Document identifier	*C22.3 No. 2-1975*
Date of issue	*1975-05-31*
Issuing body	*CSA*
Edition identifier	*1*
Title	General Grounding Requirements and Grounding Requirements for Electrical Supply Stations
Collation	*6 x 9, 14 pages.*

This Standard covers general grounding requirements for utility-owned plant and specific grounding requirements for utility-owned electrical supply stations. These are minimum requirements for the safety of personnel and the protection of equipment, and are not necessarily adequate for proper operation. This Standard gives general and specific grounding requirements as well as definitions, and describes the purposes of grounding.

The purposes of grounding are specified and include public and personnel safety, protection of equipment, and proper supply system operation. The reasons for energizing of structures and equipment from a power circuit are outlined and cover insulation failure, operation of protective devices, breakage or displacement of a conductor, arcing from the power circuit, or induction.

General requirements for grounding systems cover grounding connections and types of ground electrodes. Grounding requirements for electrical supply stations discuss general considerations, and cover grounding methods, requirements of grounding conductors, and electrical and non-electrical apparatus to be grounded. Also covered are limiting the hazard of transferred potentials, grounding of wire fences and structures in proximity to supply stations, and review of grounding systems in relation to changes in supply systems.

Key words	*grounding; earthing; safety engineering; electrical installations; electric power generation; electrical safety; electrical insulation; ground electrodes; earth electrodes.*

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Document identifier	*CAN/CSA-C225-M88*
Date of issue	*1988-12-31*
Issuing body	*CSA*
Edition identifier	*3*
Title	Vehicle-Mounted Aerial Devices
Collation	*8-1/2 X 11, 27 pages, 1 table, 9 figures.*

This Standard applies to vehicle-mounted aerial devices used to elevate personnel to job sites above ground. The devices may be made of insulating and noninsulating material; powered or manually operated; and may or may not be capable of rotating about a substantially vertical axis. The devices include
(a) telescopic aerial devices;
(b) aerial ladders;
(c) articulating boom platforms;
(d) vertical towers;
(e) material-lifting aerial devices; and
(f) any combination of these devices.

The Standard does not apply to fire-fighting equipment or devices driven from the operator's platform when it is in the operating position. The Standard gives definitions, references, and requirements for ratings, design and manufacture, testing and inspection, and documentation, as well as requirements and recommended practices for manufacturers, dealers, and users. The Standard is written in SI (metric).

Ratings requirements cover mechanical, structural, stability, and electrical specifications. Mechanical ratings include requirements for reach, height, load capacities, and the carrying vehicle specification.

Design and manufacture requirements cover basic principles; welding; quality control; structural safety factors for mechanical and hydraulic components; and control system features, interconnection, and positioning. Other requirements are given for operator protection features for levelling of the platform, boom security during travel, railings, and lanyard attachment. Further requirements cover boom and platform materials and the provision of upper and lower test electrodes.

Test and inspection requirements cover operation and stability, dielectric tests on insulated devices, loading, quality control, and the installer's responsibilities. Requirements are given for the documentation, certification, operating instructions, and manuals.

Nonmandatory appendices cover a typical operating instruction plate; guidelines for operation of controls; electrical test equipment; and the responsibilities of manufacturers, dealers, purchasers, and users.

Key words *lifting equipment; aerial equipment; work platforms; vehicle-mounted equipment; boom platforms; aerial ladders; vertical towers; vehicle components; axles; vehicle controls; dielectric strength; stability.*

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Document identifier	*CAN/CSA-C260-M90*
Date of issue	*1991-01-28*
Issuing body	*CSA*
Edition identifier	*2*
Title	Rating the Performance of Residential Mechanical Ventilating Equipment
Collation	*8-1/2 × 11, 44 pages, 5 tables, 19 figures.*

This Standard describes a uniform method of determining the air movement characteristics and measuring the sound output of residential mechanical ventilation equipment. It applies to both supply and exhaust equipment. The Standard also prescribes how the data thus obtained are to be presented in the form of performance ratings for the products. Examples of equipment covered by this Standard are bathroom fans, kitchen fans, or ventilation equipment forming part of a central ventilation system. This Standard does not apply to air circulating devices such as pedestal and ceiling fans nor to devices whose primary function is to heat or cool a space, such as a window-mounted air conditioner, whether or not the device is provided with a ventilating function. The methods used for air movement tests in this Standard are adopted from AMCA Standard 210-85/ASHRAE Standard 51-85. However, this CSA Standard CAN/CSA-C260 is not intended to be used for rating systems that operate with pressures exceeding 1 kPa or 4 in WG. The Standard includes references and requirements and is written in SI (metric).

The Standard includes general requirements and test considerations about the test specimen, the test voltage, and the categorization of ventilating equipment for the purposes of this Standard. The air movement test requirements cover instruments, accuracy, methods of measurement, and calculation; standardized test setup and calculation procedures; the symbols used in the equations in the test calculations; and the data to be included in the air movement test report. The requirements for the sound tests describe the scope of the tests, the installation and operation of the equipment for the tests, sound power measurement, sound rating, and the data to be included in the sound test report. The Standard also specifies requirements for marking.

Key words	*mechanical ventilation; air distribution systems; residential facilities; airflow; acoustic measurement; sound intensity; performance testing.*

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Document identifier	*C273.5-1980*
Date of issue	*1980-02-29*
Date of reaffirmation	*1991*
Issuing body	*CSA*
Edition identifier	*1*
Title	Installation Requirements for Air-to-Air Heat Pumps
Collation	*8-1/2 x 11, 16 pages, 1 figure.*

This Standard applies to the installation requirements for unitary air-to-air heat pumps with cooling ratings up to 19 kW (65 000 Btu/h) The heat pumps are normally used with electricity, oil, or gas as the supplementary heating source. The Standard gives definitions, references, and requirements of system design, equipment selection, installation, and information to be provided to the purchaser. It shall be used with CSA Standard C273.1 and C273.3 to form a complete Standard for the product.

The general requirements cover performance data, installation, service and maintenance guidance, warranties, and parts lists. System design and installation requirements cover load and capacity calculation for heating and cooling, location of the unit and the electrical panel, and service line alignment and insulation. Further requirements cover qualification of the installing personnel, setting of controls, and schedules of service checks.

Key words	*heat pumps; installation; air-conditioning equipment; heating equipment; cooling equipment.*

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Document identifier *CAN/CSA-C282-M89*

NFC NBCC

Date of issue *1989-05-31*

Issuing body *CSA*

Edition identifier *2*

Title Emergency Electrical Power Supply for Buildings

Collation *8-1/2 x 11, 30 pages, 2 tables.*

This Standard covers all aspects of an emergency electrical power supply up to and including the automatic transfer switches, in the event that the normal source of power fails. The Standard gives definitions, references, and requirements for the design, installation, operation, and maintenance of the emergency power supply plant, the prime mover, generators, exciters, voltage regulators, and transfer switches. The Standard is written in SI (metric).

General requirements list the loads or systems to be considered for connection to the emergency supply and the standards for installation, electrical wiring, and fuel systems. Emergency power supply plant requirements refer to the generating set cooling, location, operating voltage, reaction time to voltage failure, and layout. Other requirements are given for vibration isolation, ventilation, maintenance of enclosure temperature, and conditions where more than one emergency supply is available. Further requirements include conformance of emergency supply installation, provision for emergency lighting in emergency supply rooms, and operating control sequencing.

The engine requirements cover engine and generator power ratings, frequency variation for constant load and sudden load applications, exhaust system discharge, and fuel supply and capacity. Other engine requirements cover controls, safety sensing devices, indicators and alarms, and starting from batteries or compressed air. Requirements for generators, exciters, and automatic voltage regulators include generator performance and construction, voltage buildup, coordination of overcurrent devices, and generator controls.

Transfer switches requirements cover automatic transfer, voltage sensing, prevention of power feedback, current and voltage ratings, and provision of a manual bypass switch.

Initial installation performance test procedures are given for operational tests, a full load test, and a cycle crank test. Other requirements are given for testing emergency shutdown, alarms, and the ventilation system. Operation and maintenance requirements cover the provision of instruction manuals, special tools, and parts as well as scheduled periodic and annual tests and scheduled maintenance.

Nonmandatory appendices cover the factors and problems involved in the transfer of high speed loads and the capacity of fuel day tanks.

Key words *emergency electrical installations; buildings; prime movers; electric generators; switches; exciters; electric regulators; rated power; electric power systems; automatic control systems.*

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Document identifier	*CAN/CSA-C439-88*
Date of issue	*1988-05-31*
Issuing body	*CSA*
Edition identifier	*2*
Title	Standard Methods of Test for Rating the Performance of Heat Recovery Ventilators
Collation	*8-1/2 x 11, 28 pages, 1 table, 8 figures.*

This Standard applies to packaged heat recovery ventilators in which heat is transferred between two isolated airstreams. The ventilators are intended for use in ducted supply and exhaust systems and comprise factory assembled elements that include fans. The Standard prescribes methods for rating the sensible and total thermal effectiveness, the air movement capacities, and the leakage of air from one airstream to the other. The Standard gives definitions, establishes a uniform method of testing for performance data, and specifies the data, calculation methods to be used, and data to be reported. The Standard does not apply to mechanical vapour compression equipment, such as heat pumps. It is written in SI (metric).

Instrumentation requirements specify the instrument type, accuracy, application, procedures, and readings to be taken for temperature and static and dynamic pressures within the ventilator system. The calculation requirements give the formulae to be used for each aspect of the data calculation to provide airflow, apparent effectiveness, and supply air contamination.

The test requirements give the methods of preparation, preliminary tests, and full tests. Tests cover the ducts, installation of equipment, thermal effectiveness, heat recovery efficiency, exhaust air transfer, low temperature ventilator performance, low temperature thermal performance, and airflow performance for single- and multispeed fan type units.

Key words *heat recovery ventilators; ventilators; air-distribution systems; warm-air heating; space-heating systems; heating; heating equipment; air heaters; airflow; buildings; energy conservation; waste heat recovery; fans; performance testing.*

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Document identifier *CAN/CSA-C445-M92*
Date of issue *1992-01-30*
Issuing body *CSA*
Edition identifier *2*
Title Design and Installation of Earth Energy Heat Pump Systems for Residential and Other Small Buildings
Collation *8-1/2 x 11, 26 pages.*

This Standard applies to unitary or split system liquid source heat pumps with a maximum standard rated output of 35 kW per unit for residential applications and other small building applications of up to and including 1400 m^2 (15 000 ft^2), using surface or ground water or coupled to an earth or lake loop as a thermal source or sink for the heating and/or cooling with or without a supplementary heating source. The Standard gives definitions, references, and requirements for the collector and heat pump design, selection, installation, and testing. It is written in SI (metric).

Collector system general requirements cover sizing of the system, minimum capacity, flow rates for supply and disposal, rights of way and access, and provision of an installation certificate. Equipment and materials requirements cover pipe, jointing pipe work, antifreeze selection, compressor lockout warnings, and good installation practice.

The requirements for collector system design, application, and installation are given for closed and open system component features, location and alignment, trenches and backfilling, and the availability and quality of open system water resources. Other requirements are given for insulation of piping, dimensions of components, valving, electrical connections, boreholes, hydraulic testing, use of antifreeze, and protection of components from damage. Requirements are given for signs on valves and the collection and discharge lines and provision of an "as installed" location plan.

The requirements for the heat pump, circulation, and heat distribution equipment cover provision of performance and installation data, warranties, pumps characteristics, condensate collection and disposal, and hot water storage tank features. Further requirements cover duct work and duct airflow balance, electrical connections, and positioning of components.

Key words *heat pumps; ground water; water resources; installation; design; pipes; ducting; valves; pumps; air-conditioning equipment; heating equipment; cooling equipment.*

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Document identifier *CAN/CSA-C446-M90*

NMS

Date of issue *1990-04-30*

Issuing body *CSA*

Edition identifier *2*

Title Performance of Ground and Water Source Heat Pumps

Collation *8-1/2 x 11, 24 pages, 4 tables.*

This Standard gives methods of testing and calculating the performance of factory-made, electrically driven, mechanical, unitary heat pumps that are single-package or matching split systems rated at less than 35 kW (120 000 Btuh). The assemblies may have earth, water, or liquid as the energy source in heating and the energy sink in cooling and are for application in open and closed-loop ground and water source systems. The Standard gives definitions, references, and requirements for rating, performance, marking, and test. It is written in SI (metric) and is used as the basis of certification.

General requirements cover electric safety and installation, matching of components, and use of methanol/water for test and rating purposes.

Rating requirements for cooling and heating cover evaluation of total energy capacity and input from component parts; adjustments to be made for accessories, circulating fan heat, and the liquid circulating pump; and values for ratings, standard energy efficiency ratio (EER), and coefficients of performance (COP). Other requirements give the temperature, flow and pressure conditions, and criteria at which ratings may be stated. Requirements for published ratings cover the basis of determining data to be published, the minimum information to be provided, and the sampling plan. Performance requirements are given for minimum standard EER and COP for maximum high-temperature and low-temperature operation.

Test requirements cover installation for testing, temperature, liquid or water flow conditions, voltage and frequency, air quantity, and resistance to airflow. Other requirements cover maximum high-temperature operation for closed-loop units, low-temperature operation, enclosure insulation effectiveness, and condensate disposal.

Key words *heat pumps; performance testing; ground water; water resources; pumps; air-conditioning equipment; heating equipment; cooling equipment.*

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Document identifier *CAN/CSA-F280-M90*

NBCC

Date of issue *1990-12-08*

Issuing body *CSA*

Edition identifier *2*

Title Determining the Required Capacity of Residential Space Heating and Cooling Appliances

Collation *8-1/2 x 11, 96 pages, 19 tables.*

This Standard provides a method for calculating the capacity of a residential space heating or cooling appliance or group of appliances. The appliances are for maintaining specified indoor environmental condition under specified outdoor environmental conditions. The Standard applies to space heating and cooling in small buildings as defined in the *National Building Code of Canada.* Limitations are given. The Standard covers definitions, symbols, references, and requirements for design environmental conditions and methods of calculation for heating and cooling systems. It is written in SI (metric).

Design calculations are based on tabulated information on outdoor environmental conditions and soil temperatures for more than 500 locations across Canada together with prescribed indoor temperatures for space inside the building envelope. Standard thermal resistances are given for materials and assemblies including doors, windows, walls, roofs, and interconnections consisting of combinations of concrete, studs and joists, insulation, sheathing, and finishes. Procedures are also given for calculating values for building assemblies, by adding the RSI value of its components, and for calculating heat loss and gain factors due to air change and leakage.

Calculations for total building heat loss are based on the temperature differential between indoors and outdoors, heat loss calculations for above and below grade, and heat loss through air changes and ducts or pipes. Requirements for matching heating system capacity to the calculated total building heat loss are given. Calculations for total building heat gain are based on the temperature differential between indoors and outdoors, heat gain through opaque, transparent, and translucent building assemblies, heat gain due to people and appliances, and heat gains through air leakage, ventilation, and ducts. Requirements for matching cooling system capacity to the calculated total building heat gain are given.

Nonmandatory appendices give a method of calculation of shaded and unshaded areas of windows and the perimeter and area of below-grade floors. A commentary on the Standard is provided.

Key words *housing; heating; heating equipment; cooling equipment; temperature control; thermal insulation; thermal resistance; heat loss; heat gains.*

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Document identifier	*CAN/CSA-F326-M91*
Date of issue	*1991-05-13*
Issuing body	*CSA*
Edition identifier	*1*
Title	Residential Mechanical Ventilation Systems
Collation	*8-1/2 × 11, 91 pages, 9 tables, 2 figures.*

This Standard was developed to fulfil the need for a national set of residential ventilation requirements and to provide the necessary supporting documents to allow the requirements to be incorporated into new dwelling units being built in Canada. The Standard defines requirements for performance, installation and application, and performance verification of mechanical ventilation systems. It applies to systems that are capable of providing minimum controlled rates of ventilation air to the habitable spaces of those single-family dwellings that fall within the Scope of Part 9 of the *National Building Code of Canada* and are self-contained with respect to heating, ventilation, and air conditioning. The Standard also gives installation requirements for ventilation components such as supply and exhaust ventilation fans and associated equipment, including bathroom and kitchen exhaust fans and range hoods, with or without ducts, and for self-contained ducted heat recovery ventilators intended for operation in single-family dwelling units, whether or not such equipment constitutes part of a ventilation system conforming to this Standard. The applicable heat recovery ventilators have a maximum rated capacity of not less than 25 L/s and not more than 200 L/s. (See also CSA Standards CAN/CSA-C439-88, *Standard Methods of Test for Rating the Performance of Heat-Recovery Ventilators,* and CAN/CSA-C260-90, *Rating the Performance of Residential Mechanical Ventilating Equipment.)* The Standard does not apply to the installation of recirculating forced-air heating and air conditioning systems that are not used for ventilation but does apply to combined or integrated heating, ventilating, and air conditioning systems intended to provide ventilation air in accordance with this Standard. The Standard also covers provisions for equipment selection and installation, system installation, and information to be provided to the purchaser. It includes definitions, references, and requirements and is written in SI (metric).

In addition to general requirements, the Standard gives ventilation air requirements and dwelling unit pressure design requirements. It also gives equipment requirements, including requirements for packaged ventilators and other factory-assembled ventilation components, installation requirements, and requirements for verifying compliance.

Nonmandatory appendices include a sample form for recording residential mechanical ventilation system installation data required by this Standard; a commentary on the rationale for various requirements of the Standard; an explanation and clarification for users applying the Standard; and a guide to measurement techniques.

Key words *mechanical ventilation; ventilation equipment; air-conditioning equipment; heating equipment; residential facilities; performance; installation; conformity.*

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