.

(2) For all other humidifiers located in hospitals or ambulatory surgery centers all of the following shall apply:

(a) Steam humidifiers shall be used.

(b) Reservoir–type water spray or evaporative pan humidifiers shall not be used.

History: CR 01–135: cr. Register June 2002 No. 558, eff. 7–1–02.

Comm 64.0918 Forced–air warm–air furnaces. (1) This is a department rule in addition to the requirements in IMC section 918.6: The outside air intake openings shall be located at least 12 inches vertical from the adjoining grade level.

(2) Substitute the following wording for the requirements IMC section 918.6 item 1: Closer than 10 feet from any appliance vent outlet, a vent opening from a plumbing drainage system or the discharge outlet of an exhaust fan, unless the outlet is 2 feet above the outside air inlet.

(3) Substitute the following wording for the requirements in IMC section 918.6 item 2: Where located less than 10 feet above the surface of any abutting public way or driveway, or at grade level by a sidewalk, street, alley or driveway.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.1001 Boilers, water heaters and pressure vessels. Substitute the following wording for the requirements and exceptions in IMC chapter 10:

(1) The provisions of ch. Comm 41 shall govern the installation, alteration and repair of boilers and pressure vessels. The provisions of chs. Comm 81 to 86 shall govern the installation, alteration and repair of water heaters.

(2) Water heaters utilized both to supply potable hot water and provide hot water for space–heating applications shall be listed and labeled by the manufacturer and shall be installed in accordance with the manufacturer's installation instructions and applicable provisions in chs. Comm 81 to 86.

(3) Water heaters utilized for both potable water heating and space–heating applications shall be sized to prevent the space–heating load from diminishing the required water–heating capacity.

(4) Where a combination potable water–heating and space–heating system requires water for space heating at temperatures higher than 140°F, a tempering valve shall be provided to temper the water supplied to the potable hot water distribution system to a temperature of 140°F or less.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.1101 Refrigeration. Substitute the following wording for the requirements and exceptions in IMC chapter 11: Mechanical refrigerating systems installed in public buildings and places of employment shall comply with ch. Comm 45.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.1201 Hydronic piping. Substitute the following wording for the requirements and exceptions in IMC Chapter 12: The provisions of ch. Comm 41 shall apply to boilers, piping components associated with boilers, pressure vessels and power piping in places of employment and in public buildings.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.1300 Fuel oil piping and storage. Substitute this informational note for the requirements in IMC chapter 13:

Note: See ch. Comm 10 for fuel oil piping requirements.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

Comm 64.1500 Referenced standards. (1) Substitute the following NFPA standards for the corresponding standards listed in IMC chapter 15: NFPA 13–1999, 13–2001 and 72–1999.

(2) This is a department rule in addition to the requirements in IMC chapter 15: The following standard is hereby incorporated by reference into this code: AIA Guidelines for Design and Construction of Hospital and Health Care Facilities, 1996–97.

Note: NFPA standards may be purchased from the National Fire Protection Association, One Batterymarch Park, P.O. Box 9101, Quincy, MA 02269–9101.

AIA guidelines may be purchased from the American Institute of Architects, Order Department, 9 Jay Gould Court, P.O. Box 753, Waldorf, MD 20601.

Copies of the standards are on file in the offices of the department, the secretary of state and the revisor of statutes.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02; CR 01–139: am. Register June 2002 No. 558, eff. 7–1–02.

Comm 64.1600 Appendices. IMC Appendices A and B are not included as part of this chapter.

History: CR 00–179: cr. Register December 2001 No. 552, eff. 7–1–02.

INTERPRETATION IC 62-1999-39 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

Approved September 5, 2001

Request from: Randal Hassler, P.E. (rhassler@mcclureeng.com) McClure Engineering Associates, 7616 Big Bend Boulevard, St. Louis, MO 63119-2106.

Reference: This request for interpretation refers to the Ventilation Rate Procedure presented in ANSI/ASHRAE Standard 62-1999, particularly Section 6.1.3, Ventilation Requirements, Section 6.1.3.1, Multiple Spaces, and Section 6.1.3.4, Intermittent or Variable Occupancy.

Background 1: A school has 75 classrooms, each designed for 30 students, an auditorium designed for 500 students, and a cafeteria designed for 700 students. The school has an enrollment of 2000 students plus 80 faculty. One system serves the entire school.

Interpretation 1a: In Equation 6-1, the sum of the outdoor airflow rates for all branches on the system V_{on} would be based on the total occupancy of the school, that is, it would equal 2080 people x 15 cfm/person = 31,200 cfm.

Question 1a: Is Interpretation 1a correct?

Answer 1a: No. In Equation 6-1, V_{on} is the sum of the ventilation airflow required for each simultaneously occupied space or zone. It needs to be based on the occupancies and Table 2 requirements for the various spaces/zones, e.g. office areas - 20 cfm/person, classrooms - 15 cfm/person, hallways - 0.10 cfm/ft^2, and locker rooms - 0.50 cfm/ft^2.

Interpretation 1b: In Equation 6-1, V_{on} would be based on the occupancy levels in each individual room, that is, it would equal (75 x 30 + 500 + 700 + 80) x 15 cfm/person = 52, 950 cfm.

Question 1b: Is Interpretation 1b correct?

Answer 1b: No. As stated above, V_{on} is based on simultaneously occupied spaces or zones, not the sum of the peak occupancies in each space. If all occupants were in classrooms, then V_{on} = 2080 * 15 = 31,500 cfm. However, some occupants are in office areas, while some may be in the auditorium or cafeteria.

Comments on 1a and1b: The standard does not provide explicit guidance on how to deal with issues of “population diversity,” that is, where the sum of the design occupancies for each space served by a system is greater than the total expected occupancy of the building. Section 6.1.3.4 allows for systems to adjust outdoor air quantities to spaces based on variations in occupancy, but does not describe these adjustments in detail. Based on the total occupancy of 2080 people, the value of V_{on} would indeed be based on that value, but these people must be “distributed” among the various spaces served by the system and the individual ventilation requirements for each space type must be used. Also, note that before multiplying the number of people in a space by the ventilation requirement for that space, the designer must account for ventilation effectiveness per Section 6.1.3.3. This could lead to the value of cfm/person being increased.

Finally, Table 2 does not contain a ventilation requirement for cafeterias in educational facilities, only for cafeterias in commercial facilities.

Background 2: A gymnasium space is regularly used for gym class and recreational sports, with occupancy of less than 50 persons. This same space is also used very infrequently for homecoming dances and indoor graduation ceremonies, with 2000 people for less than 3 hours in duration. A system is configured with dampers for two different ventilation rates depending upon occupancy.

Interpretation 2a: The gym-class occupancy ventilation rate would be 50 people x 20 cfm/person = 1000 cfm (Reference 6.1.3, 2nd paragraph, page 10)

Question 2a: Is Interpretation 2a correct?

Answer 2a: Yes. (See comments below.)

Interpretation 2b: The gym-class occupancy ventilation rate would be 1/2 x 2000 people x 15 cfm/person = 15,000 cfm

Question 2b: Is Interpretation 2b correct?

Answer 2b: No, the gym-class occupancy ventilation rate should be based on the occupancy during those classes, not on the occupancy during dances and graduation ceremonies..

Interpretation 2c: The event-occupancy (dances and ceremonies) ventilation rate would be 2000 people x 15 cfm/person = 30,000 cfm (Reference Table 2)

Question 2c: Is Interpretation 2c correct?

Answer 2c: No, not if the event is less than three hours.

Interpretation 2d: The event ventilation rate would be 1/2 x 2000 people x 15 cfm/person = 15,000 cfm (Reference 6.1.3.4)

Question 2d: Is Interpretation 2d correct?

Answer 2d: Yes, but only if the ventilation requirement for the given event is 15 cfm/person. In addition, in accordance with Section 6.1.3.4, the duration of peak event-occupancy must be less than three hours and the average event-population must be less than one-half of the peak event-population, i.e., less than 1000 person.

Comments on 2a, 2b, 2c and 2d:
These questions relate to three separate issues. The first relates to the space being used for two distinct types of events with very different occupancies. The second issue relates to the ventilation requirements for different space uses. And the third related to peak occupancies of less than three hours in duration as discussed in Section 6.1.3.4.

With respect to the first issue, the phrasing of the interpretations specifically refers to "gym occupancy" and "event occupancy." This distinction implies that the two different uses are being considered separately, and indeed they would have different ventilation requirements. The system would need to be able to provide these different outdoor air ventilation rates based on the space usage. But if the system was not capable of such control and had only one possible outdoor air ventilation rate, it would need to be the larger.

While the interpretation is worded in terms of 15 cfm/person for all of the uses of the gymnasium, that might not be the appropriate ventilation requirement under all circumstances. For dances, it might be more appropriate to use a value of 25 cfm/person for Ballrooms and Discos in Table 2.1.

With respect to the peak occupancy issue during dances and other such events, since they are less than three hours in duration, Section 6.1.3.4 allows the design occupancy to be reduced to the average occupancy, but not less than one-half the peak value. The requester is directed to previous interpretations (specifically numbers 14, 18, 20, 23, 25, 27 and 32) for more information on intermittent occupancy.

Again, as noted in the comment for interpretations 1a and 1b, the designer must account for ventilation effectiveness per Section 6.1.3.3. This could conceivably lead to the per person ventilation requirement for the space being increased above 15 cfm/person or whatever rate is appropriate.

Appendix 9

Interpretation IC 62-1999-28 - Transfer to 62-1999 Approved: August 14, 2000

ASHRAE Standard 62-1999, *Ventilation for Acceptable Indoor Air Quality*

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-21) on June 26, 1995, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Gren Yuill, Ph.D, Professor, Department of Architectural Engineering, College of Engineering, The Pennsylvania State University, 104 Engineering "A" Bldg., University Park, PA 16802-1416

References. This request refers to Ventilation Rate Procedure in Standard 62-1989, particularly 6.1.3.1 Multiple Spaces Method.

Background. Mr. Yuill's letter indicates that he considers the requirements in 6.1.3.1 to be unambiguous, but is requesting this interpretation because others are interpreting it differently in referencing 62-1989 in proposed building energy design codes. Mr. Yuill's letter gives the following 1-A and 2-A as his interpretations and 1-B and 2-B as the interpretations of others:

1-A (Yuill interpretation): The outdoor air required by each space and specified in Table 2 must be delivered to that space, applying the Multiple Spaces Equation (6-1) to account for the effect of other rooms served by the same air supply system that may be receiving more than their specified amounts of outdoor air.

1-B (Alternative interpretation): The outdoor air required to be delivered to a building by an air supply system may be calculated by adding up the amount of outdoor air required to meet the requirements of Table 2 in each space served by that system, even if the percentage of outdoor air required may differ from space to space.

2-A (Yuill interpretation): If a variable air volume system is used, the system must be designed so that it will deliver the required amount of outdoor air to each space it serves not only under the conditions that prevail on the cooling design day, but under the full range of weather and load conditions that can be expected, and under the range of space ventilation rates and system airflows that the system will deliver to meet those loads.

2-B (Alternative interpretation): If the variable volume system delivers the required amount of outdoor air under the cooling design conditions, it need not be designed to do so under other operating conditions that may be expected to occur in the building.

Assuming that the answers to 1-A and 2-A are YES, Dr. Yuill's letter postulates the following two example variable air volume (VAV) system design approaches:

VAV System Design Approach No. 1: Assume that each VAV box will close to its minimum position at some time when the room is fully occupied. Find the critical space with the highest required outdoor air fraction, Z, when its VAV box is fully turned down. Find the building's uncorrected outdoor air fraction, X, with all the other VAV boxes at their minimum settings. Use the Multiple Spaces Equation to find the fraction, and thus the absolute amount, of outdoor air required. Repeat this calculation with all the other VAV boxes at their maximum settings. Choose the result that gives the higher outdoor air flow and design the air supply system to always deliver at least this amount.

VAV System Design Approach No. 2: Use a building energy analysis computer program to simulate the hour-by-hour operation of the building with a year of realistic weather data. Determine the flow rate through each VAV box in each hour, and use this data with assumed occupant densities and the Multiple Spaces Equation to find the amount of outdoor air required in each hour. Design an air supply system that never delivers less outdoor air than the highest of these air requirements.

Question 1. Is Dr. Yuill's interpretation 1-A correct?

Answer 1. Yes.

> **Comment**. The intent of 62-89 is to have the outside air requirements listed in Table 2 designed to be delivered to these spaces based upon the best estimate of occupancy at the time of design. However, the impact of Eq. 6-1 on overall system outside air rates will be minimized if (a) supply air to critical spaces is increased using fan-powered boxes transferring air from a common return air plenum for example, or (b) for rooms that are particularly densely occupied such as conference rooms, when exhaust or transfer fans are used to allow air transferred from adjacent spaces to meet part of the supply air requirement, as allowed by subclause 6.1.3.1.

Question 2. Is Dr. Yuill's interpretation 2-A correct?

Answer 2. Yes.

> **Comment**. The corrected outdoor air flow rate must be calculated for the most critical case. This outdoor air flow rate may be supplied at all times. Less air may be supplied when conditions are less critical provided the flow is recalculated based on those conditions (e.g., lower occupancy).

Question 3. Does VAV System Design Approach No. 1 satisfy Standard 62-1989?

Answer 3. Yes.

> **Comment**. This is not the only acceptable system design approach.

Question 4. Does VAV System Design Approach No. 2 satisfy Standard 62-1989?

Answer 4. Yes.

> **Comment**. This is not the only acceptable system design approach.

ASHRAE STD 90.1 FAN POWER COMPLIANCE VALIDATION

DESIGN FAN POWER LIMITATION COMPLIANCE WORKSHEET

UNIT	VAV/CV	AIRFLOW	SF HP	RF HP	EF HP	CREDITS HP	THP	ACTUAL HP/KCFM	PERMISSIBLE HP/KCFM	STD 90.1 6.3.3.1
HRAC-1	VAV	18000	40	20	3.50	2.0	61.5	3.41	1.7	FAIL
HRAC-2	VAV	22000	40	25	3.40	2.4	66.0	3.00	1.5	FAIL
HRAC-3	VAV	17000	40	20	1.42	2.6	58.8	3.46	1.7	FAIL
HRAC-4	VAV	20000	40	25	2.00	2.0	65.0	3.25	1.5	FAIL
AC-1	CV	16000	15	7.5	0.00	0	22.5	1.41	1.2	FAIL
AC-2	VAV	12500	25	7.5	1.50	0	34.0	2.72	1.7	FAIL
AC-3	CV	7020	10	0	3.17	0	13.2	1.88	1.2	FAIL
AC-4	CV	18850	20	0	0.50	0	20.5	1.09	1.2	PASS
AC-5	CV	50000	50	0	1.33	0	51.3	1.03	1.1	PASS
AC-6	VAV	7000	15	5	0.00	0	20.0	2.86	1.7	FAIL
AC-7	VAV	11500	20	7.5	25.25	0	52.8	4.59	1.7	FAIL
AC-8	CV	7220	10	0	2.67	0	12.7	1.75	1.2	FAIL
AC-9	CV	4000	5	0	7.50	0	12.5	3.13	1.2	FAIL
AC-10	CV	2850	5	0	0.50	0	5.5	1.93	1.2	FAIL

INSTALLED FAN POWER LIMITATION COMPLIANCE WORKSHEET

UNIT	VAV/CV	AIRFLOW	SF HP	RF HP	EF HP	CREDITS HP	THP	ACTUAL HP/KCFM	PERMISSIBLE HP/KCFM	STD 90.1 6.3.3.1
HRAC-1	VAV	18000	30	15	3.50	3.2	45.3	2.52	1.7	FAIL
HRAC-2	VAV	22000	30	15	3.40	3.8	44.6	2.03	1.5	FAIL
HRAC-3	VAV	17000	25	15	1.50	2.8	38.7	2.28	1.7	FAIL
HRAC-4	VAV	20000	30	15	1.25	3.9	42.3	2.12	1.5	FAIL
AC-1	CV	16000	15	7.5	0.00	0	22.5	1.41	1.2	FAIL
AC-2	VAV	12500	15	7.5	0.25	0	22.8	1.82	1.7	FAIL
AC-3	CV	7020	7.5	0	4.50	0	12.0	1.71	1.2	FAIL
AC-4	CV	18850	20	0	0.50	0	20.5	1.09	1.2	PASS
AC-5	CV	50000	50	0	1.41	0	51.4	1.03	1.1	PASS
AC-6	VAV	7000	10	5	0.00	0	15.0	2.14	1.7	FAIL
AC-7	VAV	11500	15	7.5	0.58	0	23.1	2.01	1.7	FAIL
AC-8	CV	7220	7.5	0	27.25	0	34.8	4.81	1.2	FAIL
AC-9	CV	4000	5	0	2.75	0	7.8	1.94	1.2	FAIL
AC-10	CV	2850	5	0	5.50	0	10.5	3.68	1.2	FAIL

U.S. Green Building Council
Process for Appeal of LEED Certification

1. Formal appeal of LEED certification – Appellant Action
    a. If an individual/group has evidence that a project that has been awarded LEED certification fails to meet any of the credits/prerequisites that have been awarded to the project, the individual(s) has the opportunity to file an appeal
    b. Appellant must submit a signed letter (including appellant contact information and relationship to the project in question) outlining project deficiencies (an online .pdf form is currently being developed to replace email/hard copy filing)
    c. Appellant is required to submit supplemental evidence documenting specific non-compliance with LEED requirements and indicate how this information was obtained

2. Administrative Review – USGBC Staff Action
    a. Binder/LEED Online file is pulled
    b. Credit analysis is conducted
        i. Staff determines if the credit(s)/prerequisite(s) being questioned is/are something that the project team was awarded
        ii. Staff determines if denial of the point(s)/prerequisite(s) in question change the overall LEED Rating
        iii. Staff initiates technical review if warranted

3. Technical Review – USGBC Staff Action with consultant assistance as needed (consultants will have no conflict of interest with either LEED project team or appellant)
    a. Detailed technical review of documentation submitted (by LEED project team) which served as basis of award of credit/prerequisite
    b. Detailed technical review of documentation provided by appellant
    c. Determination if further action is required

4. Communication to Owner/Project Team and or Petitioner – USGBC Staff Action
    a. If no basis for further investigation is found, petitioner will be notified that review of documentation has been conducted and that no discrepancy was found. No further action required. Process ends
    b. If technical review uncovers basis for further action, proceed to step 5

5. Conference call with LEED Project owner/project team – USGBC Staff and LEED Owner/Project Team
    a. Staff establishes basis of complaint and results of technical review which served as grounds for further action
        i. Staff provides LEED Project Team with un-edited documentation provided by Appellant

    - ii. Staff provides additional documentation (any documents generated during staff technical review) to LEED Project Team as needed
  - b. Owner/Project Team follow-up steps are defined – formal appeal of LEED Certified Project begins

6. Appeal Review – USGBC Staff with consultant assistance as needed
   - a. Technical Review of additional documentation provided to USGBC by LEED Project Team/Owner
   - b. Follows LEED review process as outlined here: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1497

7. Follow-up action taken – USGBC Staff
   - a. Credit/prerequisite is supported by additional documentation no take corrective action
     - i. Process and outcomes are documented
     - ii. Notification of LEED project team and appellant of outcome
   - b. Credit/prerequisite is not supported by additional documentation corrective action is required
     - i. Point/prerequisite is denied – owner/project team does not appeal
       1. Process is documented
       2. Process ends and Appellant is notified of results
          - a. Final review is amended
          - b. Website is adjusted
          - c. Plaque is collected/exchanged if necessary
     - ii. Point/prerequisite is denied – owner/project team appeal
       1. Follow second appeal procedures for LEED reviews
       2. Results of this process (once concluded) are documented and petitioner is notified
          - a. Final review is amended
          - b. Website is adjusted
          - c. Plaque is collected/exchanged if necessary
     - iii. Point is denied – owner/project team pursue another LEED credit
       1. Appeal review procedures are followed
       2. Results of this process (once concluded) are documented and Appellant is notified
          - a. Final review is amended
          - b. Website is adjusted
          - c. Plaque is collected/exchanged if necessary

Appendix 12

LEED for New Construction v2.0/2.1

Northland Pines High School
Project # 10001516
Certification Level: GOLD
10 May 2007

40 Points Achieved — Possible Points: **69**

Certified 26 to 32 points · Silver 33 to 38 points · Gold 39 to 51 points · Platinum 52 or more points

7 Sustainable Sites — Possible Points: 14

Y			
Y	Prereq 1	**Erosion & Sedimentation Control**	
1	Credit 1	**Site Selection**	1
	Credit 2	**Development Density**	1
	Credit 3	**Brownfield Redevelopment**	1
	Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
1	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
	Credit 4.3	**Alternative Transportation**, Alternative Fuel Vehicles	1
1	Credit 4.4	**Alternative Transportation**, Parking Capacity & Carpooling	1
1	Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
1	Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
1	Credit 6.1	**Stormwater Management**, Rate & Quantity	1
1	Credit 6.2	**Stormwater Management**, Treatment	1
	Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
	Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
	Credit 8	**Light Pollution Reduction**	1

4 Water Efficiency — Possible Points: 5

Y			
1	Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
1	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
	Credit 2	**Innovative Wastewater Technologies**	1
1	Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1	Credit 3.2	**Water Use Reduction**, 30% Reduction	1

10 Energy & Atmosphere — Possible Points: 17

Y			
Y	Prereq 1	**Fundamental Building Systems Commissioning**	
Y	Prereq 2	**Minimum Energy Performance**	
Y	Prereq 3	**CFC Reduction in HVAC&R Equipment**	
1	Credit 1.1	**Optimize Energy Performance**, 15% New / 5% Existing	1
1	Credit 1.2	**Optimize Energy Performance**, 20% New / 10% Existing	1
1	Credit 1.3	**Optimize Energy Performance**, 25% New / 15% Existing	1
1	Credit 1.4	**Optimize Energy Performance**, 30% New / 20% Existing	1
1	Credit 1.5	**Optimize Energy Performance**, 35% New / 25% Existing	1
1	Credit 1.6	**Optimize Energy Performance**, 40% New / 30% Existing	1
1	Credit 1.7	**Optimize Energy Performance**, 45% New / 35% Existing	1
	Credit 1.8	**Optimize Energy Performance**, 50% New / 40% Existing	1
	Credit 1.9	**Optimize Energy Performance**, 55% New / 45% Existing	1
	Credit 1.10	**Optimize Energy Performance**, 60% New / 50% Existing	1
	Credit 2.1	**Renewable Energy**, 5%	1
	Credit 2.2	**Renewable Energy**, 10%	1
	Credit 2.3	**Renewable Energy**, 15%	1
1	Credit 3	**Additional Commissioning**	1
1	Credit 4	**Ozone Depletion**	1
1	Credit 5	**Measurement & Verification**	1
	Credit 6	**Green Power**	1

6 Materials & Resources — Possible Points: 13

Y			
Y	Prereq 1	**Storage & Collection of Recyclables**	
	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
	Credit 1.2	**Building Reuse**, Maintain 100% of Shell	1
	Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
1	Credit 2.1	**Construction Waste Management**, Divert 50%	1
1	Credit 2.2	**Construction Waste Management**, Divert 75%	1
	Credit 3.1	**Resource Reuse**, Specify 5%	1
	Credit 3.2	**Resource Reuse**, Specify 10%	1
1	Credit 4.1	**Recycled Content**, Specify 5%	1
1	Credit 4.2	**Recycled Content**, Specify 10%	1
1	Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
1	Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
	Credit 6	**Rapidly Renewable Materials**	1
	Credit 7	**Certified Wood**	1

8 Indoor Environmental Quality — Possible Points: 15

Y			
Y	Prereq 1	**Minimum IAQ Performance**	
Y	Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	
1	Credit 1	**Carbon Dioxide Monitoring**	1
	Credit 2	**Ventilation Effectiveness**	1
1	Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
1	Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
	Credit 4.2	**Low-Emitting Materials**, Paints	1
1	Credit 4.3	**Low-Emitting Materials**, Carpet	1
	Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
1	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
	Credit 6.1	**Controllability of Systems**, Perimeter	1
	Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
1	Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
1	Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
	Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
	Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

5 Innovation & Design Process — Possible Points: 5

Y			
1	Credit 1.1	**Innovation in Design: Green Building Education**	1
1	Credit 1.2	**Innovation in Design: Green Cleaning/Housekeeping**	1
1	Credit 1.3	**Innovation in Design: Exemplary Performance, MRc4**	1
1	Credit 1.4	**Innovation in Design: Exemplary Performance, MRc5.1**	1
1	Credit 2	**LEED® Accredited Professional**	1

AIR CONDITIONING UNITS

UNIT NO.	SERVICE	TYPE	CFM OF STD AIR	CFM OF O.A.	MAX. O.V.	FAN DIA.	FAN WHEEL TYPE	EXT. S.P. IN IN. WATER	MOTOR HP	FACE AND BY-PASS TYPE	FILTER TYPE	VOLUME CONTROL	SUPPORT	VIBRATION ISOLATORS TYPE	VIBRATION ISOLATORS MIN. STATIC DEFLECTION	HEATING COIL MAX. FACE VEL.	HEATING COIL ENT. AIR TEMP.	HEATING COIL LV. AIR TEMP.	HEATING COIL ENT. WATER TEMP.	HEATING COIL LV. WATER TEMP.	HEATING COIL MAX. WATER P.D.	HEATING COIL GPM	HEATING COIL BRANCH PIPE SIZE	COOLING COIL MAX. FACE VEL.	COOLING COIL ENT. AIR D.B.	COOLING COIL ENT. AIR W.B.	COOLING COIL LV. AIR D.B.	COOLING COIL LV. AIR W.B.	COOLING COIL ENT. GLYCOL TEMP.	COOLING COIL LV. GLYCOL TEMP.	COOLING COIL ETHYLENE GLYCOL %	COOLING COIL MAX. WATER P.D.	COOLING COIL GPM	COOLING COIL BRANCH PIPE SIZE	MANUF. MODEL
AC-1	AUDITORIUM	HORIZ.	16,000	1600/8740	2150	24.5"	AF	1.25"	15	INTERNAL	4" PLEATED	–	CONC. PAD	B	1"	640	18°	85°	200°	160°	10	57.9	2-1/2"	460	85°	69°	55°	54°	42°	55°	35%	10	118.5	3"	TRANE #35
AC-2	BAND/MUSIC	HORIZ.	12,500	3120	2275	22"	AF	3.5"	15	–	4" PLEATED	VFD-1	CONC. PAD	B	1"	500	45°	70°	200°	160°	10	16.9	1-1/2"	500	79°	66°	55°	54°	42°	55°	35%	10	70.1	3"	TRANE #25
AC-3	KITCHEN	HORIZ.	7020	2375/7020	2450	16.5"	FC	2.25"	7.5	INTERNAL	4" PLEATED	–	CONC. PAD	B	1"	690	-25°	70°	200°	160°	10	36.0	2"	510	95°	75°	55°	54°	42°	55°	35%	10	76.6	3"	TRANE #14
AC-4	COMMONS	HORIZ.	18,850	1800/5670	2530	24.5"	AF	2.0"	20	INTERNAL	4" PLEATED	–	CONC. PAD	B	1"	750	41°	85°	200°	160°	10	44.8	2-1/2"	540	81°	67°	55°	54°	42°	55°	35%	10	159.2	4"	TRANE #35
AC-5	GYM	HORIZ.	50,000	5000/21,000	2040	44.5"	AF	2.25"	50	INTERNAL	4" PLEATED	VFD-4	CONC. PAD	B	1"	700	30°	85°	200°	160°	10	148.5	4"	500	83°	69°	55°	54°	42°	55°	35%	10	366.9	5"	TRANE #100
AC-6	OFFICE/ADMIN.	HORIZ.	7000	880	2450	18"	AF	3.5"	10	–	4" PLEATED	VFD-2	CONC. PAD	B	1"	500	56°	70°	200°	160°	10	5.3	1"	500	77°	65°	55°	54°	42°	55°	35%	10	34.9	2"	TRANE #14
AC-7	WEIGHT RMS.	HORIZ.	11,500	2480	2100	22"	AF	4.0"	15	–	4" PLEATED	VFD-3	CONC. PAD	B	1"	460	43°	70°	200°	160°	10	16.8	1-1/2"	460	79°	65°	55°	54°	42°	55°	35%	10	60.5	2-1/2"	TRANE #25
AC-8	WOOD SHOP/BUILD. TECH.	HORIZ.	7220	1050/7220	2200	16.5"	FC	1.75"	7.5	INTERNAL	4" PLEATED	–	CONC. PAD	B	1"	740	-25°	85°	200°	160°	10	42.9	2-1/2"	520	95°	75°	55°	54°	42°	55°	35%	10	78.9	3"	TRANE #14
AC-9	METAL SHOP	HORIZ.	4000	560/4000	2110	12.25"	FC	1.5"	5	INTERNAL	4" PLEATED	–	CONC. PAD	B	1"	820	-25°	85°	200°	160°	10	23.8	2"	500	95°	75°	55°	54°	42°	55°	35%	10	43.8	2-1/2"	TRANE #08
AC-10	TRANSPORTATION SHOP	HORIZ.	2850	1240/2850	2050	10.5"	FC	1.5"	5	INTERNAL	4" PLEATED	–	CONC. PAD	B	1"	820	-25°	85°	200°	160°	10	16.9	1-1/2"	475	95°	75°	55°	54°	42°	55°	35%	10	31.2	2"	TRANE #06

NOTE: FILTERS USED DURING CONSTRUCTION SHALL USE A MINIMUM MERV 8 FILTER MEDIA. FILTERS INSTALLED PRIOR TO OWNERS OCCUPANCY SHALL BE A MINIMUM MERV 13. FILTERS SHALL BE PROVIDED AND MAINTAINED BY THE MECHANICAL CONTRACTOR THRU CONSTRUCTION TO OWNER OCCUPANCY.

HEAT RECOVERY AIR CONDITIONING UNITS

UNIT NO.	SERVICE	SUPPLY CFM OF STD AIR	SUPPLY CFM OF O.A.	SUPPLY FAN DIA.	SUPPLY FAN WHEEL TYPE	SUPPLY EXT. S.P. IN IN. WATER	SUPPLY MOTOR HP	SUPPLY FILTER TYPE	SUPPLY VOLUME CONTROL	RELIEF CFM OF STD AIR	RELIEF FAN WHEEL TYPE	RELIEF FAN DIA.	RELIEF EXT. S.P. IN IN. WATER	RELIEF MOTOR HP	RELIEF VOLUME CONTROL	RECLAIM SUPPLY CFM OF STD. AIR	WHEEL MOTOR HP	SPEED CONTROL	WINTER E.A.T. D.B.	WINTER E.A.T. W.B.	WINTER L.A.T. D.B.	WINTER L.A.T. W.B.	SUMMER E.A.T. D.B.	SUMMER E.A.T. W.B.	SUMMER L.A.T. D.B.	SUMMER L.A.T. W.B.	RECLAIM EXHAUST CFM OF STD. AIR	FILTER TYPE	WINTER E.A.T. D.B.	WINTER E.A.T. W.B.	WINTER L.A.T. D.B.	WINTER L.A.T. W.B.	SUMMER E.A.T. D.B.	SUMMER E.A.T. W.B.	SUMMER L.A.T. D.B.	SUMMER L.A.T. W.B.
HRAC-1	FIRST FL. NORTH	18,000	4230	32"	PLUG	4.0"	30	2" PLEATED	INTEGRAL VFD	15,700	PLUG	32"	1.25"	15	INTEGRAL VFD	4230	2	INTEGRAL VFD	-25°	-28°	11°	9°	95°	75°	87°	71°	2150	2" PLEATED	70°	54°	-20°	-20°	75°	63°	94°	75°
HRAC-2	FIRST FL. SOUTH	22,000	4980	35"	PLUG	4.0"	30	2" PLEATED	INTEGRAL VFD	20,800	PLUG	35"	1.25"	15	INTEGRAL VFD	4980	2	INTEGRAL VFD	-25°	-28°	36°	28°	95°	75°	82°	68°	3780	2" PLEATED	70°	54°	-13°	-13°	75°	63°	92°	74°
HRAC-3	SECOND FL. NORTH	17,000	4900	32"	PLUG	3.75"	25	2" PLEATED	INTEGRAL VFD	15,500	PLUG	32"	1.25"	15	INTEGRAL VFD	4900	2	INTEGRAL VFD	-25°	-28°	33°	26°	95°	75°	83°	68°	3400	2" PLEATED	70°	54°	-13°	-13°	75°	63°	93°	74°
HRAC-4	SECOND FL. SOUTH	20,000	5800	35"	PLUG	4.0"	30	2" PLEATED	INTEGRAL VFD	18,250	PLUG	35"	1.25"	15	INTEGRAL VFD	5800	2	INTEGRAL VFD	-25°	-28°	31°	25°	95°	75°	83°	69°	3840	2" PLEATED	70°	54°	-13°	-13°	75°	63°	92°	74°

NOTE: FILTERS USED DURING CONSTRUCTION SHALL USE A MINIMUM MERV 8 FILTER MEDIA. FILTERS INSTALLED PRIOR TO OWNERS OCCUPANCY SHALL BE A MINIMUM MERV 13. FILTERS SHALL BE PROVIDED AND MAINTAINED BY THE MECHANICAL CONTRACTOR THRU CONSTRUCTION TO OWNER OCCUPANCY.

HEAT RECOVERY AIR CONDITIONING UNITS (CONT'D)

FACE AND BY-PASS TYPE	HEATING COIL MAX. FACE VEL.	ENT. AIR TEMP.	LV. AIR TEMP.	ENT. WATER TEMP.	LV. WATER TEMP.	MAX. WATER P.D.	GPM	BRANCH PIPE SIZE	COOLING COIL MAX. FACE VEL.	ENT. AIR D.B.	ENT. AIR W.B.	LV. AIR D.B.	LV. AIR W.B.	ENT. GLYCOL TEMP.	LV. GLYCOL TEMP.	ETHYLENE GLYCOL %	MAX. WATER P.D.	GPM	BRANCH PIPE SIZE	VOLTAGE	MANUF. MODEL
INTERNAL	525	45°	70°	200°	160°	10	24.8	2"	500	77.5°	64.4°	55°	54°	42°	55°	35%	10	152.0	4"	480-3-60	HAAKON
INTERNAL	525	45°	70°	200°	160°	10	29.8	2"	500	76.6°	64.0°	55°	54°	42°	55°	35%	10	147.7	4"	480-3-60	HAAKON
INTERNAL	525	45°	70°	200°	160°	10	23.1	2"	500	76.7°	64.1°	55°	54°	42°	55°	35%	10	114.2	3"	480-3-60	HAAKON
INTERNAL	525	45°	70°	200°	160°	10	27.1	2"	500	77.5°	64.4°	55°	54°	42°	55°	35%	10	146.8	4"	480-3-60	HAAKON

IN-LINE FANS

UNIT NO.	SERVICE	CFM OF STD. AIR	EXT. S.P. IN IN. WATER	MOTOR HP	DRIVE	FAN DIA.	SUPPORT	VIBRATION ISOLATORS TYPE	MIN. STATIC DEFLECTION	MANUF. MODEL
IF-1	TOILET B131/B137	345	0.375	1/4	BELT	10"	SUSPENDED	D	1"	GREENHECK BSQ-90
IF-2	SHOWERS G115	1755	0.5	1/4	BELT	16"	SUSPENDED	D	1"	GREENHECK BSQ-160
IF-3	SHOWERS G115	1755	0.5	1/4	BELT	16"	SUSPENDED	D	1"	GREENHECK BSQ-160

BLOWER COIL UNITS

UNIT NO.	SERVICE	TYPE	CFM OF STD AIR	CFM OF O.A.	MAX. O.V.	FAN DIA.	EXT. S.P. IN IN. WATER	MOTOR HP	FILTER TYPE	SUPPORT	VIBRATION ISOLATORS TYPE	MIN. STATIC DEFLECTION	HEATING COIL MAX. FACE VEL.	ENT. AIR TEMP.	LV. AIR TEMP.	ENT. WATER TEMP.	LV. WATER TEMP.	GPM	BRANCH PIPE SIZE	COOLING COIL MAX. FACE VEL.	ENT. AIR D.B.	ENT. AIR W.B.	LV. AIR D.B.	LV. AIR W.B.	ENT. GLYCOL TEMP.	LV. GLYCOL TEMP.	GLYCOL CONCENTRATION %	GPM	BRANCH PIPE SIZE	MANUF. MODEL
BCU-1	BOY'S TEAM LKRS. G125	HORIZ.	2065	–	1730	12 1/2"	2"	2	2" PLEATED	SUSPENDED	D	1"	520	55°	85°	200°	180°	6.7	1-1/4"	520	75°	63°	55°	54°	45°	55°	35%	8.9	1-1/4"	TRANE BCHB-054
BCU-2	GIRL'S TEAM LKSR F108	HORIZ.	1590	–	1350	12 1/2"	2"	2	2" PLEATED	SUSPENDED	D	1"	400	55°	85°	200°	180°	5.2	1"	400	75°	63°	55°	54°	45°	55°	35%	6.9	1-1/4"	TRANE BCHB-054

AIR COOLED GLYCOL CHILLER

UNIT NO.	EVAPORATOR NOM. CAP. ~~TONS~~	ENT. GLY. TEMP.	LV. GLY. TEMP.	~~GPM~~	MAX. CHILLER P.D. IN FT. WATER	COMPRESSOR-CONDENSERS TYPE	NO. OF COMP.	FULL LOAD ~~COMP. KW~~	FANS NO.	FANS DIA.	MOTOR HP	TOTAL ~~CFM~~	DRIVE	DESIGN AMBIENT TEMP.	REF. TYPE	COP	MIN. CIRC. ~~AMPS~~	MOCP	UNIT VOLTAGE	SUPPORT	VIBRATION ISOLATORS TYPE	MIN. STATIC DEFLECTION	~~MANUF. MODEL~~
GC-1	400	55°	42°	780	25	ROTARY	4	437.4	28	30	1-1/2	257,626	DIRECT	95°	HCF-134a	2.9	882	1000	480-3-60	EQUIP. CURB	C	1"	TRANE RTAC-400

FAN COIL UNITS

UNIT NO.	SERVICE	TYPE	CFM OF STD. AIR	MOTOR H.P.	DRIVE	SPEED	RECESS	HEATING COIL TOTAL CAP. MBH	ENT. WATER TEMP.	LV. WATER TEMP.	GPM	BRANCH PIPE SIZE	COOLING COIL TOTAL CAP. MBH	ENT. CHILLED WATER TEMP.	LV. CHILLED WATER TEMP.	GPM	BRANCH PIPE SIZE	MANUF. MODEL
FC-1	COACH G121	C	660	1/8	DIRECT	3	10 1/2"	20.0	200°	180°	2.0	3/4"	14.3	45°	55°	2.9	3/4"	TRANE FC-06
FC-2	BOY'S PE G109/G104	C	1165	1/16 / 1/8	DIRECT	3	10 1/2"	40.0	200°	180°	4.0	1"	25.2	45°	55°	5.0	1"	TRANE FC-12
FC-3	CONF./REF. 105/106	C	430	1/16	DIRECT	3	10 1/2"	12.5	200°	180°	1.3	1/2"	9.3	45°	55°	1.9	3/4"	TRANE FC-04
FC-4	GIRLS PE LOCKER	C	900	1/8 / 1/4	DIRECT	3	10 1/2"	25.0	200°	180°	2.5	3/4"	19.4	45°	45°	3.9	1"	TRANE FC-10
FC-5	COACH F121	C	660	1/8	DIRECT	3	10 1/2"	20.0	200°	180°	2.0	3/4"	14.3	45°	45°	2.9	3/4"	TRANE FC-06

PUMPS

UNIT NO.	SERVICE	SIZE	GPM	FT. OF WATER HEAD	MOTOR HP	MOTOR RPM	SUPPORT	VARIABLE FREQ. DRIVE	VIBRATION ISOLATORS TYPE	MIN. STATIC DEFLECTION	SUCTION DIFFUSER INLET SIZE	OUTLET SIZE	START-UP STRAINER	MANUF. MODEL
P-1	HOT WATER SYSTEM	6x5	920	150	50	1750	CONC. PAD	YES	IB	1"	8"	6"	YES	B&G 1510 5G
P-2	HOT WATER SYSTEM	6x5	~~920~~	150	50	1750	CONC. PAD	YES	IB	1"	8"	6"	YES	B&G 1510 5G
P-3	PRIMARY GLYCOL LOOP	6x5	780	70	25	1750	CONC. PAD	–	IB	1"	8"	6"	YES	B&G 1510 5BC
P-4	SECONDARY GLYCOL LOOP	6x5	780	160	60	1750	CONC. PAD	YES	IB	1"	8"	6"	YES	B&G 1510 5G

CABINET FANS

UNIT NO.	SERVICE	TYPE	CFM OF STD. AIR	MAX. O.V.	FAN DIA.	FAN WHEEL TYPE	EXT. S.P. IN IN. ~~WATER~~	MOTOR HP	VOLUME CONTROL	FILTER MIXING BOX	SUPPORT	VIBRATION ISOLATORS TYPE	MIN. STATIC DEFLECTION	MANUF. MODEL
CF-1	AC-1	HORIZ.	16,000	2150	24.5"	AF	0.75"	7 1/2	–	–	CONC. PAD	B	1"	TRANE #35
CF-2	AC-2	HORIZ.	11,760	2273	22.0"	AF	1"	7 1/2	VFD-5	–	CONC. PAD	B	1"	TRANE #25
CF-3	AC-6	HORIZ.	6660	2450	18"	AF	1"	5	VFD-6	–	CONC. PAD	B	1"	TRANE #14
CF-4	AC-7	HORIZ.	10,840	2100	22"	AF	1.25"	7 1/2	VFD-7	–	CONC. PAD	B	1"	TRANE #25
CF-5	BOILER ROOM	HORIZ.	3000	1200	10.5"	FC	0.5"	2	–	YES	SUSPENDED	D	1"	TRANE #06

GENERAL NOTES:

A. ROUTE ALL PIPING AND DUCTWORK AS REQUIRED TO AVOID CONFLICTS WITH OTHER TRADES. PROVIDE ALL OFFSETS, ELBOWS, ETC., AS REQUIRED TO CONNECT BETWEEN POINTS INDICATED.

B. MECHANICAL CONTRACTOR SHALL VERIFY CURRENT CHARACTERISTICS WITH THE ELECTRICAL CONTRACTOR PRIOR TO ORDERING EQUIPMENT.

C. MECHANICAL CONTRACTOR SHALL COORDINATE EXACT OUTLET AND GRILLE LOCATIONS WITH FINAL LIGHTING LAYOUT.

D. ELECTRICAL, STRUCTURAL, PLUMBING, ETC. REQUIREMENTS FOR THE EQUIPMENT MANUFACTURER LISTED ON THE SCHEDULE IS REFLECTED ON THE DOCUMENTS OF OTHER TRADES. ANY MODIFICATIONS NECESSARY TO ACCOMMODATE A MANUFACTURER OTHER THAN THAT LISTED IS THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR.

E. FOR ALL DUCTWORK 3" PRESSURE CLASS AND UP THE MECHANICAL CONTRACTOR SHALL PERFORM LEAK TESTING IN ACCORDANCE WITH SMACNA. SUBMIT REPORTS TO COMMISSIONING AGENT AND ENGINEER.

LEED's Bag !!?

SYMBOLS

HS	HOT WATER SUPPLY		FLOW DIRECTION
HR	HOT WATER RETURN	AD	AUTOMATIC DAMPER
GS	GLYCOL SUPPLY	VD	MANUAL VOLUME DAMPER
GR	GLYCOL RETURN	FD	FIRE DAMPER WITH ACCESSIBLE DUCT ACCESS DOOR
PGS	PRIMARY CHILLED GLYCOL SUPPLY	ASBD	ADJUSTABLE SELF-ACTING BACKDRAFT DAMPER
PGR	PRIMARY CHILLED GLYCOL RETURN		1" THICK ACOUSTICAL INSULATION LINING ON INSIDE OF DUCT. LISTED DIMENSION IS CLEAR INSIDE DIMENSION.
	FLEXIBLE DUCT		TURNING VANES
G	GAS		BRANCH TAKE-OFF
	GATE VALVE	UC	1" DOOR UNDERCUT. DOOR UNDERCUT BY GEN. CONTR.
	BUTTERFLY VALVE	T	ROOM SENSOR OR THERMOSTAT
CBV	CALIBRATED BALANCING VALVE	H	HUMIDITY SENSOR
	BALL VALVE	S1	FAN SPEED SWITCH
	BALANCING VALVE	S2	FAN SELECTOR SWITCH
DV	DRAIN VALVE		
	UNION		
	THERMOMETER		
	CHECK VALVE		

WISCONSIN BERT THOMAS FREDERICKSEN E-23249 MILWAUKEE, WIS. PROFESSIONAL ENGINEER

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		H2.5	FIRST FLR. DUCT PLAN – E	H3.1	FIRST FLR. PIPE PLAN – A	H3.11	SECOND FLR. PIPE PLAN – D	H4.7	ENLRG. MECH. RM. PLAN
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H2.2	FIRST FLR. DUCT PLAN – B	H2.12	SECOND FLR. DUCT PLAN – E	H3.8	SECOND FLR. PIPE PLAN – A	H4.4	ENLRG. MECH. RM. DUCT PLAN		
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DATE	03-18-05
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NORTHLAND PINES SCHOOL DISTRICT

NEW NORTHLAND PINES HIGH SCHOOL

1800 PLEASURE ISLAND DRIVE
EAGLE RIVER, WI. 54521

H1.1

03422

VARIABLE AIR VOLUME BOXES

BOX								HEATING COIL								
UNIT NO.	SERVICE	CFM OF STD. AIR	BOX INLET DIA.	INLET DUCT DIA.	NO. OF OUTLETS	OUTLETS DIA.	MAX. AIR P.D. IN IN. WATER	HEATING AIR FLOW	ENT. AIR TEMP.	LV. AIR TEMP.	ENT. WATER TEMP.	LV. WATER TEMP.	MAX. FINS PER IN.	GPM	BRANCH PIPE SIZE	MANUF. MODEL
V–1	CLASSROOM A109	1000	10”	12”	–	–	0.5”	680	55°	85°	200°	180°	10	2.2	3/4”	TRANE VCWF
V–2	CLASSROOM A106	1000	10”	12”	–	–	0.5”	680	55°	85°	200°	180°	10	2.2	3/4”	TRANE VCWF
V–3	TPC A113	450	6”	8”	–	–	0.5”	300	55°	85°	200°	180°	10	1.0	1/2”	TRANE VCWF
V–4	CLASSROOM A116	1000	10”	12”	–	–	0.5”	665	55°	85°	200°	180°	10	2.2	3/4”	TRANE VCWF
V–5	CORRIDOR A103	1250	12”	14”	–	–	0.5”	625	55°	85°	200°	180°	10	2.0	3/4”	TRANE VCWF
V–6	2D ART A133	1800	14”	16”	–	–	0.5”	1200	55°	95°	200°	180°	10	5.3	1”	TRANE VCWF
V–7	3D ART A135	1800	14”	16”	–	–	0.5”	1290	55°	85°	200°	180°	10	4.3	1”	TRANE VCWF
V–8	OFFICE A136/DIR. A132	840	10”	12”	–	–	0.5”	575	55°	85°	200°	180°	10	1.9	3/4”	TRANE VCWF
V–9	DRAFTING A117	1950	14”	16”	–	–	0.5”	1300	55°	85°	200°	180°	10	4.3	1”	TRANE VCWF
V–10	BUS. CLASSROOM A129	1800	14”	16”	–	–	0.5”	1030	55°	85°	200°	180°	10	3.3	3/4”	TRANE VCWF
V–11	TECH LAB A120	2200	14”	16”	–	–	0.5”	1490	55°	85°	200°	180°	10	4.9	1”	TRANE VCWF
V–12	BUS. LAB A127	2500	16”	18”	–	–	0.5”	1280	55°	85°	200°	180°	10	4.2	1”	TRANE VCWF
V–13	OFFICE A128	450	6”	8”	–	–	0.5”	375	55°	95°	200°	180°	10	1.6	1/2”	TRANE VCWF
V–14	RECORDS B144	330	5”	6”	–	–	0.5”	220	55°	85°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–15	CONFERENCE B143	280	5”	6”	–	–	0.5”	200	55°	85°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–16	GUIDANCE OFFICE B142	240	5”	6”	–	–	0.5”	200	55°	95°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–17	GUIDANCE OFFICE B141	240	5”	6”	–	–	0.5”	200	55°	95°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–18	GUIDANCE CENTER B145	980	10”	12”	–	–	0.5”	655	55°	85°	200°	180°	10	2.1	3/4”	TRANE VCWF
V–19	ITIN. OFFICE B140	240	5”	6”	–	–	0.5”	200	55°	95°	200°	180°	10	0.9	1/2”	TRANE VCWF
V–20	ITIN. OFFICE B139	200	5”	6”	–	–	0.5”	130	55°	85°	200°	180°	10	0.4	1/2”	TRANE VCWF
V–21	ITIN. OFFICE B136	200	5”	6”	–	–	0.5”	120	55°	85°	200°	180°	10	0.4	1/2”	TRANE VCWF
V–22	OFFICE B135	260	5”	6”	–	–	0.5”	175	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–23	COPY B134	300	5”	6”	–	–	0.5”	200	55°	85°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–24	OT/PT B133	400	6”	8”	–	–	0.5”	250	55°	85°	200°	180°	10	0.8	1/2”	TRANE VCWF
V–25	CD CLASSROOM B129	1000	10”	12”	–	–	0.5”	1080	55°	85°	200°	180°	10	3.5	3/4”	TRANE VCWF
V–26	PREP B107 / B106	430	6”	8”	–	–	0.5”	300	55°	85°	200°	180°	10	0.9	1/2”	TRANE VCWF
V–27	CHEM B105	2200	14”	16”	–	–	0.5”	1475	55°	85°	200°	180°	10	4.8	1”	TRANE VCWF
V–28	PHY. SCIENCE B111	2200	14”	16”	–	–	0.5”	1500	55°	85°	200°	180°	10	4.9	1”	TRANE VCWF
V–29	PREP B112	225	5”	6”	–	–	0.5”	150	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–30	HEAD HOUSE B113	490	8”	10”	–	–	0.5”	325	55°	85°	200°	180°	10	1.1	1/2”	TRANE VCWF
V–31	IND. STUDY B109	870	10”	12”	–	–	0.5”	580	55°	85°	200°	180°	10	1.9	3/4”	TRANE VCWF
V–32	BIOLOGY B115	2200	14”	16”	–	–	0.5”	1500	55°	85°	200°	180°	10	4.9	1”	TRANE VCWF
V–33	CORRIDOR B119	1000	10”	12”	–	–	0.5”	500	55°	85°	200°	180°	10	1.6	1/2”	TRANE VCWF
V–34	DIST. LEARNING B126	1300	12”	14”	–	–	0.5”	690	55°	85°	200°	180°	10	2.2	3/4”	TRANE VCWF
V–35	MED. STUDIO B125	800	10”	12”	–	–	0.5”	425	55°	85°	200°	180°	10	1.4	1/2”	TRANE VCWF
V–36	HEAD END B124	800	10”	12”	–	–	0.5”	425	55°	85°	200°	180°	10	1.4	1/2”	TRANE VCWF
V–37	COMPUTER CLSRM B123	1800	14”	16”	–	–	0.5”	915	55°	85°	200°	180°	10	2.9	3/4”	TRANE VCWF
V–38	PREP. B117	380	6”	8”	–	–	0.5”	250	55°	85°	200°	180°	10	0.8	1/2”	TRANE VCWF
V–39	WORKROOM B122	1000	10”	12”	–	–	0.5”	670	55°	85°	200°	180°	10	2.2	3/4”	TRANE VCWF
V–40	STORAGE B121	500	8”	10”	–	–	0.5”	335	55°	85°	200°	180°	10	1.1	1/2”	TRANE VCWF
V–41	OFFICE B120	300	5”	6”	–	–	0.5”	190	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–42	I.M.C. C109	2600	16”	18”	–	–	0.5”	1700	55°	85°	200°	180°	10	5.5	1”	TRANE VCWF
V–43	LIFE SCIENCE B118	2200	14”	16”	–	–	0.5”	1500	55°	85°	200°	180°	10	4.9	1”	TRANE VCWF
V–44	I.M.C. C109	2600	16”	18”	–	–	0.5”	1700	55°	85°	200°	180°	10	5.5	1”	TRANE VCWF
V–45	STAFF C107	725	8”	10”	–	–	0.5”	500	55°	85°	200°	180°	10	1.6	1/2”	TRANE VCWF
V–46	WEB ROOM C112	700	8”	10”	–	–	0.5”	350	55°	85°	200°	180°	10	1.1	1/2”	TRANE VCWF
V–47	CONFERENCE C111	300	5”	6”	–	–	0.5”	200	55°	85°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–48	CONFERENCE C110	300	5”	6”	–	–	0.5”	200	55°	85°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–49	LIASION C113	190	5”	6”	–	–	0.5”	130	55°	85°	200°	180°	10	0.4	1/2”	TRANE VCWF
V–50	A.O.D.A. C114	190	5”	6”	–	–	0.5”	120	55°	85°	200°	180°	10	0.4	1/2”	TRANE VCWF
V–51	ARCHIVES C115	160	5”	6”	–	–	0.5”	110	55°	85°	200°	180°	10	0.4	1/2”	TRANE VCWF
V–52	BREAK C116	255	5”	6”	–	–	0.5”	170	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–53	CONERENCE C117	300	5”	6”	–	–	0.5”	190	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–54	PRINCIPAL C118	400	6”	8”	–	–	0.5”	245	55°	85°	200°	180°	10	0.8	1/2”	TRANE VCWF
V–55	DEAN C119	310	5”	6”	–	–	0.5”	210	55°	85°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–56	I.S.S. C128/C129	150	5”	6”	–	–	0.5”	70	55°	85°	200°	180°	10	0.2	1/2”	TRANE VCWF
V–57	NURSE C127	240	5”	6”	–	–	0.5”	160	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–58	RECEPT. C120	880	10”	12”	–	–	0.5”	590	55°	85°	200°	180°	10	1.9	3/4”	TRANE VCWF
V–59	WORK RM C121	510	8”	10”	–	–	0.5”	340	55°	85°	200°	180°	10	1.1	1/2”	TRANE VCWF
V–60	MAIL C122	135	5”	6”	–	–	0.5”	90	55°	85°	200°	180°	10	0.3	1/2”	TRANE VCWF
V–61	RECEPT. D101	530	8”	10”	–	–	0.5”	360	55°	85°	200°	180°	10	1.2	1/2”	TRANE VCWF
V–62	OFFICE D114	240	5”	6”	–	–	0.5”	165	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–63	OFFICE D113	230	5”	6”	–	–	0.5”	160	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–64	DIST. ADMIN. D103	370	6”	8”	–	–	0.5”	250	55°	85°	200°	180°	10	0.8	1/2”	TRANE VCWF
V–65	CONF. D104	400	6”	8”	–	–	0.5”	270	55°	85°	200°	180°	10	0.9	1/2”	TRANE VCWF
V–66	BREAK D110	220	5”	6”	–	–	0.5”	145	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–67	OFFICE D105	290	5”	6”	–	–	0.5”	190	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–68	RECORDS D108	710	8”	10”	–	–	0.5”	475	55°	85°	200°	180°	10	1.5	1/2”	TRANE VCWF
V–69	OFFICE D106	240	5”	6”	–	–	0.5”	160	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–70	OFFICE D107	260	5”	6”	–	–	0.5”	175	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–71	INST. STOR. D118	850	10”	12”	–	–	0.5”	600	55°	85°	200°	180°	10	1.9	3/4”	TRANE VCWF
V–72	PRACTICE D121	424	6”	8”	–	–	0.5”	370	55°	85°	200°	180°	10	1.2	1/2”	TRANE VCWF
V–73	OFFICE D119	300	5”	6”	–	–	0.5”	200	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–74	PRACTICE D122–125	420	6”	8”	–	–	0.5”	240	55°	85°	200°	180°	10	0.8	1/2”	TRANE VCWF
V–75	BAND D127	2050	14”	16”	–	–	0.5”	1370	55°	85°	200°	180°	10	4.4	1”	TRANE VCWF
V–76	BAND D127	2050	14”	16”	–	–	0.5”	1370	55°	85°	200°	180°	10	4.4	1”	TRANE VCWF

SEALED COMBUSTION BOILERS

UNIT NO.	TYPE	AGA INPUT BTUH	AGA OUTPUT BTUH	FUEL TYPE	GAS PRESS. AT INLET TO TRAIN	EXHAUST AIR PIPE SIZE	SUPPLY AIR PIPE SIZE	SUPPORT	MANUF. MODEL
B–1	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2
B–2	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2
B–3	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2
B–4	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2
B–5	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2
B–6	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2
B–7	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2
B–8	HOT WATER	2,000,000	1,700,000	NAT. GAS	2	12”ø	12”ø	CONC. PAD	P–K SN2000–2

VARIABLE AIR VOLUME BOXES (CONT'D)

BOX								HEATING COIL								
UNIT NO.	SERVICE	CFM OF STD. AIR	BOX INLET DIA.	INLET DUCT DIA.	NO. OF OUTLETS	OUTLETS DIA.	MAX. AIR P.D. IN IN. WATER	HEATING AIR FLOW	ENT. AIR TEMP.	LV. AIR TEMP.	ENT. WATER TEMP.	LV. WATER TEMP.	MAX. FINS PER IN.	GPM	BRANCH PIPE SIZE	MANUF. MODEL
V–77	UNIFORM D126	500	8”	10”	–	–	0.5”	330	55°	85°	200°	180°	10	1.1	1/2”	TRANE VCWF
V–78	MUSIC D154	150	5”	6”	–	–	0.5”	150	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–79	OFFICE D130	250	5”	6”	–	–	0.5”	170	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–80	VOCAL D128	2700	24x16	24x16	–	–	0.5”	1800	55°	85°	200°	180°	10	5.8	1”	TRANE VCWF
V–81	ROBES D131	150	5”	6”	–	–	0.5”	170	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–82	PRACTICE D132	340	5”	6”	–	–	0.5”	190	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–83	PRACTICE D133–135	315	5”	6”	–	–	0.5”	180	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–84	SCENE SHOP D136	1780	14”	16”	–	–	0.5”	1180	55°	85°	200°	180°	10	3.8	1”	TRANE VCWF
V–85	DRAMA D137	1540	14”	16”	–	–	0.5”	1020	55°	85°	200°	180°	10	3.3	3/4”	TRANE VCWF
V–86	PIANO D159	150	5”	6”	–	–	0.5”	140	55°	85°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–87	COSTUME E106	430	6”	8”	–	–	0.5”	290	55°	85°	200°	180°	10	0.9	1/2”	TRANE VCWF
V–88	MAKE–UP E107	520	8”	10”	–	–	0.5”	340	55°	85°	200°	180°	10	1.1	1/2”	TRANE VCWF
V–89	DRESS E109	250	5”	6”	–	–	0.5”	120	55°	85°	200°	180°	10	0.4	1/2”	TRANE VCWF
V–90	DRESS E108	190	5”	6”	–	–	0.5”	170	55°	85°	200°	180°	10	0.6	1/2”	TRANE VCWF
V–91	MATH A234	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–92	MATH A232	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–93	MATH A231	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–94	MATH A229	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–95	MATH A227	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–96	CORRIDOR A203	1600	12”	14”	–	–	0.5”	1200	55°	85°	200°	180°	10	4.0	1”	TRANE VCWF
V–97	STAFF WORKROOM A210	450	6”	8”	–	–	0.5”	300	55°	85°	200°	180°	10	1.0	1/2”	TRANE VCWF
V–98	FOREIGN LANGUAGE A213	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–99	FOREIGN LANGUAGE A214	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–100	FOREIGN LANGUAGE A216	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–101	FOREIGN LANGUAGE A218	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–102	FOREIGN LANGUAGE A219	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–103	MATH A226	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–104	LD. CLASSROOM B231	1000	10”	12”	–	–	0.5”	700	55°	85°	200°	180°	10	2.3	3/4”	TRANE VCWF
V–105	OFFICE B230	220	5”	6”	–	–	0.5”	150	55°	95°	200°	180°	10	0.7	1/2”	TRANE VCWF
V–106	LD CLASSROOM B227	1000	10”	12”	–	–	0.5”	700	55°	85°	200°	180°	10	2.3	3/4”	TRANE VCWF
V–107	OFFICE B206	180	5”	6”	–	–	0.5”	120	55°	95°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–108	AT RISK B207	1000	10”	12”	–	–	0.5”	700	55°	85°	200°	180°	10	2.3	3/4”	TRANE VCWF
V–109	S.S. B226	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–110	S.S. B224	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–111	S.S. B223	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–112	S.S. B221	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–113	S.S. B219	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–114	S.S. B218	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–115	CORRIDOR B204	1300	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–116	ENGLISH B208	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–117	ENGLISH B209	1350	12”	14”	–	–	0.5”	1000	55°	90°	200°	180°	10	4.4	1”	TRANE VCWF
V–118	WRITING LAB B211	1350	12”	14”	–	–	0.5”	1000	55°	95°	200°	180°	10	4.4	1”	TRANE VCWF
V–119	ENGLISH B213	1350	12”	14”	–	–	0.5”	880	55°	85°	200°	180°	10	2.9	3/4”	TRANE VCWF
V–120	ENGLISH B214	1350	12”	14”	–	–	0.5”	880	55°	90°	200°	180°	10	2.9	3/4”	TRANE VCWF
V–121	ENGLISH B216	1350	12”	14”	–	–	0.5”	880	55°	85°	200°	180°	10	2.9	3/4”	TRANE VCWF
V–122	EBD CLASSROOM B217	1150	10”	12”	–	–	0.5”	765	55°	85°	200°	180°	10	2.6	3/4”	TRANE VCWF
V–123	FOODS LAB C208	2500	16”	18”	–	–	0.5”	1700	55°	85°	200°	180°	10	5.5	1”	TRANE VCWF
V–124	OFFICE C204	300	5”	6”	–	–	0.5”	250	55°	90°	200°	180°	10	0.8	1/2”	TRANE VCWF
V–125	EBD CLASSROOM C203	1180	10”	12”	–	–	0.5”	765	55°	85°	200°	180°	10	2.5	3/4”	TRANE VCWF
V–126	OFFICE C209	290	5”	6”	–	–	0.5”	150	55°	90°	200°	180°	10	0.5	1/2”	TRANE VCWF
V–127	FAMILY LIVING C211	1400	12”	14”	–	–	0.5”	940	55°	85°	200°	180°	10	3.0	3/4”	TRANE VCWF
V–128	CORRIDOR C202	690	8”	10”	–	–	0.5”	345	55°	85°	200°	180°	10	1.1	1/2”	TRANE VCWF
V–129	LGI CLASSROOM E202	2600	16”	18”	–	–	0.5”	1720	55°	85°	200°	180°	10	5.7	1”	TRANE VCWF
V–130	PE. CLASSROOM E207	1550	14”	16”	–	–	0.5”	1050	55°	85°	200°	180°	10	3.5	3/4”	TRANE VCWF
V–131	OFFICE F206	150	5”	6”	–	–	0.5”	100	55°	85°	200°	180°	10	0.3	1/2”	TRANE VCWF
V–132	WEIGHTS F205	2800	24x16	24x16	–	–	0.5”	1850	55°	85°	200°	180°	10	6.0	1”	TRANE VCWF
V–133	WEIGHTS F205	2800	24x16	24x16	–	–	0.5”	1850	55°	85°	200°	180°	10	6.0	1”	TRANE VCWF
V–134	FITNESS F203	~~2800~~	24x16	24x16	–	–	0.5”	1800	55°	85°	200°	180°	10	6.0	1”	TRANE VCWF
V–135	OFFICE	100	5”	6”	–	–	0.5”	1800	55°	85°	200°	180°	10	6.0	1”	TRANE VCWF

1 PBAD1

UNIT HEATERS

UNIT NO.	SERVICE	TYPE	CAP. MBH	CFM OF STD. AIR	MOTOR HP	MOTOR RPM	SPEEDS	DIFFUSERS	GPM	BRANCH PIPE SIZE	MANUF. MODEL
UH–1	SCENE SHOP D136	HORIZ.	55.7	1215	1/8	1550	1	HORIZ.	5.6	1”	TRANE 90–S
UH–2	METER ROOM E104	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–3	ELECTRIAL E105	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–4	RECEIVING E103	HORIZ.	55.7	1215	1/8	1550	1	HORIZ.	5.6	1”	TRANE 90–S
UH–5	BOILER ROOM F101	HORIZ.	34.6	815	1/20	1550	1	HORIZ.	3.5	3/4”	TRANE 60–S
UH–6	GYM STORAGE F103	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–7	MECHANICAL ROOM E201	HORIZ.	34.6	815	1/8	1550	1	HORIZ.	3.5	1”	TRANE 60–S
UH–8	MECHANICAL ROOM C212	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–9	GYM STORAGE G129	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–10	FOOTBAL STORAGE G128	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–11	GREENHOUSE	HORIZ.	181.1	4100	1/2	1100	1	HORIZ.	18.1	1–1/2”	TRANE 240–S
UH–12	TOOLS A119	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–13	WOODSHOP A115	HORIZ.	55.7	1215	1/8	1550	1	HORIZ.	5.6	1”	TRANE 90–S
UH–14	BUILDING TECH LAB A111	HORIZ.	34.6	815	1/20	1550	1	HORIZ.	3.5	3/4”	TRANE 60–S
UH–15	TOOLS A110	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–16	TRANSPORTATION SHOP A108	HORIZ.	62.5	1535	1/8	1550	1	HORIZ.	6.3	1”	TRANE 100–S
UH–17	TRANSPORTATION SHOP A108	HORIZ.	62.5	1535	1/8	1550	1	HORIZ.	6.3	1”	TRANE 100–S
UH–18	METAL SHOP A107	HORIZ.	40.4	1100	1/8	1550	1	HORIZ.	4.0	1”	TRANE 70–S
UH–19	TOOLS A105	HORIZ.	9.2	280	1/50	1075	1	HORIZ.	1.0	1/2”	TRANE 18–S
UH–20	GAS A104	HORIZ.	9.2	280	1/50	1075	1	HORIZ.	1.0	1/2”	TRANE 18–S
UH–21	MECHANICAL MEZZANINE	HORIZ.	34.6	815	1/20	1550	1	HORIZ.	3.5	3/4”	TRANE 60–S
UH–22	MECHANICAL MEZZANINE	HORIZ.	34.6	815	1/20	1550	1	HORIZ.	3.5	3/4”	TRANE 60–S
~~UH–23~~	~~MECHANICAL ROOM A205~~	~~HORIZ.~~	~~20.0~~	~~590~~	~~1/20~~	~~1550~~	~~1~~	~~HORIZ.~~	~~2.0~~	~~3/4”~~	~~TRANE 42–S~~
UH–24	LIGHTING 208	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S
UH–25	STORAGE D210	HORIZ.	20.0	590	1/20	1550	1	HORIZ.	2.0	3/4”	TRANE 42–S

~~CAP. BASED ON 60°F E.A.T., 200°F E.W.T. AND 180°F L.W.T.~~

1 AD1

DATE	03-18-05
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CHECKED BY	JF
REVISION	DATE
CURRENT	07-01-05

Hoffman
N434 Greenville Center, P.O. Box 8034, Appleton, WI 54912-8034, Phone: 920-731-2322, Fax: 920-731-4236
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NORTHLAND PINES SCHOOL DISTRICT

NEW NORTHLAND PINES HIGH SCHOOL

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EAGLE RIVER, WI. 54521

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Telephone (262) 243-5060

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CONVECTORS

UNIT NO.	SERVICE	CABINET SIZE D	L	H	ELEMENT SIZE	END POCKET SUP.	RET.	CAP. MBH	TYPE	RECESS	DAMPER	AIR VENT ASSEM.	GPM	BRANCH PIPE SIZE	MANUF. MODEL
C-1	DARK ROOM A132	4	32	24	4x32	–	–	3.5	RGB	4"	NO	NO	0.4	1/2"	TRANE
C-2	MENS C106	4	26	24	4x26	–	–	2.5	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-3	MENS C133	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-4	WOMENS C134	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-5	MENS E131	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-6	MENS C214	6	32	26	6x32	–	–	6.0	RGB	6"	NO	NO	0.6	1/2"	TRANE
C-7	WOMENS C215	6	32	26	6x32	–	–	6.0	RGB	6"	NO	NO	0.6	1/2"	TRANE
~~C-8~~	~~MENS E131~~	4	32	24	4x32	–	–	3.1	SW	–	NO	NO	0.3	1/2"	TRANE
C-9	STORAGE F202	6	44	26	6x44	–	–	8.6	SW	–	NO	NO	0.9	1/2"	TRANE
C-10	STORAGE E209	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-11	MENS A221	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-12	WOMENS A222	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-13	STORAGE A202	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-14	MENS LOCKER E206	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-15	WOMENS LOCKER E208	4	32	24	4x32	–	–	3.1	RGB	4"	NO	NO	0.3	1/2"	TRANE
C-16	STORAGE B130	4	32	24	4x32	–	–	3.1	SW	–	NO	NO	0.3	1/2"	TRANE
C-17	KILN A134	4	32	24	4x32	–	–	3.1	SW	–	NO	NO	0.3	1/2"	TRANE

CAP. BASED ON 65°F E.A.T., 200°F E.W.T. AND 180°F L.W.T.
RECESS DIMENSION TO BE FURNISHED TO THE GEN. CONTR. BY THE MECH. CONTR.

ROOF EXHAUSTERS

UNIT NO.	SERVICE	CFM OF STD. AIR	FAN DIA.	MAX. SONES	EXT. S.P. IN IN. WATER	MOTOR HP	DRIVE	BACKDRAFT DAMPER	MANUF. MODEL
RE-1	KILN A134	5000	30"	9.9	0.75	1-1/2	BELT	YES	GREENHECK GB-300
RE-2	2D ART A133	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-3	3D ART A135	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-4	DARK ROOM A132	630	10"	5.1	0.5	1/4	BELT	YES	GREENHECK GB-101
RE-5	TOILETS A211/A212	440	10"	5.0	0.5	1/4	BELT	YES	GREENHECK GB-101
RE-6	GRAPHICS A120	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-7	RESTROOMS A122/A123/A221/A222	2660	24"	7.7	0.625	3/4	BELT	YES	GREENHECK GB-240
RE-8	CHEM. / PHYSICS LAB B105	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-9	TOILET B228	140	10"	4.5	0.375	1/6	BELT	YES	GREENHECK GB-071
RE-10	PHYSICAL SCIENCE B111	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-11	BIOLOGY B115	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-12	PREP/CHEMICAL STG. B107/B112/B117	1465	16"	9.1	0.625	1/3	BELT	YES	GREENHECK GB-161
RE-13	LIFE SCIENCE B118	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-14	TOILET C105/C106/C207	380	10"	3.6	0.5	1/4	BELT	YES	GREENHECK GB-101
RE-15	FOODS LAB C208	3200	22"	9.6	0.5	1/2	BELT	YES	GREENHECK GB-220
RE-16	RESTROOM C133/C134/C214/C215	3480	24"	9.2	0.625	3/4	BELT	YES	GREENHECK GB-240
RE-17	ELEVATOR EQUIPMENT RM.	180	10"	5.8	0.375	1/6	BELT	YES	GREENHECK GB-071
RE-18	TOILET D111	100	10"	3.6	0.375	1/6	BELT	YES	GREENHECK GB-071
RE-19	MEN D157/WOMEN D156	500	10"	4.2	0.5	1/4	BELT	YES	GREENHECK GB-101
RE-20	E110/E111/E113/E114/E118/E126	720	10"	5.1	0.5	1/4	BELT	YES	GREENHECK GB-101
RE-21	KITCHEN HOOD	3750	24"	14.4	1.5	1-1/2	BELT	–	GREENHECK CUBE-240HP
RE-22	KITCHEN HOOD	3418	24"	13.7	1.5	1-1/2	BELT	–	GREENHECK CUBE-240HP
RE-23	DISHWASHER HOOD	2375	22"	11.8	1.0	3/4	BELT	YES	GREENHECK GB-180HP
RE-24	METAL SHOP	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-25	TRANSPORTATION SHOP	1240	14"	7.3	0.5	1/4	BELT	YES	GREENHECK GB-141
RE-26	BUILDING TECH LAB	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-27	WOOD SHOP	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-28	FUME HOOD B105	1250	14"	10.7	0.75	1/3	BELT	YES	GREENHECK CUBE-141
RE-29	FUME HOOD B111	1250	14"	10.7	0.75	1/3	BELT	YES	GREENHECK CUBE-141
RE-30	FUME HOOD B115	1250	14"	10.7	0.75	1/3	BELT	YES	GREENHECK CUBE-141
RE-31	FUME HOOD B118	1250	14"	10.7	0.75	1/3	BELT	YES	GREENHECK CUBE-141
RE-32	MEN & WOMEN LKRS. E206/E208	660	10"	5.5	0.5	1/4	BELT	YES	GREENHECK GB-101
RE-33	MEN E131/WOMENS E132	2100	18"	7.5	0.5	1/3	BELT	YES	GREENHECK GB-180
RE-34	RECEIVING E103	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-35	FINISHING A114	840	10"	7.2	0.5	1/4	BELT	YES	GREENHECK GB-101
RE-36	TRANSPORTATION SHOP	2500	20"	7.9	0.5	1/2	BELT	YES	GREENHECK GB-200
RE-37	GIRLS LOCKERS	3150	24"	8.5	0.625	3/4	BELT	YES	GREENHECK GB-240
RE-38	DISHWASH HOOD C208	675	10"	9.3	0.75	1/4	BELT	YES	GREENHECK GB-091
RE-39	KITCHEN HOOD C208	2000	18"	13.9	1.625	1	BELT	–	GREENHECK CUBE-180HP
RE-40	JANITOR D205	220	10"	4.2	0.375	1/4	BELT	YES	GREENHECK GB-081

CURB AND ROOF OPENING DIM. TO BE FURN. TO THE GEN. CONTR. BY THE MECH. CONTR.

CABINET HEATERS

UNIT NO.	SERVICE	TYPE	CAP. MBH	CFM OF STD. AIR	MOTOR HP	DRIVE	SPEED	RECESS	GPM	BRANCH PIPE SIZE	MANUF. MODEL
CH-1	STAIR A101	IW	45.4	540	1/8	DIRECT	1	–	4.5	1"	TRANE 06
CH-2	STAIR B101	ISGB	45.4	540	1/8	DIRECT	1	6"	4.5	1"	TRANE 06
CH-3	VESTIBULE B128	ISGB	17.7	200	1/30	DIRECT	1	6"	1.8	3/4"	TRANE 02
CH-4	VESTIBULE C101	ISGB	29.4	340	1/8	DIRECT	1	6"	2.9	3/4"	TRANE 04
CH-5	VESTIBULE C137	ISGB	45.4	540	1/8	DIRECT	1	6"	4.5	1"	TRANE 06
CH-6	VESTIBULE C137	ISGB	45.4	540	1/8	DIRECT	1	6"	4.5	1"	TRANE 06
CH-7	VESTIBULE D117	ISGB	29.4	340	1/8	DIRECT	1	6"	2.9	3/4"	TRANE 04
CH-8	VESTIBULE E101	ISGB	29.4	340	1/8	DIRECT	1	6"	2.9	3/4"	TRANE 04
CH-9	VESTIBULE G127	ISGB	29.4	340	1/8	DIRECT	1	6"	2.9	3/4"	TRANE 04
CH-10	MUD ROOM G114	ISGB	17.7	200	1/30	DIRECT	1	6"	1.8	3/4"	TRANE 02
CH-11	TOWEL G113	ISGB	17.7	200	1/30	DIRECT	1	6"	1.8	3/4"	TRANE 02
CH-12	MUD ROOM G112	ISGB	17.7	200	1/30	DIRECT	1	6"	1.8	3/4"	TRANE 02
CH-13	STAIR G101	IW	29.4	340	1/8	DIRECT	1	–	2.9	3/4"	TRANE 04
CH-14	MUD ROOM F116	ISGB	17.7	200	1/30	DIRECT	1	6"	1.8	3/4"	TRANE 02
CH-15	STAIR F115	IW	17.7	200	1/30	DIRECT	1	–	1.8	3/4"	TRANE 02
CH-16	MUD ROOM F114	ISGB	17.7	200	1/30	DIRECT	1	6"	1.8	3/4"	TRANE 02
CH-17	STAIR E138	IW	29.4	340	1/8	DIRECT	1	–	2.9	3/4"	TRANE 04
CH-18	VESTIBULE E130	ISGB	45.4	540	1/8	DIRECT	1	6"	4.5	1"	TRANE 06
CH-19	VESTIBULE E135	ISGB	45.4	540	1/8	DIRECT	1	6"	4.5	1"	TRANE 06
CH-20	COMMONS C136	ISGB	45.4	540	1/8	DIRECT	1	6"	4.5	1"	TRANE 06

CAP. BASED ON 60°F E.A.T., 200°F E.W.T. AND 180°F L.W.T.
RECESS DIM. TO BE FURN. TO GEN. CONTR. BY MECH. CONTR.

UTILITY EXHAUST FANS

UNIT NO.	SERVICE	CFM OF STD. AIR	MAX. O.V.	EXT. S.P. IN IN. WATER	MOTOR HP	DRIVE	FAN DIA.	FAN WHEEL TYPE	FAN ROTATION	FAN DISCHARGE	W.P. COVER	DAMPER	SUPPORT	MANUF. MODEL
UE-1	METAL SHOP	4000	3230	3"	5	BELT	15"	BI	CCW	TH	YES	MOTORIZED	EQUIP. SUPPORT CURB	GREENHECK 15-IPO
UE-2	TRANSPORTATION SHOP	1600	1710	4"	2	BELT	13"	BI	CCW	TH	YES	MOTORIZED	EQUIP. SUPPORT CURB	GREENHECK 13-IPO

DUST COLLECTOR

UNIT NO.	TYPE	CFM OF STD. AIR	EXT. S.P. IN IN. WATER	MOTOR HP	DRIVE	INLET DIA.	DUST HOPPER	SUPPORT	MANUF. MODEL
DC-1	CYCLONE	7210	7.0	25	DIRECT	16"ø	55 GAL. DRUM	STEEL STAND/CONC. PAD	TORIT 36-25

ROOM AIR CONDITIONING UNITS

INDOOR UNITS						OUTDOOR UNITS				
UNIT NO.	SERVICE	TYPE	CFM OF STD. AIR	COOLING CAP. (BTUH)	MAX. FUSE SIZE (AMPS)	UNIT NO.	SERVICE	NOM. TONS	COMP. RLA	MANUF. MODEL
RAC-1	HEAD END	HORIZ.	990	42,500	15	OU-1	RAC-1	3.5	20.0	MITSUBISHI PC42EK/PU42EK
RAC-2	HEAD END	HORIZ.	990	42,500	15	OU-2	RAC-2	3.5	20.0	MITSUBISHI PC42EK/PU42EK

IN-LINE PUMPS

UNIT NO.	SERVICE	SIZE	GPM	FT. OF WATER HEAD	MOTOR HP	MOTOR RPM	SUPPORT	MANUF. MODEL
IP-1	B-1	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4
IP-2	B-2	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4
IP-3	B-3	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4
IP-4	B-4	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4
IP-5	B-5	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4
IP-6	B-6	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4
IP-7	B-7	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4
IP-8	B-8	2x5-1/4	115	15	3/4	1750	PIPING	B&G SERIES 60 2x5-1/4

VARIABLE FREQUENCY DRIVES

UNIT NO.	SERVICE	H.P.	VOLTAGE	CONTROL TYPE	MANUF.
VFD-1	AC-2	20	480-3-60	VAV	ABB
VFD-2	AC-6	10	480-3-60	VAV	ABB
VFD-3	AC-7	20	480-3-60	VAV	ABB
VFD-4	AC-5	50	480-3-60	VAV	ABB
VFD-5	CF-2	7-1/2	480-3-60	VAV	ABB
VFD-6	CF-3	5	480-3-60	VAV	ABB
VFD-7	CF-4	7-1/2	480-3-60	VAV	ABB
VFD-8	P-1	50	480-3-60	H.W. P.D.C.	ABB
~~VFD-9~~	~~P-2~~	~~50~~	~~480-3-60~~	~~H.W. P.D.C.~~	~~ABB~~
VFD-10	P-4	60	480-3-60	GLYCOL P.D.C.	ABB

1 PBAD1

LINEAR DIFFUSERS

TYPE NO.	AIR FLOW DIRECTION	LENGTH	NO. OF SLOTS	INLET DIA.	PLENUM BOX HEIGHT	MAX. NC AT LISTED AIR FLOW	MANUF. MODEL
1	2-WAY	4'-0"	2	8"ø	12"	25	TITUS T-SLOT-IN
2	2-WAY	4'-0"	4	10"ø OVAL	12"	25	TITUS T-SLOT-IN
3	1-WAY	4'-0"	4	10"ø OVAL	12"	25	TITUS T-SLOT-IN
4	2-WAY	2'-0"	4	8"ø	12"	25	TITUS T-SLOT-IN

BOOSTER COILS

UNIT NO.	SERVICE	FACE SIZE	CFM OF STD. AIR	MAX. FACE VEL.	MAX. FINS PER IN.	ENT. AIR TEMP.	LV. AIR TEMP.	ACC. DOOR SIZE	GPM	BRANCH PIPE SIZE	MANUF. MODEL
BC-1	OFFICE E113	6x12	170	500	9	55°	85°	6x12	0.6	1/2"	TRANE
BC-2	LAUNDRY E116	12x12	420	500	9	55°	85°	6x12	1.4	1/2"	TRANE
BC-3	STORAGE E120	12x12	510	520	9	55°	85°	6x12	1.7	3/4"	TRANE
BC-4	DRY STORAGE E117	12x12	440	500	9	55°	85°	6x12	1.4	1/2"	TRANE
BC-5	OFFICE E125	6x12	170	500	9	55°	85°	6x12	0.6	1/2"	TRANE
BC-6	KITCHEN E123	12x24	1035	500	9	55°	85°	12x18	3.4	3/4"	TRANE
BC-7	KITCHEN E123	12x18	690	500	9	55°	85°	12x12	2.2	3/4"	TRANE
BC-8	KITCHEN E123	12x24	1035	500	9	55°	85°	12x18	3.4	3/4"	TRANE
BC-9	DISHWASH E127	12x24	920	500	9	55°	85°	12x18	3.0	3/4"	TRANE
BC-10	KITCHEN E123	12x18	690	500	9	55°	85°	12x12	2.2	3/4"	TRANE
BC-11	SERVERY E128	12x24	930	500	9	55°	85°	12x12	3.0	3/4"	TRANE

CAP. BASED ON 200°F E.W.T. AND 180°F L.W.T.

DESTRATIFICATION FANS

UNIT NO.	SERVICE	CFM OF STD. AIR	FAN DIA.	MOTOR WATTS	SOLID STATE SPEED CONTROLLER	FAN GUARD	MANUF. MODEL
DS-1	FIELDHOUSE F105	25,500	56"	110	YES	YES	LEADING EDGE 5600-ILC
DS-2	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-3	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-4	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-5	FIELDHOUSE F105	25,500	56"	110	YES	YES	LEADING EDGE 5600-ILC
DS-6	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-7	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-8	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-9	FIELDHOUSE F105	25,500	56"	110	YES	YES	LEADING EDGE 5600-ILC
DS-10	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-11	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-12	FIELDHOUSE F105	25,500	56"	110	–	YES	LEADING EDGE 5600-ILC
DS-13	COMMONS E129	25,500	56"	110	YES	NO	LEADING EDGE 5600-ILC
DS-14	COMMONS E129	25,500	56"	110	–	NO	LEADING EDGE 5600-ILC
DS-15	COMMONS E129	25,500	56"	110	–	NO	LEADING EDGE 5600-ILC
DS-16	COMMONS E129	25,500	56"	110	YES	NO	LEADING EDGE 5600-ILC
DS-17	FOREIGN LANGUAGE A216	12,500	36"	75	YES	NO	LEADING EDGE 3620-1LC
~~DS-18~~	~~MATH A229~~	~~12,500~~	~~36"~~	~~75~~	~~YES~~	~~NO~~	~~LEADING EDGE 3620-1LC~~
DS-19	WRITING LAB B211	12,500	36"	75	YES	NO	LEADING EDGE 3620-1LC
DS-20	SOCIAL STUDIES B221	12,500	36"	75	YES	NO	LEADING EDGE 3620-1LC

1 AD1

DATE	03-18-05
DRAWN BY	IV
CHECKED BY	JF

REVISION	DATE
CURRENT	07-01-05

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