

INDEX

A

Absorption

solar cooling, [A36](#)

Activated carbon adsorption, [A47](#)

Adsorbents

solid, [A47](#)

Adsorption

indoor air cleaning, [A47](#)

Aeration, of farm crops, [A26](#)

Air cleaners, [A47](#)

(*see also* Filters, air)

(*see also* Industrial exhaust gas cleaning)

Air cleaners., [A33](#)

(*see also* Filters, air\ Industrial exhaust gas cleaning)

industrial exhaust systems, [A33](#)

Air conditioners, [A1](#), [A2](#)

(*see also* Central air conditioning)

residential, [A1](#)

through-the-wall room units, [A1](#)

unitary, [A1](#)

retail stores, [A2](#)

Air conditioning, [A3](#), [A5](#), [A6](#), [A7](#), [A8](#), [A9](#), [A11](#), [A16](#), [A17](#), [A18](#), [A19](#), [A20](#), [A21](#), [A22](#), [A27](#), [A28](#), [A29](#), [A30](#), [A32](#), [A34](#), [A36](#)

(*see also* Central air conditioning)

airports, [A3](#)

arenas, [A5](#)

atriums, [A5](#)

auditoriums, [A5](#)

automobiles, [A11](#)

bus terminals, [A3](#)

clean spaces, [A19](#)

commercial buildings, [A3](#)

computer rooms, [A20](#)

concert halls, [A5](#)

convention centers, [A5](#)

data centers, [A20](#)

dormitories, [A7](#)

educational facilities, [A8](#)

engine test facilities, [A18](#)

exhibition centers, [A5](#)

fairs, [A5](#)

gymnasiums, [A5](#)

health care facilities, [A9](#)

hotels and motels, [A7](#)

houses of worship, [A5](#)

ice rinks, [A5](#)

- industrial environments, [A32](#)
- kitchens, [A34](#)
- laboratories, [A17](#)
- mines, [A30](#)
- natatoriums, [A6](#)
- nuclear facilities, [A29](#)
- office buildings, [A3](#)
- paper products facilities, [A27](#)
- places of assembly, [A5](#)
- power plants, [A28](#)
- printing plants, [A21](#)
- public buildings, [A3](#)
- solar energy systems, [A36](#)
- subway stations, [A16](#)
- telecommunication facilities, [A20](#)
- temporary exhibits, [A5](#)
- textile processing plants, [A22](#)
- theaters, [A5](#)
- transportation centers, [A3](#)
- warehouses, [A3](#)
- wood products facilities, [A27](#)

Aircraft, [A13](#)

- air conditioning, [A13](#)
- air distribution, [A13](#)
- air quality, [A13](#)
- cabin pressurization

- control, [A13](#)
- performance, [A13](#)

- carbon dioxide concentration, [A13](#)
- environmental control system (ECS), [A13](#)

- air-conditioning packs, [A13](#)
- air-cycle machine, [A13](#)
- cabin pressure control, [A13](#)
- design conditions, [A13](#)
- engine bleed air system, [A13](#)
- load determination, [A13](#)
- outdoor air, [A13](#)
- pneumatic system, [A13](#)
- regulations, [A13](#)

- heating, [A13](#)
- humidity, [A13](#)
- oxygen levels, [A13](#)
- ozone concentration, [A13](#)
- ventilation, [A13](#)

Air diffusers

- sound control, [A49](#)
- testing, [A40](#)

Air diffusion

- air terminals, [A58](#)
- applications, [A58](#)

Air diffusion performance index (ADPI), [A58](#)

- systems

- fully stratified, [A58](#)

Air distribution, [A2](#), [A5](#), [A13](#), [A14](#), [A17](#), [A22](#), [A25](#), [A32](#), [A34](#), [A40](#), [A43](#), [A48](#), [A49](#), [A58](#)

- aircraft cabins, [A13](#)
- animal environments, [A25](#)
- applications, [A58](#)
- central system, [A43](#)
- industrial environments, [A32](#)
- kitchen makeup air, [A34](#)
- laboratories, [A17](#)
- places of assembly, [A5](#)
- retail stores, [A2](#)
- ships, [A14](#)
- sound control, [A49](#)
- systems, [A58](#)
 - design considerations, [A58](#)
 - mixed, [A58](#)
 - rooms, [A58](#)
- terminal boxes, [A48](#)
- testing, adjusting, balancing, [A40](#)
- textile processing plants, [A22](#)

Airflow

- around buildings
 - patterns, [A46](#)
- clean spaces, [A19](#)
- computer-aided modeling, [A19](#)
- exhaust hoods, [A33](#)
- laminar, [A19](#)
- measurement of, [A40](#)
- non-unidirectional, [A19](#)
- solar energy systems, [A36](#)
- tracking, [A48](#)
- transport velocity, [A33](#)
- unidirectional, [A19](#)

Air handlers

- distribution systems, [A43](#)
- sequencing, [A43](#)
- set point reset, [A43](#)
- sound levels, [A49](#)
- strategies, [A43](#)

Air intakes

- design, [A46](#)
- location to avoid contamination, [A46](#)
- vehicular facilities, enclosed, [A16](#)

Airports, air conditioning, [A3](#)

Air quality, [A13](#), [A16](#), [A16](#), [A16](#), [A16](#), [A16](#), [A25](#)

(see also Indoor air quality (IAQ))

- aircraft cabins, [A13](#)
- animal buildings, [A25](#)
- bus terminals, [A16](#)
- diesel locomotive facilities, [A16](#)
- parking garages, [A16](#)
- road tunnels, [A16](#)
- tollbooths, [A16](#)

Air washers

- textile processing plants, [A22](#)
- water treatment, [A50](#)

Algae, control, [A50](#)
Ammonia

in animal environments, [A25](#)

Anchor bolts, seismic restraint, [A56](#)
Anemometers

air devices, [A40](#)

Animal environments

air contaminants

ammonia, [A25](#)
carbon dioxide, [A25](#)

air distribution, [A25](#)
air inlets, [A25](#)
air quality control, [A25](#)
cattle, beef and dairy, [A25](#)
design, [A25](#)
disease control, [A25](#)
evaporative cooling, [A53](#)
fans, [A25](#)
hydrogen sulfide, [A25](#)
insulation, [A25](#)
laboratory conditions, [A17](#), [A25](#)
particulate matter (PM), [A25](#)
poultry, [A25](#)
shades, [A25](#)
swine, [A25](#)
ventilation, [A25](#)

Apartment buildings

service water heating, [A51](#)
ventilation, [A1](#)

Arenas

air conditioning, [A5](#)
smoke control, [A54](#)

Atriums

air conditioning, [A5](#)
smoke control, [A54](#)

Auditoriums, [A5](#)

Automated fault detection and diagnostics (AFDD), [A63](#)

benefits, [A63](#)
controller-embedded, [A63](#)
detection, [A63](#)
diagnosis, [A63](#)
evaluation, [A63](#)
methods, [A63](#)
tools, [A63](#)

Automobiles

engine test facilities, [A18](#)
HVAC, [A11](#)

design factors, [A11](#)
subsystems, [A11](#)

Autopsy rooms, [A10](#)

B

BACnet®, [A41](#)

Bacteria

control, [A50](#)

Balancing, [A34](#), [A40](#)

(*see also* Testing, adjusting, and balancing)

air distribution systems, [A40](#)

HVAC systems, [A40](#)

hydronic systems, [A40](#)

kitchen ventilation systems, [A34](#)

steam distribution systems, [A40](#), [A40](#)

temperature controls, [A40](#)

Basements

conditioned, [A45](#)

moisture control, [A45](#)

unconditioned, [A45](#)

Behavior

occupant, [A65](#)

Biocides, control, [A50](#)

Biological safety cabinets, [A17](#)

Biomanufacturing cleanrooms, [A19](#)

Boilers

central

multifamily, [A1](#)

controls, [A43](#), [A48](#)

residential, [A1](#)

service water heating, [A51](#)

water treatment, [A50](#)

blowdown, [A50](#)

Building automation systems (BAS), [A41](#), [A63](#)

Building energy monitoring, [A42](#)

Building envelopes

air barrier, [A45](#)

requirements, [A45](#)

air intrusion, [A45](#)

air leakage control, [A45](#)

bound water, [A45](#)

building assembly, [A45](#)

building enclosure, [A45](#)

component, [A45](#)

condensation, [A45](#)

convective loop, [A45](#)

dropped ceiling, [A45](#)

durability, [A45](#)

energy conservation, [A45](#)

exfiltration, [A45](#)

existing buildings

changing HVAC equipment in, [A45](#)

envelope modifications in, [A45](#)

face-sealed systems, [A45](#)

fenestration, [A45](#)

foundations, [A45](#)

heat transfer through, [A45](#)

moisture effects, [A45](#)

historic buildings, [A45](#)

hygrothermal design analysis, [A45](#)

infiltration, [A45](#)

interstitial spaces, [A45](#)

interzonal environmental loads, [A45](#)

moisture content, [A45](#)

moisture control, [A45](#)

museums, galleries, archives, and libraries, [A24](#)

plenum, [A45](#)

return air, [A45](#)

rain screen designs, [A45](#)

roofs, [A45](#)

insulated sloped assemblies, [A45](#)

low-slope assemblies, [A45](#)

steep-roof assemblies, [A45](#)

vegetated roofing, [A45](#)

R-value, [A45](#)

clear-wall, [A45](#)

material, [A45](#)

system, [A45](#)

total, [A45](#)

sorption, [A45](#)

surface condensation, [A45](#)

terminology, [A45](#)

thermal

break, [A45](#)

bridges, [A45](#)

insulation, [A45](#)

mass, [A45](#)

performance, [A45](#)

transmittance, [A45](#)

U-factor (thermal transmittance), [A45](#)

vapor

barrier, continuous, [A45](#)

diffusion control, [A45](#)

retarder (vapor barrier), [A45](#)

wall/window interface, [A45](#)

walls, [A45](#)

curtain, [A45](#)

precast concrete panels, [A45](#)

steel-stud, [A45](#)

water-resistive barrier (WRB), [A45](#)

wind washing, [A45](#)

zone method, [A45](#)

Building information modeling (BIM), [A41](#), [A60](#)

Building performance simulation (BPS), [A65](#)

Buildings

air barrier, [A64](#)

airtight duct connections, [A64](#)
damp, [A64](#)

human health, [A64](#)

dampness risk, [A64](#)
dew point, [A64](#)
drainage plane, [A64](#)
flashing, [A64](#)
moisture, [A64](#)

content, [A64](#)
risk, [A64](#)

mold, [A64](#)
mold-resistant gypsum board, [A64](#)
positive pressure, [A64](#)
problems

causes, [A64](#)
dampness, [A64](#)

sill pans, [A64](#)
vinyl wall covering, [A64](#)
water barrier, [A64](#)

Building thermal mass

precooling, [A43](#)

Buses

garage ventilation, [A16](#)

Bus terminals

air conditioning, [A3](#)
physical configuration, [A16](#)
ventilation

effects of alternative fuel use, [A16](#)
equipment, [A16](#)
operation areas, [A16](#)
platforms, [A16](#)

C

Cafeterias, service water heating, [A51](#)

Carbon dioxide

greenhouse enrichment, [A25](#)
in aircraft cabins, [A13](#)
in animal environments, [A25](#)

Carbon monoxide

analyzers, [A16](#)
parking garages, [A16](#)
road tunnels, [A16](#)
tollbooths, [A16](#)

Cattle, beef and dairy, [A25](#)

Ceilings

sound correction, [A49](#)
sound transmission, [A49](#)

Central air conditioning, [A43](#)
Central plant optimization, [A8](#)

Central plants

hotels and motels, [A7](#)

Central systems

in tall buildings, [A4](#)

acoustical considerations, [A4](#)

economic considerations, [A4](#)

location, [A4](#)

Chemical, biological, radiological, and explosive (CBRE) incidents, [A61](#)

biological events, [A61](#)

chemical agent types, [A61](#)

gases and vapors, [A61](#)

gases and vapors, *corrosive*, [A61](#)

gases and vapors, *toxic*, [A61](#)

incapacitating, [A61](#)

incapacitating, *warfare*, [A61](#)

irritants, [A61](#)

toxic, [A61](#)

toxic, *blister*, [A61](#)

toxic, *blood*, [A61](#)

toxic, *lung-damaging*, [A61](#)

toxic, *nerve*, [A61](#)

chemical events, [A61](#)

chemical warfare agents

incapacitating, [A61](#)

commissioning, [A61](#)

explosive events, [A61](#)

design considerations, [A61](#)

loading description, [A61](#)

loading description, *direct air blast*, [A61](#)

loading description, *free-field blast wave*, [A61](#)

loading description, *quasi-static pressure*, [A61](#)

radiological events, [A61](#)

dispersion, [A61](#)

effects and sources, [A61](#)

facility response, [A61](#)

radiation monitoring, [A61](#)

Chemisorption, [A47](#)

Chilled beams

in tall buildings, [A4](#)

Chilled water (CW)

optimal temperature, [A43](#)

pumping system, [A43](#)

pump sequencing, [A43](#)

reset, [A43](#)

systems

central plant, [A40](#)

heat transfer vs. flow, [A40](#)

testing, adjusting, balancing, [A40](#)

thermal storage, [A50](#)

Chillers

central plants, [A48](#)

control, [A48](#)

load distribution, [A43](#)

noise generation, [A49](#)

optimization, [A48](#)

sequencing, [A43](#)

Chlorinated polyvinyl chloride (CPVC), [A35](#)

Cinemas, [A5](#)

Clean spaces, [A19](#)

air filters, [A19](#)

airflow, [A19](#)

applications, [A19](#)

biomanufacturing, [A19](#)

contaminant control, [A19](#)

cooling, [A19](#)

energy conservation, [A19](#)

fire safety, [A19](#)

high-bay, [A19](#)

humidity control, [A19](#)

makeup air, [A19](#)

noise control, [A19](#)

operation, [A19](#)

particle sources, [A19](#)

pharmaceutical

aseptic, [A19](#)

biomanufacturing, [A19](#)

contaminant control, [A19](#)

control and monitoring, [A19](#)

design, [A19](#)

isolators, [A19](#)

nonaseptic, [A19](#)

unidirectional hoods, [A19](#)

pressurization, [A19](#)

process exhaust, [A19](#)

start-up, [A19](#)

system sizing and redundancy, [A19](#)

temperature control, [A19](#)

terminology, [A19](#)

testing, [A19](#)

vibration control, [A19](#)

Coal

handling facilities, [A28](#)

Coanda effect, [A34](#)

Codes, [A4](#), [A57](#), [A58](#)

(see also Standards)

air distribution, [A58](#)

chilled-beam system, [A58](#)

electrical, [A57](#)

tall buildings, [A4](#)

Coils

air-cooling

control, [A48](#)

on ships, [A14](#)

air-heating

electric, [A48](#)

shipboard, [A14](#)

Collaborative design, [A60](#)

Collectors, solar, [A36](#)

Colleges and universities, [A8](#)

Comfort, [A65](#)

(see also Physiological principles, humans)

occupant, [A65](#)

thermal, [A65](#)

Commercial and public buildings, [A3](#)

airports, [A3](#)

bus terminals, [A3](#)

central cooling systems, [A43](#)

cruise terminals, [A3](#)

design concepts, [A3](#)

general design considerations, [A3](#)

kitchen ventilation, [A34](#)

load characteristics, [A3](#)

malls, [A2](#)

office buildings, [A3](#)

retail facilities, [A2](#)

service water heating, [A51](#)

transportation centers, [A3](#)

warehouses, [A3](#)

Commercial kitchen ventilation (CKV), [A34](#)

Commissioning, [A44](#)

acceptance, [A44](#)

basis of design (BOD), [A44](#), [A60](#)

certification, [A44](#)

checklist, [A44](#)

construction, [A44](#)

costs, [A44](#)

design, [A44](#), [A48](#)

collaborative, [A60](#)

design review, [A44](#)

existing buildings, [A44](#)

in integrated building design, [A60](#)

issues log, [Activities](#)

laboratories, [A17](#)

new construction, [A44](#)

objectives, [A44](#)

occupancy and operations, [A44](#)

owner's project requirements (OPR), [A44](#), [A60](#)

predesign, [A44](#)

recommissioning, [A44](#)

retrocommissioning, [A44](#)

systems manual, [A44](#)

team, [A44](#)

test procedures, [Activities](#)

Compressors

noise generation, [A49](#)

Computer-aided design (CAD), [A19](#)

and integrated design, [A60](#)

Computerized maintenance management system (CMMS), [A60](#)

Computers, [A41](#)

BACnet®, [A41](#)

computational fluid dynamics, [A16](#), [A54](#)

computer-aided design (CAD), [A19](#)

design tools

smoke control analysis, [A54](#)

ventilation, *road tunnel*, [A16](#)

smoke control analysis, [A54](#)

software, [A41](#)

custom programming, [A41](#)

development tools, [A41](#)

readymade, [A41](#)

road tunnel, [A16](#)

Concert halls, [A5](#)

Concrete

water heating for, [A51](#)

Condensate

water treatment, [A50](#)

Constant air volume (CAV)

control, [A43](#)

supply air temperature reset, [A43](#)

versus variable air volume (VAV), [A17](#)

Contaminants

clean spaces, [A19](#)

effects on museum, gallery, archive, library collections, [A24](#)

gaseous

concentration, indoor, measurement, [A47](#)

nuclear facilities, [A29](#)

ozone, [A47](#)

radon, [A47](#)

removal, [A47](#)

textile processing, [A22](#)

Control, [A1](#), [A10](#), [A11](#), [A13](#), [A14](#), [A16](#), [A17](#), [A21](#), [A24](#), [A29](#), [A36](#), [A43](#), [A48](#), [A49](#), [A50](#), [A52](#), [A54](#), [A65](#)

(*see also* Controls, automatic)

(*see also* Supervisory control)

(*see also* Controls, automatic\ Supervisory control)

(*see also* Controls, automatic\ Supervisory control)

aircraft cabin pressure, [A13](#)

air-handling systems, [A48](#)

automobile air conditioning, [A11](#)

boilers, [A48](#)

building automation systems (BASs), [A48](#)

building pressurization, [A48](#)

bus terminal ventilation, [A16](#)

central air conditioning, [A43](#)

chilled beams, [A48](#)

chillers, [A48](#)

cooling

coils, [A48](#)

towers, [A48](#)

corrosion, [A50](#)
demand-controlled ventilation (DCV), [A48](#)
design principles
 controlled area size, [A48](#)
 load matching, [A48](#)
 sensor location, [A48](#)
 system selection, [A48](#)
direct expansion (DX), [A48](#)
economizers, [A48](#)
fans, [A48](#)
fire, [A54](#)
freezestat, [A48](#)
functional performance testing (FPT), [A48](#)
heat exchangers, [A48](#)
heating coils, [A48](#)
heat pumps, [A48](#)
humidity, [A48](#)
induction VAV terminals, [A48](#)
justice facilities, [A10](#)
laboratory systems, [A17](#)
makeup air units, [A48](#)
morning warm-up, [A48](#)
nuclear facilities, [A29](#)
occupant-centric, [A65](#)
of museum, galleries, archives, and libraries, [A24](#)
optimization, [A43](#)
outdoor air quantity, [A48](#)
paper moisture content, [A21](#)
parking garage ventilation, [A16](#)
performance monitoring, [A48](#)
pipe-tracing systems, [A52](#)
pneumatic, [A48](#)
predictive, [A65](#)
pressurization, [A48](#)
radiant panels, [A48](#)
radioactivity, [A29](#)
residential heating and cooling, [A1](#)
return fan, [A48](#)
road tunnel ventilation, [A16](#)
scale, [A50](#)
sequence of operation, [A48](#)
ship air conditioning

 merchant, [A14](#)
 naval surface, [A14](#)

solar energy, [A36](#)
solid-state, [A48](#)
sound, [A49](#)
static pressure, and variable flow rates, [A48](#)
steam coils, [A48](#)
system selection, [A48](#)
terminal units, [A48](#)
unit ventilators, [A48](#)
variable-air-volume (VAV) systems, [A48](#)
ventilation reset control (VRC), [A48](#)

Controlled-atmosphere (CA) storage

 cold storage for archives, [A24](#)

Control rooms, [A10](#)

 justice facilities, [A10](#)

Controls, automatic, [A40](#), [A48](#), [A65](#)

(see also Control)

components, [A65](#)

controllers, [A40](#)

sensors, [A65](#)

explosive atmospheres, [A48](#)

extraordinary incidents, [A48](#)

mobile applications, [A48](#)

safety, [A48](#)

sensors

location, [A48](#)

static pressure, [A48](#)

testing, [A40](#)

Convention centers, [A5](#)

Coolants, secondary

brines

corrosion inhibition, [A50](#)

Coolers

liquid, [A1](#)

(see also Evaporators)

residential, [A1](#)

Cooling, [A18](#), [A25](#), [A35](#), [A36](#), [A43](#)

(see also Air conditioning)

animal environments, [A25](#)

controls, [A43](#)

geothermal energy systems, [A35](#)

greenhouses, [A25](#)

plant environments, [A25](#)

radiative, [A36](#)

solar energy systems, [A36](#)

water systems

dynamometers, [A18](#)

Cooling towers

capacity control

airflow, [A43](#)

fan sequencing, [A43](#)

flow modulation, [A43](#)

variable- vs. fixed-speed fans, [A43](#)

recommissioning, [A50](#)

shutdown, [A50](#)

start-up, [A50](#)

water treatment, [A50](#)

Corn, drying, [A26](#)

Correctional facilities (see Justice facilities)

Corrosion

concentration cell corrosion, [A50](#)

contributing factors, [A50](#)

control, [A50](#)

cathodic protection, [A50](#)
 coupons, [A50](#)
 cycles of concentration, [A50](#)
 in boilers, [A50](#)
 in cooling towers, [A50](#)
 in geothermal energy systems, [A35](#)
 inhibitors, [A50](#)
 in steam and condensate systems, [A50](#)
 materials selection, [A50](#)
 passivation, [A50](#)
 protective coatings, [A50](#)

microorganism influence, [A50](#)
 oxygen corrosion, [A50](#)
 service water systems, [A51](#)
 tuberculation, [A50](#)
 types, [A50](#)
 white rust, [A50](#)

Costs, [A17](#), [A38](#), [A52](#)

(see also Economics)

analysis period, [A38](#)

economic analysis techniques

computer analysis, [A38](#)
 inflation, [A38](#)
 internal rate of return, [A38](#)
 life-cycle cost analyses, [A38](#)
 payback, [A38](#)
 present value (worth), [A38](#)
 savings-to-investment ratio (SIR), [A38](#)

energy, [A38](#)

financing alternatives, [A38](#)

property assessment for clean energy (PACE), [A38](#)

inflation, [A38](#)
 interest and discount rate, [A38](#)
 laboratory systems, [A17](#)
 life-cycle, [A38](#)
 maintenance, [A38](#)
 operating

actual, [A38](#)
 electrical energy, [A38](#)
 natural gas, [A38](#)
 other fuels, [A38](#)
 snow-melting systems, [A52](#)

owning

initial cost, [A38](#)
 insurance, [A38](#)
 taxes, [A38](#)

periodic, [A38](#)

refrigerant phaseout, [A38](#)

Cotton, drying, [A26](#)

Courthouses, [A10](#)

Courtrooms, [A10](#)

Crawlspaces

insulation, [A45](#)
 vented vs. unvented, [A45](#)
 wall insulation, [A45](#)

Critical spaces

- data centers, [A20](#), [A43](#)
- forensic labs, [A10](#)
- justice facilities, [A10](#)

Cruise terminals, [A3](#)

D

Dampers

- fire and smoke, [A54](#)
- outdoor air, [A48](#)
- sound control, [A49](#)
- vehicular facilities, enclosed, [A16](#)

Dampness problems in buildings, [A64](#)

Data centers, [A20](#)

Dehumidification, [A48](#)

- evaporative cooling, [A53](#)
- residential, [A1](#)

Dehumidifiers

- museums, archives, [A24](#)

Dehydration

- farm crops, [A26](#)
- industrial systems for, [A31](#)

Demand control kitchen ventilation (DCKV), [A34](#)

Detection

- occupant, [A65](#)

Dew point, [A64](#)

Diffusers, air, sound control, [A49](#)

Dilution

- smoke, [A54](#)
- ventilation, [A32](#), [A47](#)

Dining halls, in justice facilities, [A10](#)

Dirty bombs. See Chemical, biological, radiological, and explosive (CBRE) incidents, [A61](#)

Disabilities, [A8](#)

Display cases

- museums, [A24](#)

District heating and cooling (DHC)

- central plants

 - chiller, [A48](#)

- costs, [A38](#)

- geothermal heating systems, [A35](#)

Dormitories

- air conditioning, [A7](#)
- design criteria, [A7](#)
- energy systems, [A7](#)
- load characteristics, [A7](#)
- service water heating, [A51](#)

Dryers, [A26](#), [A31](#)

(see also Driers)
commercial and industrial

- agitated-bed, [A31](#)
- calculations, [A31](#)
- conduction, [A31](#)
- constant-moisture solvent, [A31](#)
- convection, [A31](#)
- dielectric, [A31](#)
- drying time determination, [A31](#)
- flash, [A31](#)
- fluidized-bed, [A31](#)
- freeze drying, [A31](#)
- mechanism, [A31](#)
- microwave, [A31](#)
- psychrometrics, [A31](#)
- radiant infrared, [A31](#)
- selection, [A31](#)
- superheated vapor, [A31](#)
- tunnel, [A31](#)
- ultraviolet (UV), [A31](#)
- vacuum drying, [A31](#)

farm crops, [A26](#)

Drying

farm crops, [A26](#)

Dual-duct systems

- control, [A48](#)
- terminal boxes, [A48](#)

Duct connections, [A64](#)

Ducts

- acoustical lining, [A49](#)
- airflow measurement in, [A40](#)
- industrial exhaust systems, [A33](#)
- noise in, [A49](#)
- road tunnels, [A16](#)
- sealing, [A64](#)
- security concerns, [A61](#)
- ships, [A14](#)
- sound

- attenuation, [A49](#)

vibration control, [A49](#)

Dynamometers, [A18](#)

E

Earthquakes, seismic-resistant design, [A56](#)

Economic analysis

- computer analysis, [A38](#)
- inflation, [A38](#)
- internal rate of return, [A38](#)
- life-cycle cost analyses, [A38](#)
- payback, [A38](#)

- improved, [A38](#)

simple, [A38](#)

present value (worth), [A38](#)

savings-to-investment ratio (SIR), [A38](#)

Economic performance degradation index (EPDI), [A63](#)

Economics, [A17](#), [A37](#), [A38](#), [A47](#), [A53](#)

(see also Costs)

energy management planning, [A37](#)

evaporative cooling, [A53](#)

indoor gaseous contaminant removal, [A47](#)

laboratory systems, [A17](#)

owning and operating costs, [A38](#)

Economizers

control, [A43](#)

kitchen ventilation, [A34](#)

occupant behavior, [A65](#)

Educational facilities, [A8](#)

air conditioning, [A8](#)

disabilities, [A8](#)

service water heating, [A51](#)

Electricity

billing rates, [A57](#)

building electrical systems, [A57](#)

codes, [A57](#)

costs, [A38](#)

emergency and standby power systems, [A57](#)

generation, on-site, [A38](#)

grid, [A63](#)

motors, [A57](#)

motor starting, [A57](#)

performance, [A57](#)

power quality variations, [A57](#)

principles, [A57](#)

safety, [A57](#)

smart grid, [A63](#)

utility strategies, [A63](#)

voltage, [A57](#)

wiring, [A57](#)

Elevators

in tall buildings, [A4](#)

smoke control, [A54](#)

Enclosed vehicular facilities, [A16](#)

dynamometers, [A18](#)

exhaust, [A18](#)

noise levels, [A18](#)

ventilation, [A18](#)

Energy

audit, [A37](#)

conservation, [A65](#)

building envelopes, [A45](#)

building supervisory control, [A43](#)

clean spaces, [A19](#)

educational facilities, [A8](#)

farm crop drying, [A26](#)

greenhouses, [A25](#)

industrial environments, [A32](#)

kitchen ventilation, [A34](#)

textile processing, [A22](#)

consumption

benchmarking, [A37](#)

building HVAC, control effect on, [A43](#)

emergency reduction, [A37](#)

gaseous contaminant removal, [A47](#)

costs, [A38](#)

emergency use reduction, [A37](#)

estimating

forecasting, [A43](#)

forecasting building needs, [A43](#)

management, [A37](#)

cost control, [A37](#)

emergency energy use reduction, [A37](#)

energy audits, [A37](#)

energy-efficiency measures (EEM), comparing, [A37](#)

implementation, [A37](#)

improving discretionary operations, [A37](#)

resource evaluation, [A37](#)

monitoring, [A42](#)

applications, [A42](#)

data, [A42](#)

design and implementation methodology, [A42](#)

documentation, [A42](#)

planning, [A42](#)

quality assurance, [A42](#)

recovery, [A32](#)

(*see also* Heat recovery)

industrial environments, [A32](#)

savings verification, [A42](#)

Energy and water use and management, [A37](#)

Energy efficiency ratio (EER)

geothermal systems, [A35](#)

Energy savings performance contracting (ESPC), [A38](#)

Energy use benchmarking, [A42](#)

Engines

heat release, [A18](#)

Engine test facilities, [A18](#)

air conditioning, [A18](#)

Environmental control system (ECS), [A13](#)

Equipment vibration, [A49](#)

Evaporative coolers

liquid, [A1](#)

(*see also* Evaporators)

in chillers, [A1](#)

Evaporative cooling, [A53](#)

applications

air cleaning, [A53](#)
 animal environments, [A53](#)
 commercial, [A53](#)
 dehumidification, [A53](#)
 gas turbines, [A53](#)
 greenhouses, [A25](#), [A53](#)
 industrial, *area cooling*, [A53](#)
 industrial, *process cooling*, [A53](#)
 industrial, *spot cooling*, [A53](#)
 laundries, [A53](#)
 motors, [A53](#)
 power generation facilities, [A53](#)
 produce storage, [A53](#)
 residential, [A53](#)
 wood and paper products facilities, [A53](#)

direct, [A53](#)
 economics, [A53](#)
 entering air condition, [A53](#)
 exhaust requirement, [A53](#)
 heat recovery and, [A53](#)
 indirect, [A53](#)
 psychrometrics, [A53](#)
 staged

 booster refrigeration, [A53](#)
 two-stage (indirect/direct), [A53](#)

water treatment, [A50](#)

Evaporators, [A11](#)

(*see also* Coolers, liquid)
 automobile air conditioning, [A11](#)

Exhaust

animal buildings, [A25](#)
 clean spaces, [A19](#)
 enclosed vehicular facilities, [A18](#)
 industrial environments, [A33](#)
 kitchens, [A34](#)
 laboratories, [A17](#)

stack height, [A17](#)

stacks

buildings, [A46](#)
 design strategies, [A46](#)
 exhaust dilution prediction equations, [A46](#)
 exhaust velocity, [A46](#)
 industrial exhaust systems, [A33](#)
 location relative to air intake, [A46](#)
 wake downwash, [A46](#)

vehicular facilities, enclosed, [A16](#)

Exhibit buildings, temporary, [A5](#)

Exhibit cases

museums, galleries, archives, and libraries, [A24](#)

Exhibition centers, [A5](#)

smoke control, [A54](#)

Expansion tanks

solar energy systems, [A36](#)

Explosions. See Chemical, biological, radiological, and explosive (CBRE) incidents, [A61](#)

F

Fairs, [A5](#)

Family courts, [A10](#)

Fans

animal environments, [A25](#)

control, [A48](#)

cooling tower capacity control, [A43](#)

fixed- vs. variable-speed, [A43](#)

industrial exhaust systems, [A33](#)

kitchen exhaust, [A34](#)

selection, [A49](#)

ships, naval surface, [A14](#)

smoke exhaust, [A54](#)

sound level, [A49](#)

unstable operation, [A48](#)

variable- vs. fixed-speed, [A43](#)

vehicular facilities, enclosed, [A16](#)

Farm crops, drying and storing, [A26](#)

aeration, [A26](#)

dryeration, [A26](#)

drying

combination, [A26](#)

corn, [A26](#)

cotton, [A26](#)

deep-bed, [A26](#)

energy conservation, [A26](#)

equipment, [A26](#)

full-bin, [A26](#)

hay, [A26](#)

layer, [A26](#)

peanuts, [A26](#)

rice, [A26](#)

shallow-layer, [A26](#)

soybeans, [A26](#)

specific, [A26](#)

microbial growth, [A26](#)

recirculation, [A26](#)

storing

grain aeration, [A26](#)

moisture migration, [A26](#)

f-Chart method, sizing heating and cooling systems, [A36](#)

Fenestration, [A45](#)

(see also Windows)

area, [A45](#)

building envelopes, [A45](#)

control of rain entry, [A45](#)

solar gain, [A45](#)

Filters, air, [A1](#), [A5](#), [A14](#), [A17](#), [A19](#), [A21](#), [A29](#), [A34](#)

(see also Air cleaners)

clean spaces, [A19](#)

demisters, [A29](#)

high-efficiency particulate air (HEPA) filters, [A19](#), [A29](#)

- kitchens, [A34](#)
- laboratories, [A17](#)
- nuclear facilities, [A29](#)
- places of assembly, [A5](#)
- printing plants, [A21](#)
- residential, [A1](#)
- ships, [A14](#)
- ultralow-penetration air (ULPA) filters, [A19](#)

Fire/smoke management

- justice facilities, [A10](#)

Firearm laboratories, [A10](#)

Fire management, [A54](#)

Fire safety

- clean space exhaust systems, [A19](#)
- justice facilities, [A10](#)
- kitchens, [A34](#)
- laboratories, [A17](#)
- nuclear facilities, [A29](#)
- penetration fire stopping, [A54](#)
- smoke control, [A54](#)

Fitness facilities, [A10](#)

- (*see also* Gymnasiums)
- in justice facilities, [A10](#)

Fixture units, [A51](#)

Flowmeters, [A40](#)

- bypass spring impact meters, [A40](#)
- devices, [A40](#)
- orifice plates, [A40](#)
- turbine meters, [A40](#)
- ultrasonic, [A40](#)
- velocity impact meters, [A40](#)
- venturi meters, [A40](#)

Fluid flow

- measurement, [A40](#)

Food service

- service water heating, [A51](#)

Forced-air systems, residential, [A1](#)

Forensic labs, [A10](#)

- autopsy rooms, [A10](#)
- critical spaces, [A10](#)
- firearm labs, [A10](#)
- intake air quality, [A10](#)

Foundations

- moisture control, [A45](#)

Fountains, Legionella pneumophila control, [A50](#)

Freeze drying, [A31](#)

Freeze prevention, [A36](#)

- (*see also* Freeze protection systems)
- solar energy systems, [A36](#)

Freeze protection systems, [A52](#)

Fruits

fresh

apples, storage, [A53](#)
citrus, [A53](#)

Fume hoods, laboratory exhaust, [A17](#)

Fungi

and moisture, [A64](#)

Furnaces

residential, [A1](#)**G**

Garages

automotive repair, [A16](#)
bus, [A16](#)
contaminant criteria, [A16](#)
parking, [A3](#), [A16](#)
ventilation

airflow rate, [A16](#)
control, [A16](#)
equipment, [A16](#)

Gases

compressed, storage, [A17](#)Geothermal energy, [A35](#)

corrosion control, [A35](#)
direct-use systems

cooling, [A35](#)
equipment, [A35](#)
heating, [A35](#)
service water heating, [A35](#)

district heating, [A35](#)
geothermal fluids, [A35](#)

disposal, [A35](#)
temperature, [A35](#)

ground-source heat pump (GSHP) systems, [A35](#)
heat exchangers, [A35](#)
materials performance, [A35](#)
resources, [A35](#)
valves, [A35](#)
water wells

flow rate, [A35](#)
pumps, [A35](#)
terminology, [A35](#)
water quality testing, [A35](#)

Geothermal heat pumps (GHP), [A35](#)Greenhouses, [A25](#), [A53](#)

(*see also* Plant environments)
evaporative cooling, [A53](#)
plant environments, [A25](#)

Ground-coupled heat pumps (GCHP)

closed-loop ground-source, [A35](#)

Ground-source heat pumps (GSHP), [A35](#)

Groundwater heat pumps (GWHP), [A35](#)

Guard stations, in justice facilities, [A10](#)

Gymnasiums, [A5](#), [A8](#)

H

Hay, drying, [A26](#)

Health

in justice facilities, [A10](#)

Health care facilities, [A9](#)

Health effects, mold, [A64](#)

Heaters

automobiles, [A11](#)

hydronic snow melting, [A52](#)

water, [A51](#)

Heat exchangers

geothermal energy systems, [A35](#)

systems

solar energy, [A36](#)

Heat gain, [A17](#), [A18](#)

(*see also* Load calculations)

enclosed vehicular facilities, dynamometers, [A18](#)

laboratories, [A17](#)

Heating

control, [A43](#)

geothermal energy systems, [A35](#)

greenhouses, [A25](#)

infrared

radiant, [A55](#)

places of assembly, [A5](#)

power plants, [A28](#)

residential, [A1](#)

systems

solar energy, [A36](#)

Heating and cooling plants

in justice facilities, [A10](#)

Heat pumps

direct-exchange

ground-coupled (DXGCHP), [A35](#)

ground-source

ground-coupled, [A35](#)

groundwater, [A35](#)

surface water, [A35](#)

terminology, [A35](#)

split systems, [A1](#)
unitary

application, [A1](#)

water heaters, [A51](#)
water-source

groundwater, [A35](#)
groundwater, *indirect systems*, [A35](#)
surface water, [A35](#)

Heat recovery, [A2](#), [A17](#), [A33](#), [A34](#), [A51](#), [A53](#)

(*see also* Energy, recovery)
evaporative cooling, [A53](#)
industrial exhaust systems, [A33](#)
kitchen ventilation, [A34](#)
laboratories, [A17](#)
service water heating, [A51](#)
supermarkets, [A2](#)

Heat stress

index (HSI), [A32](#)
industrial environments, [A32](#)
thermal standards, [A32](#)

Heat transfer, [A35](#), [A36](#), [A52](#)

(*see also* Heat flow)
lakes, [A35](#)
snow-melting systems, [A52](#)
solar energy systems, [A36](#)

Heat traps, [A51](#)

High-efficiency particulate air (HEPA) filters, [A29](#)

High-rise buildings. (*see* Tall buildings)

Homeland security. *See* Chemical, biological, radiological, and explosive (CBRE) incidents, [A61](#)

Hoods

gaseous contaminant removal, [A47](#)
industrial exhaust systems

canopy hoods, [A33](#)
capture velocities, [A33](#)
compound hoods, [A33](#)
design principles, [A33](#)
entry loss, [A33](#)
overhead hoods, [A33](#)
sidedraft hoods, [A33](#)
volumetric flow rate, [A33](#)

kitchen exhaust, [A34](#)

ductless, [A34](#)
recirculating systems, [A34](#)
residential, [A34](#)
type I, [A34](#)
type II, [A34](#)

laboratory fume, [A17](#)

sound control, [A49](#)

unidirectional, [A19](#)

Hotels and motels, [A7](#)

- accommodations, [A7](#)
- back-of-the-house (BOTH) areas, [A7](#)
- central plant, [A7](#)
- design criteria, [A7](#)
- guest rooms, [A7](#)
- indoor air quality (IAQ), [A7](#)
- load characteristics, [A7](#)
- makeup air units, [A7](#)
- public areas, [A7](#)
- service water heating, showers, [A51](#)
- sound control, [A7](#)
- systems, [A7](#)

Houses of worship, [A5](#)

Humidification

- control, [A48](#)

Humidifiers

- Legionella pneumophila control, [A50](#)
- residential, [A1](#)

Humidity, [A48](#)

- (*see also* Moisture)

- control, [A48](#)

HVAC security, [A61](#)

- commissioning, [A61](#)
- owner's project requirements (OPR), [A61](#)
- risk evaluation, [A61](#)
- system design, [A61](#)

- design measures, [A61](#)
 - maintenance management, [A61](#)
 - modes of operation, [A61](#)

Hydronic systems, [A1](#), [A40](#)

- (*see also* Water systems)

- central multifamily, [A1](#)
- heat transfer vs. flow, [A40](#)
- residential, [A1](#)
- testing, adjusting, balancing, [A40](#)

I

Ice rinks, [A5](#)

Indoor airflow, [A59](#)

- CFD examples, [A59](#)

- chilled beam, [A59](#)
 - data center design, [A59](#)
 - displacement ventilation, [A59](#)
 - industrial warehouse, [A59](#)
 - natural ventilation, [A59](#)
 - simple office, [A59](#)
 - viral containment in hospital ward, [A59](#)

- computational fluid dynamic (CFD) method, [A59](#)

- simulation process, [A59](#)
 - terminology, [A59](#)

- modeling, [A59](#)

considerations, [A59](#)

multizone simulation method, [A59](#)

office building, [A59](#)

Indoor air quality (IAQ), [A7](#), [A47](#)

(see also Air quality)

gaseous contaminant removal, [A47](#)

hotels and motels, [A7](#)

Indoor environmental quality (IEQ), kitchens, [A34](#)

(see also Air quality)

Indoor swimming pools, [A6](#)

(see also Natatoriums)

Industrial applications

service water heating, [A51](#)

steam generators, [A28](#)

Industrial environments, [A32](#), [A33](#)

air conditioning

spot cooling, [A32](#), [A53](#)

ventilation, [A32](#)

air distribution, [A32](#)

energy

conservation, [A32](#)

recovery, [A32](#)

sustainability, [A32](#)

evaporative cooling, [A53](#)

heat control, [A32](#)

heat exposure control, [A32](#)

heat stress, [A32](#)

local exhaust systems, [A32](#), [A33](#)

air cleaners, [A33](#)

airflow near hood, [A33](#)

air-moving devices, [A33](#)

ducts, [A33](#)

energy recovery, [A33](#)

exhaust stacks, [A33](#)

fans, [A33](#)

hoods, [A33](#)

hot processes, [A33](#)

operation and maintenance, [A33](#)

system testing, [A33](#)

spot cooling, [A32](#)

ventilation systems, [A32](#)

Industrial exhaust gas cleaning

gaseous (indoor air)

adsorbers, [A47](#)

chemisorbers, [A47](#)

economics, [A47](#)

energy consumption, [A47](#)

environmental effects on, [A47](#)

installation, [A47](#)

- media selection, [A47](#)
- operation and maintenance, [A47](#)
- safety, [A47](#)
- sizing, [A47](#)
- terminology, [A47](#)
- testing, [A47](#)
- types, [A47](#)

Infrared applications

- drying, [A31](#)
- greenhouse heating, [A25](#)
- snow-melting systems, [A52](#)

Instruments

- flowmeters, [A40](#)
- manometers, [A40](#)

Insulation, thermal

- animal environments, [A25](#)
- foundations, [A45](#)

Intake air quality

- justice facilities, [A10](#)

Integrated building design (IBD), [A60](#)

- design
 - intent, [A60](#)
- quality assurance/quality control (QA/QC), [A60](#)

Integrated project delivery (IPD), [A60](#)

Integrated project delivery and building design

- process, [A60](#)
 - phase 1–project justification, [A60](#)
 - phase 2–project initiation, [A60](#)
 - phase 3–concept development, [A60](#)
 - phase 4–design, [A60](#)
 - phase 5–construction preparation, [A60](#)
 - phase 6–construction, [A60](#)
 - phase 7–owner acceptance, [A60](#)
 - phase 8–use, operation, and maintenance, [A60](#)

J

- Jails, [A10](#)

- Judges' chambers, [A10](#)

- Jury facilities, [A10](#)

- Justice facilities, [A10](#)

- control rooms, [A10](#)
- courthouses, [A10](#)
- courtrooms, [A10](#)
- dining halls, [A10](#)
- energy considerations, [A10](#)
- fire/smoke management, [A10](#)
- firearm laboratories, [A10](#)
- fitness facilities, [A10](#)
- forensic labs, [A10](#)
- guard stations, [A10](#)
- health issues, [A10](#)

- heating and cooling plants, [A10](#)
- jail cells, [A10](#)
- jails, [A10](#)
- judges' chambers, [A10](#)
- jury rooms, [A10](#)
- juvenile, [A10](#)
- kitchens, [A10](#)
- laundries, [A10](#)
- libraries, [A10](#)
- police stations, [A10](#)
- prisons, [A10](#)
- shooting ranges, indoor, [A10](#)
- system controls, [A10](#)
- system requirements, [A10](#)
- tear gas and pepper spray, [A10](#)
- terminology, [A10](#)
- types of, [A10](#)
- U.S. Marshals, [A10](#)
- Juvenile detention facilities, [A10](#)

(see also Family courts)

K

- K-12 schools, [A8](#)
- Kitchens, [A34](#)

- air balancing, [A34](#)

- multiple-hood systems, [A34](#)

- air filtration, [A34](#)

- cooking effluent

- control of, [A34](#)

- generation of, [A34](#)

- thermal plume behavior, [A34](#)

- dishwashers, piping, [A51](#)

- energy conservation

- economizers, [A34](#)

- reduced airflow, [A34](#)

- residential hoods, [A34](#)

- restaurants, [A34](#)

- exhaust hoods, [A34](#)

- ductless, [A34](#)

- recirculating systems, [A34](#)

- replacement air, [A34](#)

- residential, [A34](#)

- systems, [A34](#)

- type I, [A34](#)

- type II, [A34](#)

- exhaust systems, [A34](#)

- downdraft, [A34](#)

- ducts, [A34](#)

- effluent control, [A34](#)

- fans, [A34](#)

- hoods, [A34](#)

- maintenance, [A34](#)

- multiple-hood systems, [A34](#)

- residential, [A34](#)

- terminations, [A34](#)

fire safety, [A34](#)

fire suppression, [A34](#)

multiple-hood systems, [A34](#)

prevention of fire spread, [A34](#)

residential, [A34](#)

grease removal, [A34](#)

heat recovery, [A34](#)

high-performance green design, [A34](#)

indoor environmental quality (IEQ), [A34](#)

in justice facilities, [A10](#)

integration and design, [A34](#)

maintenance, [A34](#)

makeup air systems

air distribution, [A34](#)

maintenance, [A34](#)

replacement, [A34](#)

residential, [A34](#)

operation, [A34](#)

replacement air, [A34](#)

residential, [A34](#)

service water heating, [A51](#)

ventilation, [A34](#)

L

Laboratories, [A17](#)

air distribution, [A17](#)

air filtration, [A17](#)

air intakes, [A17](#)

animal labs, [A17](#)

cage environment, [A25](#)

ventilation performance, [A25](#)

biological safety cabinets, [A17](#)

biosafety levels, [A17](#)

clean benches, [A17](#)

cleanrooms, [A19](#)

clinical labs, [A17](#)

commissioning, [A17](#)

compressed gas storage, [A17](#)

containment labs, [A17](#)

controls, [A17](#)

design parameters, [A17](#)

duct leakage rates, [A17](#)

economics, [A17](#)

exhaust devices, [A17](#)

exhaust systems, [A17](#)

fire safety, [A17](#)

fume hoods, [A17](#)

controls, [A17](#)

performance, [A17](#)

hazard assessment, [A17](#)

heat recovery, [A17](#)

loads, [A17](#)

nuclear facilities, [A29](#)

paper testing labs, [A27](#)

radiochemistry labs, [A17](#)

safety, [A17](#)

- scale-up labs, [A17](#)
- stack heights, [A17](#)
- supply air systems, [A17](#)
- system maintenance, [A17](#)
- system operation, [A17](#)
- teaching labs, [A17](#)
- types, [A17](#)
- ventilation, [A17](#)

Laboratory information management systems (LIMS), [A10](#)

Lakes, heat transfer, [A35](#)

Laminar flow

- air, [A19](#)

Laundries

- evaporative cooling, [A53](#)
- in justice facilities, [A10](#)
- service water heating, [A51](#)

Leakage

- ducts, [A64](#)

Legionella pneumophila, [A50](#)

- control, [A50](#)
- Legionnaires' disease, [A50](#)
- service water systems, [A51](#)

Lighting

- greenhouses, [A25](#)

LIMS. See Laboratory information management systems (LIMS), [A10](#)

Load calculations

- snow-melting systems, [A52](#)

Load collector ratio (LCR), [A36](#)

Local exhaust. See Exhaust, [A32](#)

M

Maintenance, [A2](#), [A17](#), [A34](#), [A36](#), [A38](#), [A40](#), [A47](#)

- (*see also* Operation and maintenance)

- air conditioners, retail store, [A2](#)
- cooking equipment, [A34](#)
- costs, [A38](#)
- documentation, [A40](#)
- gaseous air cleaners, [A47](#)
- kitchen ventilation systems, [A34](#)
- laboratory HVAC equipment, [A17](#)
- manual, [A40](#)
- solar energy systems, [A36](#)
- staffing, [A40](#)

Makeup air units

- controls, [A48](#)

Malls, [A2](#)

Manometers

- differential pressure readout, [A40](#)

Manometers, differential pressure readout, [A40](#)

Manufactured homes, [A1](#)

Mass-transit systems

bus garages, [A16](#)

bus terminals, [A16](#)

diesel locomotive facilities, [A16](#)

enclosed vehicular facilities, [A16](#)

rapid transit, [A16](#)

stations, [A16](#)

thermal comfort, [A16](#)

thermal load analysis, [A16](#)

tunnels

railroad, [A16](#)

rapid transit, [A16](#)

subway, [A16](#)

ventilation, [A16](#)

Mean infectious dose (ID50), [A61](#)

Mean lethal dose (LD50), [A61](#)

Measurement, [A40](#), [A42](#), [A47](#)

(see also Instruments)

airflow, [A40](#)

fluid flow, [A40](#)

gaseous contaminants, [A47](#)

uncertainty analysis, [A42](#)

Mechanical equipment room, central

central fan room, [A4](#)

floor-by-floor fan room, [A4](#)

floor-by-floor units, [A4](#)

multiple floors, [A4](#)

Megatall buildings, [A4](#)

Mines, [A30](#)

heat sources, [A30](#)

mechanical refrigeration plants, [A30](#)

spot coolers, [A30](#)

ventilation, [A30](#)

wall rock heat flow, [A30](#)

Modeling, [A19](#)

(see also Data-driven modeling\ Energy, modeling)

airflow, [A19](#)

Model predictive control (MPC), [A65](#)

Moisture, [A26](#), [A64](#)

(see also Humidity)

content, [A64](#)

farm crops content, [A26](#)

meters, [A64](#)

Mold, [A64](#)

Mold-resistant gypsum board, [A64](#)

Motors

evaporative cooling, [A53](#)

Movie theaters, [A5](#)

MPC (model predictive control), [A65](#)

Multifamily residences, [A1](#)

Multiple-use complexes

air conditioning, [A7](#)
 design criteria, [A7](#)
 load characteristics, [A7](#)
 systems, [A7](#)

energy inefficient, [A7](#)
 total energy, [A7](#)

Museums, galleries, archives, and libraries

air filtration, [A24](#)
 artifact deterioration, [A24](#)
 building construction, [A24](#)
 building envelope, [A24](#)
 climate, [A24](#)
 dehumidification, [A24](#)
 environmental control of, [A24](#)
 exhibit cases, [A24](#)
 humidification, [A24](#)
 moisture control, [A24](#)
 mold growth, [A24](#)
 outdoor air, [A24](#)
 planning, [A24](#)
 relative humidity, effect on museums, galleries, archives, and library collections, [A24](#)
 system selection, [A24](#)
 temperature, effect on museums, galleries, archives, and library collections, [A24](#)

N

Natatoriums, [A6](#)

(see also Swimming pools)
 envelope design, [A6](#)
 pool water chemistry, [A6](#)
 ventilation requirements, [A6](#)

Net positive suction head (NPSH), [A35](#)

Neutral pressure level (NPL), [A4](#)

Night setback, recovery, [A43](#)

Noise, [A18](#), [A19](#)

(see also Sound)
 controls, [A19](#)
 enclosed vehicular facilities, [A18](#)

NPL. (see Neutral pressure level (NPL))

Nuclear facilities, [A29](#)

air filtration, [A29](#)
 criticality, [A29](#)
 decommissioning, [A29](#)
 Department of Energy facilities requirements

confinement systems, [A29](#)
 ventilation, [A29](#)

fire protection, [A29](#)
 HVAC design considerations, [A29](#)
 Nuclear Regulatory Commission requirements

boiling water reactors, [A29](#)
 laboratories, [A29](#)
 medical and research reactors, [A29](#)
 other buildings and rooms, [A29](#)
 power plants, [A29](#)
 pressurized water reactors, [A29](#)

- radioactive waste facilities, [A29](#)
- safety design, [A29](#)
- terminology, [A29](#)
- tornado and wind protection, [A29](#)

Nursing facilities

- service water heating, [A51](#)

O

Office buildings

- air conditioning, [A3](#)
- space requirements, [A3](#)
- service water heating, [A51](#)

Oil, fuel

- storage buildings, [A28](#)

Operating costs, [A38](#)

Operation and maintenance, [A17](#), [A40](#)

(*see also* Maintenance)

- commissioning, [A40](#)
- documentation, [A40](#)
- laboratory HVAC equipment, [A17](#)
- manuals, [A40](#)
- responsibilities, [A40](#)
- staffing, [A40](#)
- training, [A40](#)

Operation and maintenance, A39, [A33](#)

(*see also* Maintenance)

- industrial exhaust systems, [A33](#)

Optimization, [A43](#)

- applications, [A43](#)
- dynamic, [A43](#)
- static, [A43](#)

Owning costs, [A38](#)

Oxygen

- in aircraft cabins, [A13](#)

Ozone

- activated carbon air cleaner, [A47](#)
- in aircraft cabins
- catalytic converters, [A13](#)
- limits, [A13](#)

P

Packaged terminal air conditioners (PTACs)

- residential, [A1](#)

Packaged terminal heat pumps (PTHPs)

- residential, [A1](#)

Paper

moisture content, [A21](#)

Paper products facilities, [A27](#)

air conditioning, [A27](#)
conduction drying, [A31](#)
control rooms, [A27](#)
evaporative cooling, [A53](#)
finishing area, [A27](#)
machine area, [A27](#)
system selection, [A27](#)
testing laboratories, [A27](#)

Peak dew point, [A64](#)

Peanuts, drying, [A26](#)

Performance contracting, [A42](#)

Pharmaceutical manufacturing cleanrooms, [A19](#)

Piping, [A35](#), [A36](#), [A40](#), [A49](#), [A51](#)

(see also Pipes)

geothermal energy systems, [A35](#)

service hot water, [A51](#)

solar energy, [A36](#)

sound

control, [A49](#)
transmission, [A40](#)

systems

solar energy, [A36](#)

vibration control, [A49](#)

vibration transmission, [A40](#)

Pitot tubes, [A40](#)

Places of assembly, [A5](#)

air conditioning, [A5](#)
air distribution, [A5](#)
air filtration, [A5](#)
air stratification, [A5](#)
arenas, [A5](#)
atriums, [A5](#)
auditoriums, [A5](#)
concert halls, [A5](#)
convention centers, [A5](#)
exhibition centers, [A5](#)
fairs, [A5](#)
gymnasiums, [A5](#)
houses of worship, [A5](#)
lighting loads, [A5](#)
mechanical equipment rooms, [A5](#)
movie theaters, [A5](#)
playhouses, [A5](#)
precooling, [A5](#)
sound control, [A5](#)
space conditions, [A5](#)
stadiums, [A5](#)
temporary exhibit buildings, [A5](#)
vibration control, [A5](#)

Plant environments, [A25](#)

greenhouses, [A25](#)

- carbon dioxide enrichment, [A25](#)
- cooling, [A25](#)
- energy conservation, [A25](#)
- evaporative cooling, [A25](#)
- heating, [A25](#)
- heat loss calculation, [A25](#)
- humidity control, [A25](#)
- photoperiod control, [A25](#)
- shading, [A25](#)
- site selection, [A25](#)
- supplemental irradiance, [A25](#)
- ventilation, [A25](#)

- other facilities, [A25](#)
- photoperiod control, [A25](#)
- phytotrons, [A25](#)
- supplemental irradiance, [A25](#)
- ventilation, [A25](#)

Plenums

- sound attenuation, [A49](#)
- stratification in, [A40](#)

Police stations, [A10](#)

Pollution

- effects on museum, gallery, archive, library collections, [A24](#)

Positive building pressure, [A64](#)

Potatoes

- storage, [A53](#)

Poultry, [A25](#)

- (*see also* Animal environments)
- recommended environment, [A25](#)

Power grid, [A63](#)

Power plants, [A28](#)

buildings

- oil pump, [A28](#)
- oil storage, [A28](#)
- steam generator, [A28](#)
- turbine generator, [A28](#)

- coal-handling facilities, [A28](#)
- combustion turbine areas, [A28](#)
- control center, [A28](#)
- cooling, [A28](#)
- design criteria, [A28](#)
- dust collectors, [A28](#)
- evaporative cooling, [A53](#)
- heating, [A28](#)
- safety, [A28](#)
- substations, [A28](#)
- switchyard control structures, [A28](#)
- ventilation, [A28](#)

- rates, [A28](#)

Precooling

buildings, [A43](#)
indirect evaporative, [A53](#)
places of assembly, [A5](#)

Preschools, [A8](#)

Pressure

aircraft cabins, [A13](#)
clean spaces, [A19](#)
differential

conversion to head, [A40](#)
readout, [A40](#)

measurement, [A40](#)
smoke control, [A54](#)

stairwells, [A54](#)

static control, [A48](#)

Printing plants, [A21](#)

air conditioning, [A21](#)

air filtration, [A21](#)
binding areas, [A21](#)
collotype printing rooms, [A21](#)
letterpress areas, [A21](#)
lithographic pressrooms, [A21](#)
paper moisture content control, [A21](#)
platemaking rooms, [A21](#)
relief printing areas, [A21](#)
rotogravure pressrooms, [A21](#)
salvage systems, [A21](#)
shipping areas, [A21](#)

ink drying, [A31](#)

Prisons, [A10](#)

Property assessment for clean energy (PACE), [A38](#)

Psychrometrics

evaporative cooling systems, [A53](#)
industrial drying, [A31](#)

Pumps

as fluid flow indicators, [A40](#)
chilled-water, [A43](#)

sequencing, [A43](#)

condenser water, [A43](#)
geothermal wells, [A35](#)

lineshaft, [A35](#)
submersible, [A35](#)

solar energy systems, [A36](#)
variable-speed, [A43](#)

R

Radiant heating and cooling, [A48](#), [A52](#), [A55](#)

(see also Panel heating and cooling)
control, [A48](#)

panels

control, [A48](#)

snow-melting systems, [A52](#)

Radiation

atmospheric, [A36](#)

solar, [A36](#)

Radon

removal, [A47](#)

Railroad tunnels, ventilation

design, [A16](#)

diesel locomotive facilities, [A16](#)

equipment, [A16](#)

locomotive cooling requirements, [A16](#)

tunnel aerodynamics, [A16](#)

tunnel purge, [A16](#)

Refrigerant control devices

automobile air conditioning, [A11](#)

Refrigerants

automobile air conditioning, [A11](#)

phaseout, costs, [A38](#)

Refrigeration, [A51](#)

(*see also* Absorption)

(*see also* Adsorption)

heat reclaim, service water heating, [A51](#)

Refrigerators

retail food store

display, [A2](#)

Residential systems, [A1](#)

dehumidifiers, [A1](#)

equipment sizing, [A1](#)

heating and cooling systems, [A1](#)

kitchen ventilation, [A34](#)

water heating, [A51](#)

Restaurants

energy conservation, [A34](#)

kitchen ventilation, [A34](#)

service water heating, [A51](#)

Retail facilities, [A2](#)

air conditioning, [A2](#)

convenience centers, [A2](#)

department stores, [A2](#)

design considerations, [A2](#)

discount and big-box stores, [A2](#)

load determination, [A2](#)

malls, [A2](#)

multiple-use complexes, [A2](#)

shopping centers, [A2](#)

small stores, [A2](#)
supermarkets, [A2](#)

service water heating, [A51](#)
Retrofit performance monitoring, [A42](#)
Rice, drying, [A26](#)
Road tunnels, [A16](#)

carbon monoxide

allowable concentrations, [A16](#)
analyzers and recorders, [A16](#)

computer analysis, [A16](#)
vehicle emissions, [A16](#)
ventilation

air quantities, [A16](#)
computer analysis, [A16](#)
controls, [A16](#)
ducts, [A16](#)
emergency, [A16](#)
emergency, *air quantities*, [A16](#)
enclosed facility, [A16](#)
enhancements, [A16](#)
equipment, [A16](#)
hybrid, [A16](#)
mechanical, [A16](#)
natural, [A16](#)
normal air quantities, [A16](#)
normal conditions, [A16](#)
pressure evaluation, [A16](#)
temporary, [A16](#)

Room air distribution, [A58](#)

air terminals, [A58](#)
chilled beams, [A58](#)
classification, [A58](#)
fully stratified, [A58](#)
isovels, [A58](#)
mapping, [A58](#)
mixed, [A58](#)
occupant comfort, [A58](#)
occupied zone, [A58](#)
partially mixed, [A58](#)
systems

partially mixed, [A58](#)

S

Safety

air cleaners, [A47](#)
automatic controls, [A48](#)
electrical, [A57](#)
nuclear facilities, [A29](#)
service water heating, [A51](#)
solar energy systems, [A36](#)
UVGI systems, [A62](#)

Savings-to-investment ratio (SIR), [A38](#)
Savings-to-investment-ratio (SIR), [A38](#)
Scale

control, [A50](#)

service water systems, [A51](#)
water treatment, [A50](#)

scaling indices, [A50](#)

Schools

air conditioning, [A8](#)
service water heating, [A51](#)

elementary, [A51](#)
high schools, [A51](#)

Seeds, storage, [A26](#)

Seismic restraint, [A49](#), [A56](#)

anchor bolts, [A56](#)
design, [A56](#)
design calculations

examples, [A56](#)
static analysis, [A56](#)

dynamic analysis, [A56](#)
installation problems, [A56](#)
terminology, [A56](#)
weld capacities, [A56](#)

Sensors

location, [A48](#)

Service water heating, [A51](#)

commercial and institutional, [A51](#)
corrosion, [A51](#)
design considerations, [A51](#)
distribution system

for commercial kitchens, [A51](#)
manifolding, [A51](#)
piping, [A51](#)
pressure differential, [A51](#)
return pump sizing, [A51](#)
two-temperature service, [A51](#)

geothermal energy, [A35](#)
indirect, [A51](#)
industrial, [A51](#)
Legionella pneumophila, [A51](#)
requirements, [A51](#)
residential, [A51](#)
safety, [A51](#)
scale, [A51](#)
sizing water heaters

instantaneous and semi-instantaneous, [A51](#)
storage heaters, [A51](#)

solar energy, [A36](#), [A51](#)
system planning, [A51](#)
water heating equipment

placement, [A51](#)
sizing, [A51](#)
types, [A51](#)

water quality, [A51](#)

Set points, [A65](#)

Ships

air conditioning

air distribution, [A14](#)

controls, [A14](#)

design criteria, [A14](#)

equipment selection, [A14](#)

systems, [A14](#)

coils, [A14](#)

ducts, [A14](#)

merchant, [A14](#)

naval surface, [A14](#)

regulatory agencies, [A14](#)

Shooting ranges, indoor, [A10](#)

Slab heating, [A52](#)

Slab-on-grade foundations, [A45](#)

Smart building systems, [A63](#)

actuators, [A63](#)

diagnostics, [A63](#)

levels of intelligence, [A63](#)

Smart grid, [A63](#)

basics, [A63](#)

interconnections, [A63](#)

sensors, [A63](#)

strategy, [A63](#)

Smoke control, [A54](#)

acceptance testing, [A54](#)

atriums, [A54](#)

commissioning, [A54](#)

compartmentation, [A54](#)

computer analysis, [A54](#)

design fires, [A54](#)

dilution, [A54](#)

extraordinary incidents, [A54](#)

fire and smoke dampers, [A54](#)

fire management, [A54](#)

pressurization, [A54](#)

rapid-transit systems, [A16](#)

road tunnels, [A16](#)

smoke movement, [A54](#)

buoyancy, [A54](#)

elevator piston effect, [A54](#)

expansion, [A54](#)

forced ventilation, [A54](#)

stack effect, [A54](#)

wind, [A54](#)

stairwells

analysis, [A54](#)

compartmentation, [A54](#)

open doors, [A54](#)

pressurized, [A54](#)

tenability systems, [A54](#)

testing, [A54](#)

weather data, [A54](#)

zones, [A54](#)

Snow-melting systems, [A52](#)

back and edge heat losses, [A52](#)

electric system design

constant wattage systems, [A52](#)

gutters and downspouts, [A52](#)

heat flux, *idling*, [A52](#)

infrared systems, [A52](#)

installation, [A52](#)

free area ratio, [A52](#)

freeze protection systems, [A52](#)

heat balance, [A52](#)

heating requirement

annual operating data, [A52](#)

heat flux equations, [A52](#)

hydronic and electric, [A52](#)

load frequencies, [A52](#)

surface size, [A52](#)

transient heat flux, [A52](#)

weather data, [A52](#)

wind speed, [A52](#)

hydronic system design

fluid heater, [A52](#)

slab design, hydronic and electric, [A52](#)

Snubbers, seismic, [A56](#)

Software, [A65](#)

AFDD, [A63](#)

custom programming, [A41](#)

road tunnel, [A16](#)

Solar energy, [A1](#), [A36](#), [A36](#), [A51](#)

(*see also* Solar heat gain)

(*see also* Solar radiation)

(*see also* Solar heat gain\ Solar radiation)

active systems, [A36](#)

airflow, [A36](#)

collectors, [A36](#)

concentrating, [A36](#)

design and installation, [A36](#)

efficiency, [A36](#)

mounting, [A36](#)

performance, [A36](#)

combi systems, [A36](#)

control, [A36](#)

cooling systems, [A36](#)

absorption refrigeration, [A36](#)

sizing, [A36](#)

types, [A36](#)

design, installation, operation checklist, [A36](#)

design values, solar irradiation, [A36](#)

domestic hot water, [A36](#)

f-Chart method, [A36](#)

freeze protection, [A36](#)

heat exchangers, [A36](#)

heating systems, [A36](#)

- active, [A36](#)
- components, [A36](#)
- control, [A36](#)
- direct circulation, [A36](#)
- hybrid, [A36](#)
- indirect, [A36](#)
- integral collector storage systems, [A36](#)
- passive, [A36](#)
- pool heating, [A36](#)
- recirculation, [A36](#)
- residential, [A1](#)
- sizing, [A36](#)
- thermosiphon, [A36](#)

- hybrid systems, [A36](#)
- hydraulics, [A36](#)
- installation, [A36](#)
- irradiation, [A36](#)
- maintenance, [A36](#)
- overheat protection, [A36](#)
- passive systems, [A36](#)
- photovoltaic (PV) systems, [A36](#)
- quality and quantity, [A36](#)
- radiation at earth's surface, [A36](#)
- radiative cooling, [A36](#)
- safety, [A36](#)
- service water heating systems, [A36](#), [A51](#)
- sizing heating and cooling systems, [A36](#)
- solar angles, [A36](#)
- solar time, [A36](#)
- spectrum, [A36](#)
- start-up procedure, [A36](#)
- thermal storage systems, [A36](#)
- time, [A36](#)
- uses, [A36](#)

Solar-load ratio (SLR), [A36](#)

Solvent drying, constant-moisture, [A31](#)

Sound, [A5](#), [A7](#), [A10](#), [A18](#), [A19](#), [A40](#), [A49](#)

(*see also* Noise)

- acoustical design of HVAC systems, [A49](#)
- attenuators, [A49](#)
- barriers, [A49](#)
- ceiling sound transmission, [A49](#)
- chillers, [A49](#)
- clean spaces, [A19](#)
- compressors, [A49](#)
- control, [A5](#), [A7](#), [A10](#), [A18](#), [A19](#), [A40](#), [A49](#)
- data reliability, [A49](#)
- design, [A49](#)
- ducts, [A49](#)

sound attenuation, [A49](#)

- enclosed vehicular facilities, [A18](#)
- equipment sound levels, [A49](#)
- fans, [A49](#)
- fume hood duct design, [A49](#)
- hotels and motels, [A7](#)
- insertion loss, [A49](#)
- justice facilities, [A10](#)
- measurement

instrumentation, [A40](#)

- mechanical equipment rooms, [A49](#)
- outdoor equipment, [A49](#)
- pipng, [A49](#)
- places of assembly, [A5](#)
- return air system sound transmission, [A49](#)
- rooftop air handlers, [A49](#)
- room sound correction, [A49](#)
- testing, [A40](#)
- transmission, [A40](#)
- troubleshooting, [A40](#)
- variable-air-volume (VAV) systems, [A49](#)

Soybeans, drying, [A26](#)

Spot cooling

- evaporative, [A53](#)
- industrial environments, [A32](#), [A53](#)
- mines, [A30](#)

Stack effect

- in tall buildings, [A4](#)
- smoke movement, [A54](#)

Stadiums, [A5](#)

Stairwells

- smoke control, [A54](#)

Standards, [A4](#), [A57](#), [A58](#)

- (see also Codes)
- air distribution, [A58](#)
- chilled-beam system, [A58](#)
- electrical, [A57](#)
- tall buildings, [A4](#)

Steam

- distribution systems

 - testing, adjusting, balancing, [A40](#)

- testing, adjusting, balancing, [A40](#)

Steam systems

- generator buildings, [A28](#)
- heating, [A50](#)

Storage

- apples, [A53](#)
- citrus, [A53](#)
- compressed gases, [A17](#)
- farm crops, [A26](#)
- potatoes, [A53](#)
- seeds, [A26](#)
- wood products, [A27](#)

Stratification

- of air
 - in places of assembly, [A5](#)
 - in plenums, [A40](#)

Subway environment simulation (SES) program, [A16](#)

Subway systems, [A16](#)

(see also Mass-transit systems)
station air conditioning, [A16](#)
ventilation, [A16](#)

Supertall buildings, [A4](#)
Supervisory control, [A43](#)

air-handling systems, [A43](#)

air distribution, [A43](#)
sequencing, [A43](#)
set point reset, [A43](#)

boilers, [A43](#)
building temperature set point

night setback recovery, [A43](#)
precooling, [A43](#)

chilled-water pumps, [A43](#)
chillers, [A43](#)

load distribution, [A43](#)
sequencing, [A43](#)

cooling

tower fans, [A43](#)

cooling tower fans, [A43](#)
cool thermal storage systems, [A43](#)

ice storage control optimization, [A43](#)

forecasting energy requirements, [A43](#)
optimization methods, [A43](#)
smoke, [A54](#)
thermal storage systems, [A43](#)
variable-air-volume (VAV) systems, [A43](#)
vibration, [A49](#)

Surface transportation

automobiles, [A11](#)

Surface water heat pump (SWHP), [A35](#)
Swimming pools, [A6](#), [A36](#), [A51](#)

(see also Natatoriums)
solar heating, [A36](#)
water chemistry, [A6](#)
water heating for, [A51](#)

Swine, recommended environment, [A25](#)

T

Tall buildings, [A4](#)

chilled beams, [A4](#)
codes, [A4](#)
HVAC design process, [A4](#)
hydrostatic considerations, [A4](#)
life safety, [A4](#)
low-temperature air VAV systems, [A4](#)
megatall buildings, [A4](#)
neutral pressure level (NPL), [A4](#)
refrigeration machine location, [A4](#)

reverse stack effect, [A4](#)
stack effect, [A4](#)

elevator doors, [A4](#)
heating problems, [A4](#)
manual doors, [A4](#)
minimizing, [A4](#)
smoke and odor propagation, [A4](#)

standards, [A4](#)
static head, [A4](#)
supertall buildings, [A4](#)
system selection, [A4](#)
underfloor air distribution (UFAD) systems, [A4](#)
vertical transportation, [A4](#)
water distribution systems, [A4](#)

Telecommunication facilities, air-conditioning systems, [A20](#)

Temperature

effective, [A53](#)

Terminal units, [A48](#), [A49](#)

(*see also* Air terminal units (ATUs))
boxes

reheat, [A48](#)
variable-air-volume (VAV), [A49](#)

induction, [A48](#)

Terrorism. *See* Chemical, biological, radiological, and explosive (CBRE) incidents, [A61](#)

Testing

air cleaners, [A47](#)
clean spaces, [A19](#)
cooling towers, [A40](#)
industrial exhaust systems, [A33](#)
smoke control systems, [A54](#)
sound

instrumentation, [A40](#)
procedure, [A40](#)
transmission problems, [A40](#)

vibration

equipment, [A40](#)
instrumentation, [A40](#)
isolators, [A40](#), [A49](#)
piping transmission, [A40](#)
procedure, [A40](#)

Testing, adjusting, and balancing, [A40](#)

(*see also* Balancing)

air diffusers, [A40](#)
air distribution systems, [A40](#)

reporting results, [A40](#)

airflow measurement, [A40](#)
central plant chilled-water systems, [A40](#)
cooling towers, [A40](#)
design considerations, [A40](#)
fluid flow measurement, [A40](#)

differential pressure readout, [A40](#)

HVAC systems, [A40](#)
hydronic systems, [A40](#)

heat transfer vs. flow, [A40](#)
water-side balancing, *instrumentation*, [A40](#)
water-side balancing, *proportional method*, [A40](#)
water-side balancing, *rated differential method*, [A40](#)
water-side balancing, *sizing balancing valves*, [A40](#)
water-side balancing, *temperature difference method*, [A40](#)
water-side balancing, *total heat transfer method*, [A40](#)

instruments, [A40](#)
sound transmission problems, [A40](#)
steam distribution systems, [A40](#), [A40](#)
temperature controls, [A40](#)
terminology, [A40](#)
variable-air-volume (VAV) systems, [A40](#)

Textile processing plants, [A22](#)

air conditioning design

air cleaning, [A22](#)
air distribution, [A22](#)
collector systems, [A22](#)
health considerations, [A22](#)

energy conservation, [A22](#)
fabric making, [A22](#)
fiber making, [A22](#)
yarn making, [A22](#)

Theaters, [A5](#)

Thermal energy storage (TES)

controls

strategies, [A43](#)

cool storage, [A43](#)
ice storage

charging and discharging, [A43](#)
control optimization, [A43](#)

solar energy systems, [A36](#)

Thermally activated building systems (TABS), [A43](#)

Thermosiphons

solar energy systems, [A36](#)

Thermostats

location, [A48](#)

Tobacco smoke

contaminants, [A47](#)

Tollbooths

air quality criteria, [A16](#)
ventilation, [A16](#)

Transportation centers

commercial and public buildings, [A3](#)
ventilation, [A16](#)

Tunnels, vehicular, [A16](#)

fires, [A16](#)

railroad, [A16](#)

rapid transit, [A16](#)

road, [A16](#)

Turbines

enclosed vehicular facilities, gas, [A18](#)

gas

evaporative cooling, [A53](#)

U

U.S. Marshal spaces, [A10](#)

Ultraviolet (UV) lamp systems

in-duct, [A62](#)

lamps, [A62](#)

maintenance, [A62](#)

surface disinfection, [A62](#)

upper-air, [A62](#)

Ultraviolet air and surface treatment, [A62](#)

Ultraviolet germicidal irradiation (UVGI), [A62](#)

(see *also* Ultraviolet (UV) lamp systems)

terminology, [A62](#)

Uncertainty analysis

measurement, [A42](#)

statistical regression, [A42](#)

Underfloor air distribution (UFAD) systems, [A4](#), [A58](#)

Utility rates, [A63](#)

demand response, [A63](#)

UV. See Ultraviolet (UV) lamp systems, [A62](#)

V

Valves, [A35](#), [A36](#), [A40](#)

(see *also* Regulators)

balancing

sizing, [A40](#)

geothermal energy, [A35](#)

solar energy systems, [A36](#)

Variable-air-volume (VAV) systems

control, [A43](#)

duct static pressure control, [A48](#)

fan

selection, [A49](#)

sequencing, [A48](#)

unstable operation, [A48](#)

museums, galleries, archives, and libraries, [A24](#)

sound control, [A49](#)
static pressure reset, [A43](#)
terminal boxes, [A48](#), [A49](#)
versus constant air volume (CAV), [A17](#)

Ventilation

aircraft, [A13](#)
animal environments, [A25](#)
bus garages, [A16](#)
bus terminals, [A16](#)
dilution, [A32](#), [A47](#)
engine test facilities, [A18](#)
gaseous contaminant removal, [A47](#)
health care facilities, [A9](#)
industrial environments, [A32](#)

exhaust systems, [A33](#)

kitchens, [A34](#)
laboratories, [A17](#)
mines, [A30](#)
natatoriums, [A6](#)
nuclear facilities, [A29](#)
power plants, [A28](#)
railroad tunnels, [A16](#)
rapid-transit systems, [A16](#)
road tunnels, [A16](#)
roof ventilators, [A32](#)
security concerns, [A61](#)
ships, [Load Calculations](#)
shooting ranges, indoor, [A10](#)
tear gas and pepper spray, [A10](#)
tollbooths, [A16](#)

Ventilation, plant environments, [A25](#)

Ventilators

roof, [A32](#)
unit

control, [A48](#)

Vibration

control, [A49](#)

clean spaces, [A19](#)
criteria, [A49](#)
data reliability, [A49](#)
ducts, [A49](#)
equipment vibration, [A40](#)
equipment vibration, *analysis*, [A40](#)
floor flexibility, [A49](#)
isolators, *noise*, [A49](#)
isolators, *resonance*, [A49](#)
isolators, *specifications*, [A49](#)
isolators, *testing*, [A40](#)
piping, *connectors*, [A49](#)
piping, *noise*, [A49](#)
piping, *resilient hangers and supports*, [A49](#)
places of assembly, [A5](#)
resonance, [A49](#)
seismic restraint, [A49](#), [A56](#)
troubleshooting, [A40](#), [A49](#)

measurement

instrumentation, [A40](#)

testing, [A40](#)

Virgin rock temperature (VRT), and heat release rate, [A30](#)

Voltage, [A57](#)

W

Warehouses, [A3](#)

Water

activity, [A64](#)

alkalinity, [A50](#)

anion, [A50](#)

anode, [A50](#)

biological growth, [A50](#)

cathode, [A50](#)

cation, [A50](#)

corrosion, [A50](#)

electrolyte, [A50](#)

filtration, [A50](#)

fungi, [A64](#)

galvanic corrosion, [A50](#)

hardness, [A50](#)

heating

geothermal energy systems, [A35](#)

solar energy systems, [A36](#)

inhibitor, [A50](#)

ion, [A50](#)

Legionnaires' disease, [A50](#)

passivity, [A50](#)

properties, [A50](#)

sludge, [A50](#)

treatment, [A50](#)

tuberculation, [A50](#)

Water heaters

blending injection, [A51](#)

boilers (indirect), [A51](#)

circulating tank, [A51](#)

combination, [A51](#)

electric, [A51](#)

gas-fired, [A51](#)

indirect, [A51](#)

instantaneous, [A51](#)

oil-fired, [A51](#)

placement, [A51](#)

refrigeration heat reclaim, [A51](#)

semi-instantaneous, [A51](#)

sizing, [A51](#)

solar energy, [A51](#)

storage, [A51](#)

terminology, [A51](#)

usable hot-water storage, [A51](#)

waste heat recovery, [A51](#)

Water systems

in tall buildings, [A4](#)

Water treatment, [A50](#)

air washers, [A50](#)

biological control, [A50](#)

Legionella pneumophila, [A50](#)

boilers, [A50](#)

brine systems, [A50](#)

cooling towers, [A50](#)

corrosion control, [A50](#)

fundamentals, [A50](#)

nonchemical (physical), [A50](#)

once-through systems, [A50](#)

open recirculating systems, [A50](#)

scale control, [A50](#)

sprayed-coil units, [A50](#)

steam and condensate systems, [A50](#)

terminology, [A50](#)

Water use and management (*see* Energy and water use and management)

Water vapor control, [A45](#)

Water wells, [A35](#)

Wet-bulb globe temperature (WBGT), heat stress, [A32](#)

Whirlpools and spas

Legionella pneumophila control, [A50](#)

service water heating, [A51](#)

Wind, [A54](#)

(*see also* Climatic design information)

(*see also* Weather data)

effect on

smoke movement, [A54](#)

Wind restraint design, [A56](#)

minimum design wind load, [A56](#)

Wireless sensors, [A63](#)

Wood products facilities, [A27](#)

evaporative cooling, [A53](#)

process area, [A27](#)

storage, [A27](#)

Wood pulp, [A27](#)