CHAPTER 17

Other Gas Appliances

Learning Objectives

Upon completion of this chapter, students will be able to:

1. Install and service gas cooking appliances according to manufacturer specifications and CSA B149.1
2. Properly vent and install gas clothes dryers with appropriate exhaust systems
3. Install and inspect gas fireplaces and decorative appliances per code requirements
4. Configure pool and spa heaters for safe outdoor installations
5. Select and install unit heaters for commercial and industrial applications
6. Safely operate construction heaters following temporary heating guidelines
7. Install infrared heaters for various heating applications
8. Troubleshoot common problems with specialty gas appliances
9. Apply CSA B149.1 code requirements for all gas appliance types
10. Perform safety inspections and maintenance on various gas appliances

17.1 Cooking Appliances

Gas cooking appliances remain popular in residential and commercial kitchens due to precise temperature control, instant heat adjustment, and reliability during power outages.

Ranges and Cooktops

Understanding the various types and configurations ensures proper installation and service.

Residential Ranges

Freestanding Ranges:

- Complete cooking unit with oven and cooktop
- Typical widths: 24", 30", 36", 48", 60"
- Gas input: 40,000-80,000 BTU/hr typical
- Finished sides for flexible placement
- Anti-tip bracket required

Slide-In Ranges:

- Designed to fit between cabinets
- No backguard or side panels
- Controls typically on front
- Creates built-in appearance
- Width tolerance critical: ±1/8"

Drop-In Ranges:

- Requires cabinet cutout
- Supported by countertop lip
- No storage drawer
- Professional appearance
- Complex installation

Professional-Style Ranges:

- Commercial appearance for residential use
- High BTU burners: 15,000-25,000 BTU/hr
- Heavy-duty grates
- Convection ovens standard
- Stainless steel construction

Cooktop Configurations

Sealed Burners:

- Spills contained on cooktop surface
- Easier cleaning
- Slightly lower efficiency
- Most common in residential
- Burner caps removable

Open Burners:

- Commercial style
- Higher heat output
- Better heat distribution
- Requires drip pans
- More complex cleaning

Burner Specifications:

- Simmer burner: 500-1,000 BTU/hr
- Standard burner: 9,000-12,000 BTU/hr
- Power burner: 15,000-20,000 BTU/hr
- Wok burner: 20,000-30,000 BTU/hr

Wall Ovens

Separate oven installations provide kitchen design flexibility.

Types of Wall Ovens

Single Ovens:

- Standard 27" or 30" widths
- Gas input: 16,000-22,000 BTU/hr
- Convection models available
- Electronic ignition standard
- Self-cleaning options

Double Ovens:

- Two independent ovens
- Same or different sizes
- Total input: 35,000-45,000 BTU/hr
- Simultaneous operation capability
- Upper oven often smaller

Convection Ovens:

- Fan circulates heated air
- 25% faster cooking
- More even temperature
- Multiple rack usage
- Temperature reduction: 25°F typical

Installation Requirements

Proper installation ensures safe operation and optimal performance.

Gas Supply Sizing

Pipe Sizing Considerations:

- Calculate total appliance load
- Include future appliances
- Account for pipe length
- Consider fitting losses
- Verify adequate pressure

Example Calculation:

- Range: 65,000 BTU/hr
- Water heater: 40,000 BTU/hr
- Furnace: 80,000 BTU/hr
- Total: 185,000 BTU/hr
- Pipe size: 3/4" minimum for 20 feet

Flexible Connectors:

- Maximum length: 6 feet (1.8 m)
- Must be certified for gas
- No concealment in walls
- Single appliance only
- Coated for corrosion resistance

Shut-Off Valves:

- Required within 6 feet (1.8 m)
- Must be accessible
- Ball valves recommended
- Quarter-turn operation
- Approved for gas service

Clearances and Ventilation

Safety clearances prevent fire hazards and ensure proper operation.

Minimum Clearances to Combustibles

Freestanding Ranges:

Location	Minimum Clearance
Rear wall	0" with backguard
Side walls	6" typical
Side cabinets	1"-3" varies
Above cooktop	30" minimum
Above with hood	24" minimum

Cooktops:

- Side clearance: 2" minimum
- Rear clearance: 2" minimum
- Below counter: 2" minimum
- Above to hood: 24"-30"
- Cutout per manufacturer

Wall Ovens:

- Top clearance: 1" minimum
- Side clearance: 0" typical
- Bottom support required
- Electrical junction accessible

- Anti-tip provisions needed

Ventilation Requirements

Range Hoods:

- Recommended CFM: 100 per linear foot of range
- Professional ranges: 1 CFM per 100 BTU
- Ducted preferred over recirculating
- Make-up air for over 400 CFM
- Variable speed control ideal

Downdraft Ventilation:

- Integrated or separate units
- 300-600 CFM typical
- Less effective than overhead
- Complex ductwork
- Higher energy use

Make-Up Air Requirements:

- Required over 400 CFM exhaust
- Interlocked operation
- Tempered in cold climates
- Prevents negative pressure
- Protects venting systems

Anti-Tip Devices

Critical safety devices preventing range tip-over accidents.

Requirements and Installation

CSA B149.1 Requirements:

- Mandatory on all freestanding ranges
- Must engage with movement
- Tested to support range weight
- Documentation required
- Customer education essential

Types of Anti-Tip Devices:

1. **Floor-Mounted Bracket:**
    - Most common type

    - Attached to floor
    - Engages rear leg
    - Allows range removal
    - Adjustment required
2. **Wall-Mounted Bracket:**
    - Alternative to floor mount
    - Attached to wall studs
    - Engages range back
    - Height critical
    - More permanent
3. **Chain Restraints:**
    - Heavy-duty chain
    - Wall to range connection
    - Length adjustment needed
    - Visible installation
    - Commercial applications

Installation Verification:

- Test by grasping rear edge
- Apply 50 lbs downward force
- Verify bracket engagement
- Document installation
- Demonstrate to customer

Commercial Cooking Equipment

Commercial equipment requires special consideration for installation and service.

Equipment Types

Commercial Ranges:

- Input: 100,000-200,000 BTU/hr
- Heavy-duty construction
- Open burner design
- Standing pilot typical
- NSF certification required

Griddles:

- Flat cooking surface
- 20,000-30,000 BTU/hr per foot
- Thermostatic control
- Even heat distribution
- Grease management system

Fryers:

- 80,000-120,000 BTU/hr typical
- High-efficiency models available
- Automatic ignition
- Temperature limiting
- Oil filtration systems

Broilers and Salamanders:

- Overhead radiant heating
- 30,000-45,000 BTU/hr
- Infrared or ceramic burners
- Height adjustment
- Continuous operation design

Commercial Installation Requirements

Type I Hood Systems:

- Required for grease-producing equipment
- Automatic fire suppression
- Minimum 6" overhang
- Grease filters required
- Regular cleaning mandatory

Ansul System Requirements:

- Wet chemical suppression
- Automatic and manual activation
- Gas shut-off integration
- Regular inspection required
- K-class fire extinguisher backup

Gas Piping:

- Welded steel preferred
- Accessible shut-offs
- Quick-disconnect fittings
- Restraint cables required
- Pressure testing mandatory

Clearances:

- Minimum 6" to combustibles
- 18" service clearance

- Adequate aisle width
- Emergency shut-off accessible
- Fire-rated construction

Troubleshooting Common Issues

Systematic diagnosis ensures efficient repair.

No Ignition Problems

Diagnosis Steps:

1. Verify gas supply on
2. Check electrical power
3. Test igniter operation
4. Inspect electrode position
5. Verify control module
6. Check safety interlocks

Electronic Ignition Issues:

- Spark gap: 1/8" to 3/16"
- Electrode ceramic intact
- Ground connection clean
- Module voltage correct
- Spark rate normal: 1-2 per second

Standing Pilot Problems:

- Pilot orifice clean
- Thermocouple position correct
- Pilot flame blue, steady
- Thermocouple output: 20-30 mV
- Gas valve coil resistance

Uneven Heating

Causes and Solutions:

- Burner ports clogged → Clean thoroughly
- Air shutter misadjusted → Set to blue flame
- Orifice wrong size → Verify for gas type
- Manifold pressure incorrect → Adjust regulator
- Burner warped → Replace burner

Oven Temperature Issues:

- Calibration drift → Adjust ±35°F
- Sensor resistance wrong → Replace sensor
- Control board failure → Test and replace
- Door seal damaged → Replace gasket
- Vent blocked → Clear obstruction

17.2 Clothes Dryers

Gas dryers provide fast, economical clothes drying with proper installation and maintenance.

Residential Dryers

Modern residential dryers incorporate efficiency and safety features.

Types and Features

Standard Dryers:

- Capacity: 5.0-7.4 cubic feet
- Gas input: 20,000-22,000 BTU/hr
- 120V electrical required
- Moisture sensors standard
- Multiple temperature settings

High-Efficiency Dryers:

- Moisture sensing technology
- Modulating gas valves
- Variable drum speed
- Heat pump hybrid models
- Energy Star certified

Compact Dryers:

- 24" width typical
- 3.5-4.5 cubic feet
- Stackable designs
- 15,000-18,000 BTU/hr
- Ventless options available

Steam Dryers:

- Steam generator included
- Wrinkle reduction
- Sanitization cycles
- Water connection required

- Higher electrical demand

Installation Requirements

Proper installation ensures safety and efficiency.

Location Considerations

Acceptable Locations:

- Laundry rooms
- Basements
- Utility rooms
- Garages (heated)
- Closets with proper door

Prohibited Locations:

- Bedrooms
- Bathrooms
- Storage areas
- Unheated spaces (freeze risk)
- Areas without adequate ventilation

Gas Supply Requirements

Piping Specifications:

- Minimum 1/2" pipe
- Sediment trap required
- Shut-off valve within 6 feet
- Flexible connector acceptable
- Pressure test required

Gas Pressure:

- Natural gas: 7" W.C. nominal
- Propane: 11" W.C. nominal
- Maximum: 14" W.C.
- Minimum: 4.5" W.C.
- Regulator if needed

Electrical Requirements:

- 120V, 15A circuit minimum
- Grounded outlet required

- No extension cords
- GFCI in specific locations
- Dedicated circuit recommended

Clearances:

Location	Minimum Clearance
Sides	1" minimum
Rear	5" minimum
Front	Closet door + 24"
Top	12" minimum
Floor	Level and solid

Exhaust Venting Requirements

Proper venting is critical for dryer operation and safety.

Duct Materials

Acceptable Materials:

- Rigid metal duct (best)
- Semi-rigid metal duct
- ULC-listed flexible metal (short runs)
- Smooth interior required
- 4" diameter standard

Prohibited Materials:

- Plastic ducting
- Foil ducting
- Reduced diameter
- Combustible materials
- Screened terminations

Duct Routing

Maximum Length Calculations:

- Straight duct: 35 feet maximum
- Deduct 5 feet per 90° elbow
- Deduct 2.5 feet per 45° elbow
- Manufacturer may vary
- Booster fans if exceeded

Example Calculation:

- Straight run: 20 feet
- Two 90° elbows: -10 feet
- One 45° elbow: -2.5 feet
- Effective length: 32.5 feet
- Within 35 feet limit ✓

Best Practices:

- Minimize length
- Minimize turns
- Slope to exterior
- Support every 4 feet
- Seal all joints

Termination Requirements

Exterior Terminations:

- Backdraft damper required
- No screens permitted
- 12" from grade minimum
- 3 feet from openings
- Pest-proof design

Roof Terminations:

- Approved roof cap
- Adequate height
- Weather protection
- Accessible for cleaning
- Proper flashing

Through-Wall Terminations:

- Wall cap with damper
- Caulked penetration
- Insulated in cold climates
- Removable for cleaning
- Protected location

Make-Up Air Considerations

Adequate combustion and ventilation air required.

When Required

Conditions Requiring Make-Up Air:

- Tight house construction
- Exhaust fans over 150 CFM
- Multiple exhaust appliances
- Negative pressure detected
- Combustion air insufficient

Solutions:

- Dedicated make-up air opening
- Mechanical make-up air
- Interlocked systems
- Pressure relief dampers
- Balanced ventilation

Sizing Make-Up Air:

- Equal to exhaust CFM
- Temperature considerations
- Distribution method
- Control integration
- Energy recovery options

Commercial Dryers

Commercial dryers require special considerations.

Types of Commercial Dryers

On-Premise Laundry (OPL):

- Hotels and hospitals
- 25-200 lb capacity
- 200,000-500,000 BTU/hr
- Steam or gas heated
- Computerized controls

Coin-Operated:

- Laundromats
- 25-75 lb capacity
- 75,000-150,000 BTU/hr
- Robust construction

- Timer controls

Stack Dryers:

- Space-saving design
- Independent operation
- 15,000-20,000 BTU/hr each
- Common venting possible
- ADA compliance options

Installation Specifications

Gas Requirements:

- 3/4" to 2" piping
- Individual shut-offs
- Pressure regulators
- Leak detection systems
- Emergency shut-offs

Venting Requirements:

- Individual or common venting
- Larger diameters: 6"-12"
- Fire dampers required
- Access panels needed
- Professional design required

Electrical:

- 120V or 208/240V
- Disconnect switches
- Control circuits
- Ground fault protection
- Emergency stops

Make-Up Air Systems:

- Engineered systems
- Tempered air supply
- Negative pressure prevention
- Energy recovery
- Building code compliance

Troubleshooting Procedures

Systematic troubleshooting ensures quick diagnosis.

No Heat Problems

Diagnostic Sequence:

1. **Verify Gas Supply:**
    - Valve open
    - Adequate pressure
    - Other appliances working
2. **Check Ignition System:**
    - Glow bar resistance: 50-400Ω
    - Spark gap correct
    - Electrode clean
    - Ground good
3. **Test Safety Systems:**
    - Airflow switch
    - High limit thermostat
    - Thermal fuse
    - Door switches
4. **Control Board:**
    - Voltage inputs
    - Control outputs
    - Error codes
    - Component testing

Poor Drying Performance

Common Causes:

Restricted Venting:

- Lint accumulation
- Crushed duct
- Excessive length
- Too many elbows
- Improper termination

Solutions:

- Clean entire duct run
- Inspect with camera
- Replace damaged sections
- Reroute if needed
- Install booster fan

Component Issues:

- Blower wheel dirty → Clean thoroughly
- Belt slipping → Adjust or replace
- Moisture sensor dirty → Clean with alcohol
- Timer advancing slowly → Replace timer
- Thermostat cycling → Test and replace

Long Drying Times

Diagnosis Steps:

1. Check exhaust flow at termination
2. Measure duct static pressure
3. Verify proper gas pressure
4. Test burner operation
5. Check control settings
6. Inspect door seal

Specifications:

- Exhaust velocity: 1,200 FPM minimum
- Static pressure: 0.6" W.C. maximum
- Temperature rise: 100-140°F
- Cycle time: 30-60 minutes normal

17.3 Fireplaces and Log Sets

Gas fireplaces provide ambiance and supplemental heating with convenience and safety.

Vented Decorative Appliances

Vented appliances provide realistic flame appearance with heat output.

Types of Vented Appliances

Direct Vent Fireplaces:

- Sealed combustion
- Coaxial or dual pipe venting
- 15,000-40,000 BTU/hr
- 60-80% efficiency
- No indoor air used

B-Vent Fireplaces:

- Natural draft venting
- Indoor combustion air
- 20,000-40,000 BTU/hr
- 20-30% efficiency typical
- Decorative primarily

Fireplace Inserts:

- Fits existing fireplace
- Direct vent or B-vent
- 20,000-35,000 BTU/hr
- Blower equipped
- Improved efficiency

Gas Log Sets:

- Installed in wood fireplace
- Vented required
- 30,000-90,000 BTU/hr
- Damper clamp required
- Yellow flame burners

Installation Requirements per CSA Codes

Strict code compliance ensures safe operation.

B149.1 Code Requirements

General Requirements:

- Certified appliances only
- Manufacturer instructions followed
- Permits required
- Inspections mandatory
- Annual service recommended

Venting Requirements:

Direct Vent Systems:

- Termination clearances:
    - 12" from opening
    - 12" above grade
    - 6" from corner
    - 3 feet below soffit
    - 7 feet above public walkway

B-Vent Systems:

- Minimum height: 5 feet
- 2 feet above roof
- 10 feet from roof opening
- Proper support
- Fire stops required

Specific Installation Details

Floor Protection:

- Non-combustible hearth
- Extension requirements:
    - 18" front (USA)
    - 16" front (Canada)
    - 8" sides
    - Sealed to floor

Wall Protection:

- Clearances per rating plate
- Non-combustible materials
- Air gaps if required
- Proper mounting
- Mantel clearances critical

Gas Supply:

- Dedicated shut-off
- Accessible location
- Sediment trap
- Flex connector acceptable
- Pressure test required

Vent-Free Appliances (Where Permitted)

Vent-free appliances have specific requirements and limitations.

Types and Ratings

Vent-Free Fireplaces:

- Maximum 40,000 BTU/hr
- ODS (Oxygen Depletion Sensor)
- 99.9% combustion efficiency

- Blue flame or infrared
- Not permitted everywhere

Vent-Free Log Sets:

- Maximum 40,000 BTU/hr
- Installed in vented fireplace
- Damper locked open slightly
- ODS required
- Yellow or blue flame

Installation Restrictions

Where Prohibited:

- Bedrooms
- Bathrooms
- Recreational vehicles
- Below grade in some jurisdictions
- Some provinces/states entirely

Where Permitted (with conditions):

- Minimum room volume
- Adequate ventilation
- Not sole heat source
- Annual inspection
- CO detectors required

Room Size Requirements:

- Minimum 50 cubic feet per 1,000 BTU/hr
- Example: 30,000 BTU = 1,500 cubic feet
- Open to adjacent rooms acceptable
- Mechanical ventilation helps
- ACH (Air Changes per Hour) considered

Safety Requirements:

- ODS mandatory
- CO detectors required
- Annual inspection
- Clear instructions
- Warning labels visible

Clearances and Hearth Extensions

Proper clearances prevent fire hazards.

Clearance Requirements

Top Clearances:

Surface	Minimum Clearance
Mantel (combustible)	Per manufacturer chart
TV above fireplace	12" + per TV specs
Ceiling	36-84" varies
Projecting trim	Chart required

Side Clearances:

- Combustible walls: 6-36" varies
- Windows: 12" typical
- Furniture: 36" minimum
- Drapes: 12" minimum
- Walkways: 36" recommended

Hearth Extensions:

Requirements:

- Material: Non-combustible
- Thickness: 3/8" minimum
- Support: Self-supporting
- Joint: Sealed to fireplace
- Warning: Hot surface labels

Dimensions:

- Front: 16-20" typical
- Sides: 8-12" typical
- Full width plus 8"
- Raised hearths acceptable
- Combustible trim limits

Glass Door Requirements

Safety glass prevents burns and injuries.

Glass Specifications

Tempered Glass:

- Required on all units
- Withstands thermal shock
- Breaks into small pieces
- Thickness varies by size
- Ceramic glass optional

Safety Screens:

- Required since 2015
- Fixed or removable
- Prevents glass contact
- Maximum 1/2" openings
- Warning labels required

Operating Temperatures:

- Glass surface: 200-500°F
- Varies by model
- BTU rating affects
- Barrier screens reduce
- Cool-down time significant

Safety Requirements:

- Warning labels visible
- Screen in place
- Child safety education
- Cleaning when cool
- Annual inspection

Annual Inspection Requirements

Regular inspection ensures safe operation.

Inspection Checklist

Visual Inspection:

- [ ] Glass intact
- [ ] Gaskets good condition
- [ ] Logs positioned correctly
- [ ] Burner ports clear
- [ ] No soot or damage

Operational Checks:

- [ ] Ignition proper
- [ ] Flame pattern correct
- [ ] No gas odors
- [ ] Controls functioning
- [ ] Safety shut-off works

Venting Inspection:

- [ ] Termination clear
- [ ] No blockages
- [ ] Joints sealed
- [ ] Proper draft
- [ ] Condensation check

Documentation:

- Date of inspection
- Deficiencies noted
- Repairs completed
- Customer signature
- Next inspection due

Common Problems:

1. Pilot won't stay lit
2. Glass sooting
3. Odors during operation
4. Delayed ignition
5. Log deterioration

17.4 Pool and Spa Heaters

Pool and spa heaters extend swimming seasons and provide year-round enjoyment.

Installation Location Requirements

Proper location ensures safe operation and serviceability.

Outdoor Installations

Preferred Locations:

- Near pool equipment
- Level concrete pad
- Protected from wind
- Accessible for service

- Away from windows

Environmental Considerations:

- Wind protection
- Snow load areas
- Flooding potential
- Salt air corrosion
- Freeze protection

Indoor Installations:

- Adequate ventilation
- Combustion air openings
- Condensate drainage
- Service clearances
- Heat dissipation

Prohibited Locations:

- Under decks
- In crawl spaces
- Near air intakes
- Storage areas
- Confined spaces

Clearances to Combustibles

Safety clearances prevent fires and ensure proper operation.

Minimum Clearances

Standard Requirements:

Location	Minimum Clearance
Top	4 feet minimum
Front	24" service access
Rear	6-18" varies
Sides	6-18" varies
Exhaust	4 feet horizontal

From Building Openings:

- Windows: 4 feet
- Doors: 4 feet

- Mechanical air intakes: 10 feet
- Property lines: Per local code
- Electrical meters: 3 feet

Special Considerations:

- Fence clearances
- Landscaping growth
- Overhead structures
- Adjacent equipment
- Future access needs

Venting Provisions

Proper venting ensures complete combustion and prevents hazards.

Venting Types

Category I Venting:

- Natural draft
- Vertical termination
- B-vent materials
- Minimum height requirements
- Draft hood equipped

Category IV Venting:

- Positive pressure
- PVC/CPVC materials
- Condensate management
- Horizontal termination allowed
- High efficiency units

Power Venting:

- Forced draft
- Longer runs possible
- Horizontal termination
- Wind resistant
- Electrical required

Outdoor Units:

- No venting required
- Stack included

- Wind deflectors
- Rain caps
- Screen protection

Installation Requirements:

- Proper materials
- Adequate support
- Condensate drainage
- Termination location
- Manufacturer specifications

Outdoor Installation Specifics

Outdoor installations face environmental challenges.

Weather Protection

Wind Considerations:

- Wind deflectors recommended
- Fence or screen protection
- Prevailing wind direction
- Pilot protection
- Pressure switch adjustment

Rain and Snow:

- Proper drainage
- Elevated pad
- Cover during off-season
- Snow fence regions
- Ice damage prevention

Sun Exposure:

- UV-resistant materials
- Temperature considerations
- Control panel protection
- Fade-resistant finishes
- Ventilation adequate

Freeze Protection

Preventing freeze damage is critical in cold climates.

Protection Methods

Automatic Freeze Protection:

- Built-in freeze sensors
- Circulation pumps activate
- 35°F typical set point
- Power must remain on
- Battery backup recommended

Manual Winterization:

1. Turn off power
2. Close gas valve
3. Drain heat exchanger
4. Blow out with air
5. Add antifreeze if needed
6. Remove drain plugs
7. Cover unit

Year-Round Operation:

- Maintain circulation
- Temperature above 40°F
- Monitor during cold snaps
- Emergency procedures ready
- Backup heat source

Component Protection:

- Pressure switch lines
- Condensate drains
- Water connections
- Control systems
- Heat exchanger

Troubleshooting

Common problems require systematic diagnosis.

No Heat Output

Diagnostic Steps:

1. **Verify Flow:**
    - Pump operating

    - Filter clean
    - Valves open
    - Flow switch activated
    - Adequate GPM
2. **Check Ignition:**
    - Gas valve open
    - Pilot lit (if applicable)
    - Igniter operating
    - Control calling for heat
    - Safety switches closed
3. **Temperature Controls:**
    - Thermostat setting
    - High limit switch
    - Water temperature sensor
    - Control board logic
    - Time clock settings

Low Heat Output

Common Causes:

- Low gas pressure → Check and adjust
- Dirty burners → Clean orifices
- Scaled heat exchanger → Chemical cleaning
- Bypass valve open → Adjust properly
- Undersized heater → Verify BTU needs

Heat Exchanger Issues:

- Copper: Check for erosion
- Cast iron: Inspect for cracks
- Titanium: Verify flow rates
- Condensation damage
- Chemical balance critical

Cycling Problems

Short Cycling Causes:

- Inadequate flow
- Thermostat differential
- Oversized heater
- Wind effects
- Control board issues

Solutions:

- Increase flow rate
- Adjust differential
- Add buffer tank
- Install wind screen
- Replace controls

17.5 Unit Heaters

Unit heaters provide efficient space heating for commercial and industrial applications.

Separated Combustion Unit Heaters

Modern designs separate combustion from heated air.

Design Features

Heat Exchanger Types:

- Tubular steel
- Stainless steel
- Aluminized steel
- Cast iron
- Titanium (corrosive environments)

Combustion Systems:

- Atmospheric burners
- Power burners
- Infrared burners
- Modulating controls
- Low NOx designs

Fan Systems:

- Propeller fans
- Centrifugal blowers
- Variable speed
- Horizontal/vertical discharge
- Adjustable louvers

Control Options:

- Room thermostats
- Built-in controls
- BMS integration
- Modulating operation

- Zone control capability

Installation and Mounting

Proper installation ensures safe and efficient operation.

Mounting Methods

Ceiling Suspended:

- Most common method
- Threaded rod support
- Minimum 1" from ceiling
- Level installation critical
- Vibration isolation

Wall Mounted:

- Heavy-duty brackets
- Wall reinforcement needed
- Service access maintained
- Tilt adjustment possible
- Height considerations

Floor Mounted:

- Portable units available
- Permanent installations
- Housekeeping pad
- Fork lift protection
- Flexible connections

Support Requirements:

- Weight calculation
- Safety factor 4:1
- Seismic bracing
- Building structure verified
- Professional engineering

Venting Requirements

Proper venting ensures safe exhaust removal.

Venting Systems

Category I Venting:

- Natural draft
- Vertical rise required
- B-vent materials
- Draft hood included
- Common venting possible

Category III Venting:

- Positive pressure
- Horizontal runs allowed
- Stainless steel required
- Condensate provisions
- Single appliance only

Power Venting:

- Integral exhaust fan
- Long horizontal runs
- Smaller vent sizes
- Pressure switches
- Electrical interlock

Direct Venting:

- Sealed combustion
- Outside air supply
- Concentric venting
- Wind resistant
- High efficiency

Installation Requirements:

- Proper materials
- Support every 4 feet
- Expansion joints
- Access panels
- Termination clearances

Clearances

Adequate clearances ensure safety and service access.

Minimum Clearances

From Combustibles:

Location	Minimum Clearance
Top	6-18" varies
Bottom	6-18" varies
Sides	6-18" varies
Front	24" service
Flue pipe	6-18" varies

From Operations:

- Overhead doors: 8 feet
- Travel lanes: 7 feet
- Work areas: 10 feet
- Storage: 3 feet
- Sprinkler heads: 3 feet

Air Flow Clearances:

- Inlet side: 24" minimum
- Discharge: Unobstructed
- Return path provided
- Stratification prevention
- Proper air circulation

Applications and Limitations

Unit heaters suit specific applications.

Ideal Applications

Warehouses:

- High mounting possible
- Spot heating available
- Quick warm-up
- Energy efficient
- Low maintenance

Garages:

- Vehicle exhaust consideration
- Door opening compensation
- Separated combustion
- Freeze protection

- Multiple zones

Workshops:

- Dust considerations
- Spot heating
- Ventilation integration
- Noise levels
- Safety compliance

Loading Docks:

- Door seal supplementation
- Quick recovery
- Weather curtains
- Multiple units
- Controls integration

Limitations

Not Recommended For:

- Hazardous locations (without special ratings)
- Corrosive atmospheres
- Excessive dust/lint
- Paint spray areas
- Food processing (direct)

Special Considerations:

- Noise sensitive areas
- Low ceiling applications
- Precision temperature control
- High humidity locations
- Extreme temperatures

17.6 Construction Heaters

Temporary heating enables cold weather construction activities.

Temporary Heating Devices

Construction heaters provide temporary heat during building construction.

Types of Construction Heaters

Direct-Fired Heaters:

- 35,000-400,000 BTU/hr
- Combustion products in space
- 100% efficiency
- Ventilation critical
- Moisture added to space

Indirect-Fired Heaters:

- 75,000-1,000,000 BTU/hr
- Vented combustion
- 80% efficiency typical
- Ductable heat
- No moisture addition

Salamander Heaters:

- 30,000-200,000 BTU/hr
- Radiant heating
- Open flame
- Limited applications
- High fire risk

Portable Forced Air:

- 35,000-150,000 BTU/hr
- Propane or natural gas
- Thermostat control
- Indoor/outdoor use
- Safety features included

Safety Requirements

Construction environments demand strict safety measures.

General Safety Rules

Equipment Requirements:

- CSA certification
- Safety shut-offs
- Tip-over switches
- Overheat protection
- Flame failure devices

Installation Rules:

- Level, stable surface
- Clearances maintained
- Secured from tipping
- Protected from damage
- Warning signs posted

Operation Requirements:

- Trained operators only
- Daily inspections
- Fuel supply monitoring
- Emergency procedures
- Fire extinguishers ready

Prohibited Practices:

- Unattended operation (except designed units)
- Modification of safety devices
- Use in confined spaces
- Blocking of exits
- Storage near heaters

Proper Ventilation

Adequate ventilation prevents CO poisoning and maintains air quality.

Ventilation Requirements

Direct-Fired Heaters:

- 4 CFM per 1,000 BTU/hr minimum
- Cross-ventilation provided
- CO monitors required
- Mechanical ventilation preferred
- Emergency ventilation plan

Calculation Example:

- Heater: 100,000 BTU/hr
- Required: 400 CFM minimum
- Safety factor: 1.5
- Design: 600 CFM

Indirect-Fired Heaters:

- Combustion vented outside
- Space ventilation still needed
- Building air changes
- Moisture control
- Dust management

Natural Ventilation:

- Window/door openings
- Stack effect utilized
- Wind effects considered
- Inadequate alone usually
- Weather dependent

Mechanical Ventilation:

- Exhaust fans
- Supply fans
- Balanced systems
- Controls integration
- Backup power considered

Code Restrictions on Use

Building codes strictly regulate construction heating.

Occupancy Restrictions

Prohibited Uses:

- Occupied residential
- Assembly occupancies
- Institutional buildings
- Schools in session
- Healthcare facilities

Permitted Uses:

- Construction sites
- Renovation projects (unoccupied)
- Emergency heating
- Special events (with permit)
- Industrial processes

Time Restrictions:

- Construction phase only
- Temporary permit required
- 180 days typical maximum
- Extensions possible
- Inspection requirements

Documentation Requirements:

- Permit applications
- Safety plans
- Training records
- Inspection logs
- Incident reports

Carbon Monoxide Awareness

CO poisoning is a serious construction site hazard.

CO Sources and Risks

Sources:

- Direct-fired heaters
- Engine-driven equipment
- Poor ventilation
- Wind conditions
- Multiple equipment operating

Health Effects:

CO Level (ppm)	Exposure Time	Effects
35	8 hours	OSHA PEL
50	8 hours	NIOSH REL
200	2-3 hours	Headache
400	1-2 hours	Serious headache
800	45 minutes	Dizziness, nausea
1,600	20 minutes	Death possible

Prevention Measures

Engineering Controls:

- Adequate ventilation
- Equipment maintenance
- Vented heaters preferred

- CO monitors installed
- Alarm systems

Administrative Controls:

- Worker training
- Rotation schedules
- Regular monitoring
- Emergency procedures
- Medical surveillance

Personal Protection:

- CO monitors personal
- Evacuation procedures
- First aid training
- Emergency contacts
- Rescue equipment

Emergency Response:

1. Evacuate immediately
2. Call 911
3. Ventilate area
4. Do not re-enter
5. Medical attention
6. Investigation required

17.7 Infrared Heaters

Infrared heaters provide efficient radiant heating for various applications.

Vented vs. Unvented

Understanding the differences ensures proper selection.

Vented Infrared Heaters

Tube Heaters:

- 10,000-200,000 BTU/hr
- 40-50 feet lengths
- 4" tube diameter typical
- Reflectors direct heat
- 80-85% radiant efficiency

Advantages:

- No combustion products in space
- Lower operating temperatures
- Suitable for low clearances
- Quiet operation
- Zone control easy

Applications:

- Industrial facilities
- Warehouses
- Aircraft hangars
- Loading docks
- Service bays

Unvented Infrared Heaters

High-Intensity Heaters:

- 15,000-150,000 BTU/hr
- Ceramic or metal screens
- 1,650°F surface temperature
- 35-50% radiant efficiency
- Direct combustion exposure

Low-Intensity Heaters:

- 25,000-150,000 BTU/hr
- Lower surface temperatures
- Better efficiency
- Reduced clearances
- Improved comfort

Limitations:

- Ventilation required
- Moisture production
- Not for all occupancies
- Height restrictions
- CO concerns

Installation Requirements

Proper installation ensures optimal performance and safety.

Mounting Heights

Recommended Heights:

BTU Rating	Minimum Height	Optimal Height
30,000	8 feet	10-12 feet
50,000	10 feet	12-15 feet
75,000	12 feet	15-18 feet
100,000	14 feet	18-22 feet
150,000	17 feet	22-25 feet

Angle and Spacing:

- 30-45° angle typical
- Overlap patterns 20%
- Edge losses considered
- Reflector positioning
- Coverage uniformity

Clearances:

Combustibles:

- Above: 24-60" varies
- Sides: 24-36" typical
- Below: 7-10 feet
- Reflector design affects
- Manufacturer specifications

From People:

- Minimum 8 feet
- Comfort considerations
- Direct exposure limits
- Protective barriers
- Warning signs

Support Systems:

- Chain or rod hanging
- Rigid mounting optional
- Seismic requirements
- Thermal expansion
- Service position

Applications

Infrared heaters excel in specific applications.

Industrial Applications

Manufacturing:

- Assembly areas
- Work stations
- Loading areas
- Process heating
- Spot comfort

Warehouses:

- High bay areas
- Rack storage zones
- Shipping/receiving
- Cold storage transitions
- Mezzanine heating

Aircraft Hangars:

- Large door openings
- High ceilings
- Spot heating capability
- Quick recovery
- Energy efficiency

Commercial Applications

Retail Spaces:

- Garden centers
- Auto dealerships
- Outdoor dining
- Entry vestibules
- Loading areas

Sports Facilities:

- Ice rinks
- Gymnasiums
- Indoor tennis
- Swimming pools

- Spectator areas

Agricultural:

- Livestock buildings
- Greenhouses
- Equipment storage
- Processing areas
- Poultry houses

Outdoor Applications:

- Patios
- Stadium seating
- Waiting areas
- Smoking areas
- Transit platforms

Safety Considerations

Infrared heaters require specific safety measures.

Fire Prevention

Combustible Materials:

- Maintain clearances
- No storage below
- Protected installation
- Warning signs
- Regular inspections

Hot Surfaces:

- Guards required
- Warning labels
- Height restrictions
- Protective barriers
- Cool-down procedures

Electrical Safety:

- Proper grounding
- Disconnect means
- Control circuits
- Interlocks

- Emergency stops

Health Considerations

Exposure Limits:

- ACGIH TLV: 10 mW/cm²
- Exposure time factors
- Distance effects
- PPE requirements
- Medical monitoring

Comfort Factors:

- Asymmetric radiation
- Air temperature balance
- Humidity effects
- Air movement
- Personal factors

Eye Protection:

- UV radiation minimal
- IR exposure considerations
- Protective equipment
- Warning signs
- Training required

Ventilation Needs:

Unvented Units:

- 4 CFM/1,000 BTU minimum
- CO monitoring
- Moisture removal
- Combustion air
- Emergency ventilation

Vented Units:

- Space ventilation
- Make-up air
- Building balance
- Condensation control
- Air quality maintenance

Chapter Review

Summary

This chapter covered comprehensive knowledge of specialty gas appliances:

Cooking Appliances:

- Range types and configurations
- Commercial equipment requirements
- Ventilation and make-up air critical
- Anti-tip devices mandatory
- Regular maintenance essential

Clothes Dryers:

- Proper venting crucial for safety
- Maximum duct lengths calculated
- Make-up air prevents problems
- Commercial units need engineering
- Regular cleaning mandatory

Fireplaces and Decorative Appliances:

- Various venting options available
- Clearances critical for safety
- Glass barriers required
- Annual inspections recommended
- Code compliance essential

Pool and Spa Heaters:

- Outdoor installation typical
- Freeze protection critical
- Water chemistry affects longevity
- Proper sizing important
- Wind protection beneficial

Unit Heaters:

- Separated combustion preferred
- Proper mounting essential
- Various venting options
- Application specific selection
- Clearances for safety and service

Construction Heaters:

- Temporary use only
- Ventilation critical
- CO monitoring required
- Safety procedures mandatory
- Code restrictions apply

Infrared Heaters:

- Radiant heating efficient
- Height and angle critical
- Various applications
- Vented preferred
- Safety considerations important

Key Takeaways:

- Each appliance type has specific installation requirements
- Proper venting is critical for all gas appliances
- Regular maintenance prevents problems
- Code compliance is mandatory
- Safety features must never be bypassed

Appliance Identification Exercises

Exercise 1: Range Sizing

Given:

- Kitchen: 12' × 15'
- Family of 6
- Frequent entertaining

Solution:

- Minimum 30" range
- Prefer 36" for capacity
- 5-6 burners ideal
- 65,000-80,000 BTU/hr total
- Convection oven beneficial

Exercise 2: Dryer Venting

Given:

- Dryer location: Basement
- Run to exterior: 25 feet
- Three 90° elbows required

Calculate Maximum Length:

- Base length: 35 feet
- Three elbows: -15 feet
- Effective length: 20 feet
- Actual run: 25 feet
- Solution: Add booster fan or relocate

Exercise 3: Pool Heater Sizing

Given:

- Pool: 20' × 40' × 5' average
- Volume: 30,000 gallons
- Temperature rise: 30°F
- Heat-up time: 24 hours

Calculate BTU Required:

- Gallons × 8.33 × Temperature rise ÷ Hours
- 30,000 × 8.33 × 30 ÷ 24
- = 312,375 BTU/hr
- Select: 400,000 BTU/hr heater

Installation Requirement Summaries

Quick Reference Guide

Cooking Appliances:

- Clearances per manufacturer
- Anti-tip device required
- Ventilation recommended
- Flexible connector okay
- Shut-off within 6 feet

Clothes Dryers:

- 4" rigid duct preferred
- 35 feet maximum typical
- No screens on termination
- Slope to exterior

- Annual cleaning

Fireplaces:

- Certified appliances only
- Glass barrier required
- Annual inspection
- Clearances critical
- CO detectors recommended

Pool Heaters:

- Outdoor typical
- Wind protection
- Freeze protection
- Chemical balance critical
- Bonding required

Unit Heaters:

- Proper support critical
- Service clearance
- Venting required
- Controls accessible
- Air flow unobstructed

Construction Heaters:

- Temporary only
- Ventilation mandatory
- CO monitors required
- Attended operation
- Fire extinguishers ready

Infrared Heaters:

- Height critical
- Angle affects coverage
- Clearances important
- Vented preferred
- Zone control possible

Code Compliance Exercises

Scenario 1: Restaurant Kitchen

Equipment:

- 6-burner range
- Griddle
- Fryer
- Salamander

Code Requirements:

- Type I hood required
- Ansul system mandatory
- Make-up air required
- K-class extinguisher
- Gas shut-off accessible

Scenario 2: Residential Fireplace

Installation:

- Direct vent fireplace
- Living room location
- Wood mantel planned

Code Compliance:

- Mantel clearances per chart
- Termination clearances met
- Hearth extension adequate
- Glass barrier included
- Permit and inspection

Scenario 3: Construction Site

Heating Plan:

- 200,000 BTU direct-fired
- 5,000 sq ft space
- 20' ceiling height

Requirements:

- Ventilation: 800 CFM minimum
- CO monitors multiple locations
- Attended operation
- Emergency procedures posted
- Fire watch assigned

Application Selection Scenarios

Scenario 1: Auto Repair Shop

Requirements:

- 5,000 sq ft
- 14' ceiling
- 3 bay doors
- Year-round operation

Solution:

- Infrared tube heaters
- 3 units @ 60,000 BTU/hr
- Mounted at 12 feet
- 30° angle
- Zones per bay

Scenario 2: Community Center Pool

Requirements:

- 25-meter pool
- Indoor installation
- Year-round use
- Quick recovery needed

Solution:

- 500,000 BTU heater
- High-efficiency model
- Indoor venting
- Titanium heat exchanger
- Digital controls

Scenario 3: Warehouse

Requirements:

- 50,000 sq ft
- 30' ceiling
- Forklift traffic
- Spot heating needed

Solution:

- Unit heaters
- 10 units @ 100,000 BTU/hr
- Separated combustion
- Mounted at 20 feet
- Thermostat control

Troubleshooting Quick Reference

Common Problems and Solutions

Appliance	Problem	Likely Cause	Solution
Range	No ignition	Electrode position	Adjust gap to 1/8"
Dryer	Long dry time	Restricted vent	Clean duct system
Fireplace	Pilot won't stay	Thermocouple bad	Replace thermocouple
Pool heater	Cycling	Low flow	Clean filter
Unit heater	No heat	Air flow switch	Check fan operation
Infrared	Uneven heating	Wrong angle	Adjust to 30-45°

Safety Reminders

Critical Safety Points:

1. Never bypass safety devices
2. Maintain required clearances
3. Ensure adequate ventilation
4. Perform regular maintenance
5. Follow manufacturer instructions
6. Obtain required permits
7. Complete proper training
8. Document all work
9. Test safety systems
10. Educate customers

Key Terms and Definitions

Anti-tip Device: Safety device preventing range tip-over.

Backdraft Damper: Prevents reverse air flow in exhaust systems.

Construction Heater: Temporary heating device for building sites.

Direct-Fired: Combustion products enter heated space.

Direct Vent: Sealed combustion with dedicated air supply.

Hearth Extension: Non-combustible floor protection for fireplaces.

Infrared Heater: Radiant heating using infrared energy.

Make-Up Air: Replacement air for exhausted air.

ODS: Oxygen Depletion Sensor safety device.

Salamander: Overhead broiler or construction heater type.

Separated Combustion: Combustion air isolated from heated air.

Type I Hood: Commercial kitchen exhaust with grease filters.

Unit Heater: Self-contained space heating appliance.

Vent-Free: Appliance operating without venting (restricted use).

End of Chapter 17

This comprehensive chapter on Other Gas Appliances provides essential knowledge for installing, servicing, and maintaining the wide variety of gas appliances beyond traditional heating systems. Understanding these diverse applications ensures technicians can safely work with any gas-fired equipment encountered in residential, commercial, and industrial settings.

Students should be able to properly install each appliance type following manufacturer specifications and code requirements, perform necessary maintenance and safety inspections, troubleshoot common problems efficiently, and educate customers on safe operation. The variety of appliances covered demonstrates the versatility of natural gas and propane as fuel sources.

Regular training updates are essential as appliance technology continues to advance, particularly in controls, efficiency, and safety features. The fundamental principles of combustion, venting, and safety covered in this chapter remain constant regardless of technological improvements. Proper installation and maintenance of these appliances ensures safe, efficient operation and customer satisfaction.