

A professional gas technician with a beard and short hair, wearing a light-colored long-sleeved shirt, is shown from the side and slightly from behind. He is focused on working on the internal components of a gas furnace. The furnace is dark metal with various pipes, wires, and mechanical parts visible. The background is a plain, light color.

# **Canadian Gas Technician - Learning Module 20**

## **Maintenance and Service**

Comprehensive training in preventive maintenance programs, equipment servicing, combustion testing, and professional service agreements for gas heating systems.

## Module 20

# Learning Objectives

Upon completion of this chapter, students will master comprehensive maintenance procedures, safety testing protocols, and professional service delivery for all types of gas heating equipment.

# Learning Objectives

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

01

**Develop and implement comprehensive preventive maintenance programs**

02

**Perform thorough furnace maintenance following manufacturer specifications**

03

**Complete water heater maintenance procedures safely and effectively**

04

**Service boiler systems including water treatment and component maintenance**

05

**Execute seasonal start-up and shut-down procedures properly**

01

**Conduct combustion testing and make appropriate adjustments**

02

**Create and manage maintenance contracts professionally**

03

**Document all maintenance activities for liability protection**

04

**Communicate maintenance needs effectively to customers**

05

**Schedule and prioritize maintenance tasks efficiently**

## **20.1 Preventive Maintenance Programs**

**Well-designed preventive maintenance programs extend equipment life, improve efficiency, and prevent costly breakdowns.**



# **Maintenance is not optional—it's essential for safety, efficiency, and reliability.**

Regular maintenance protects customers, prevents emergencies, and builds professional reputation through consistent, quality service delivery.

# Safety Benefits

## Preventing Hazards:

- Carbon monoxide prevention
- Fire hazard reduction
- Gas leak detection
- Electrical safety
- Venting integrity
- Component reliability

## Statistics:

Hazard	Maintenance Impact
CO incidents	75% reduction with annual service
House fires	60% reduction in HVAC-related
Gas leaks	80% found during maintenance
Premature failure	50% reduction with PM

# Critical Safety Points

## Heat exchanger cracks detected early

Visual inspection and testing identifies dangerous cracks before carbon monoxide exposure occurs.

## Venting problems identified

Proper draft and vent integrity verified to ensure safe exhaust removal from living spaces.

## Gas leaks found and repaired

Comprehensive leak testing at all connections prevents fire hazards and gas exposure.

## Electrical hazards corrected

Loose connections, damaged wiring, and improper grounding identified and repaired.

## Safety controls verified

All limit switches, pressure switches, and safety devices tested for proper operation.

## Documentation for liability

Complete records protect technicians and companies from legal liability issues.

# Efficiency Benefits

## Energy Savings:

- 5-15% efficiency improvement
- Lower utility bills
- Reduced carbon footprint
- Optimal performance
- Consistent comfort
- Extended equipment life

## Cost Analysis:

**Annual Maintenance:** \$150-250

**Annual Savings:** \$100-300

**Prevented Repairs:** \$500-2000

**Extended Life:** 5-10 years

## Performance Metrics:

Maintenance Level	Efficiency Loss/Year
None	3-5%
Basic	1-2%
Comprehensive	<1%

# Reliability Benefits

## Breakdown Prevention:

- 90% of failures preventable
- Predictable replacement
- Planned downtime
- No emergency calls
- Customer satisfaction
- Professional reputation

### Common Prevented Failures:

Component	Failure Rate Without PM	With PM
Inducer motor	15%/year	3%/year
Igniter	20%/year	5%/year
Flame sensor	25%/year	2%/year
Blower motor	10%/year	2%/year

# Comfort Advantages

## Consistent temperatures

Properly maintained equipment delivers even heating throughout the home without hot or cold spots.

## Proper humidity

Well-functioning systems maintain comfortable humidity levels for health and comfort.

## Quiet operation

Lubricated motors, clean blowers, and adjusted components operate smoothly and quietly.

## Better air quality

Clean filters and components improve indoor air quality and reduce allergens.

## No surprises

Regular maintenance identifies issues before they become emergency breakdowns.

## Peace of mind

Customers rest easy knowing their equipment is safe, efficient, and reliable.

# Seasonal Maintenance Tasks

Different seasons require specific maintenance focus to ensure optimal performance and prevent seasonal failures.

## HVAC Maintenance Schedule Outline

Welcome to the HVAC Maintenance Schedule for April 2050. This document outlines the weekly tasks and procedures to ensure your HVAC system operates efficiently throughout the month. Please follow the schedule diligently to maintain optimal performance and longevity of your equipment.

Week	Maintenance Tasks
Week 1 (April 1-7)	<ul style="list-style-type: none"><li>Inspect and clean air filters</li><li>Check thermostat settings and functionality</li><li>Inspect electrical connections and tighten as necessary</li></ul>
Week 2 (April 8-14)	<ul style="list-style-type: none"><li>Examine heating and cooling coils for dust and debris</li><li>Lubricate moving parts</li><li>Inspect the condensate drain lines</li></ul>
Week 3 (April 15-21)	<ul style="list-style-type: none"><li>Check the level of refrigerant and recharge if necessary</li><li>Inspect and clean the blower assembly</li><li>Review and update the HVAC system software (if applicable)</li></ul>
Week 4 (April 22-30)	<ul style="list-style-type: none"><li>Inspect ducts for any leaks or blockages</li><li>Clean the exterior HVAC unit</li><li>Test system efficiency and document performance metrics</li></ul>

### Notes:

- Ensure all maintenance activities are performed by qualified personnel.
- Always power off the HVAC system before performing any maintenance tasks.
- Record all maintenance activities and findings for future reference and compliance.
- Use manufacturer-recommended parts and tools for repairs and replacements.

# **Spring Maintenance**

## **Cooling Preparation:**

### **1. Air Conditioning:**

- Clean condenser coil
- Check refrigerant
- Test capacitors
- Verify controls
- Check drainage

### **2. Ventilation:**

- Clean/replace filters
- Check dampers
- Test exhaust fans
- Verify air flow
- Balance system

### **3. Dehumidification:**

- Test humidistat
- Clean dehumidifier
- Check drainage
- Verify operation

### **Heating Wind-Down:**

- Final combustion test
- Document readings
- Note any issues
- Schedule repairs
- Clean up area

# Summer Maintenance

## Off-Season Heating Work:

Task	Benefit
Deep cleaning	Better access
Major repairs	No heat needed
Upgrades	Time available
Replacements	Planned timing
Duct sealing	Complete access

## Water Heater Focus:

- Tank flushing ideal
- Anode rod inspection
- Element testing
- Vacation settings
- Efficiency checks

# Fall Maintenance

## Heating Preparation:

### Priority Tasks:

1

#### Combustion Equipment

- Clean burners
- Check heat exchanger
- Test ignition
- Verify safeties
- Combustion analysis

2

#### Air Handling

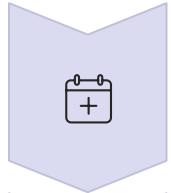
- Replace filters
- Clean blower
- Check belts
- Lubricate bearings
- Test operation

3

#### Controls

- Calibrate thermostat
- Test limits
- Verify sequences
- Check programming
- Update settings

## Customer Communication:



### Schedule early

Book appointments before the rush begins



### Avoid rush

Better service when not overwhelmed



### Better availability

More time slots and flexible scheduling



### Prevent no-heat calls

Identify issues before cold weather



### Time for repairs

Address problems before heating season

# Winter Maintenance

## Emergency Prevention:

### Limited Service:

- Visual inspections
- Filter changes
- Minor adjustments
- Emergency repairs
- Safety checks

### Planning:

- Schedule for fall
- Emergency parts stock
- On-call rotation
- Weather monitoring
- Customer alerts

### Focus Areas:

Task	Frequency
Filter check	Monthly
Condensate lines	Monthly
Snow/ice removal	As needed
Vent inspection	After storms
Emergency response	24/7

## **Manufacturer Recommendations**

Following manufacturer guidelines maintains warranties and ensures proper operation. Deviation from specified procedures can void warranties and create liability issues.

# Warranty Requirements

## Typical Requirements:

- Annual professional service
- Certified technician
- Genuine parts
- Documentation
- Proper procedures

## Documentation Needed:

Document	Purpose
Service invoice	Proof of maintenance
Part receipts	Warranty claims
Test results	Performance verification
Technician certification	Qualified service
Date stamps	Timing compliance

# Specific Procedures

## High-Efficiency Equipment:

### Special Requirements:

- Condensate system service
- Venting inspection critical
- Heat exchanger cleaning
- Combustion analysis mandatory
- Control calibration

### Manufacturer Variations:

Brand	Specific Requirement
Carrier	Annual filter change minimum
Lennox	Combustion test required
Rheem	Inducer inspection
Goodman	Electrical check
Trane	Control update check

## **Service Intervals:**

## **Component Schedules:**

Component	Interval
Filters	1-3 months
Burners	Annual
Heat exchanger	Annual inspection
Blower	Annual
Igniter	Inspect annual
Flame sensor	Clean annual
Venting	Annual
Controls	Test annual

## **Extended Warranties:**

- May require bi-annual service
- Specific dealer service
- Online registration
- Enhanced documentation
- Premium parts

## Creating Maintenance Schedules

Organized scheduling ensures comprehensive service delivery and maximizes efficiency for both technicians and customers.

# COMPUTER MAINTENANCE SCHEDULE

own for selecting the Name

## Computer Maintenance Schedule

Name: Stan Lee

Tasks to Check and Maintain	Daily	Weekly	Monthly	Annually
Antivirus Scan				
Update Operating System				
Backup Important Files				
Clean Dust from Hardware				
Check Disk Health and Performance				
Data Restoration from Backup				
Check for Software Updates				
Check Cable Connections				
Check System Security Settings				
Check Computer Fans and Vents				

# Customer Database Development

## Information to Track:

### Customer Data:

- Name and address
- Phone numbers
- Email address
- Equipment details
- Service history
- Preferences
- Contract status

### Equipment Records:

Field	Purpose
Make/Model	Parts and procedures
Serial number	Warranty tracking
Install date	Age tracking
BTU rating	Performance specs
Efficiency	Baseline data
Location	Access planning

## **Service History:**

### **Dates of service**

Complete chronological record of all maintenance visits and timing patterns.

### **Work performed**

Detailed description of all tasks completed during each service call.

### **Parts replaced**

Complete inventory of all components replaced with part numbers and dates.

### **Test results**

Combustion analysis, pressure readings, and all performance measurements.

### **Technician notes**

Observations, concerns, and special conditions noted during service.

### **Recommendations**

Suggested repairs, upgrades, or improvements for future consideration.

### **Follow-up needed**

Items requiring attention, monitoring, or scheduling for future service.

# Scheduling Systems

## Annual Rotation:

### Monthly Distribution:

- Balance workload
- Geographic grouping
- Customer preferences
- Equipment types
- Contract priorities

### Example Monthly Plan:

Month	Focus	Customer Count
January	Repairs	50
February	Commercial	75
March	Spring prep	100
April	AC prep	125
May	AC service	150
June	Off-season	75
July	Installations	50
August	Pre-season	100
September	Heating prep	175
October	Heating service	200
November	Heating service	150
December	Emergency	50

## **Reminder Systems:**

### **Methods:**

- Email reminders
- Text messages
- Phone calls
- Postal mail
- Online portals
- Apps

### **Timing:**

- 30 days advance
- 14 days reminder
- 7 days confirmation
- Day before alert
- Follow-up if missed

## **Route Optimization:**

- Geographic clustering
- Drive time minimization
- Multiple stops
- Emergency slots
- Weather contingencies

## **Documentation and Record Keeping**

Proper documentation protects all parties and ensures continuity. Complete records are essential for liability protection, warranty compliance, and quality service delivery.

# **Service Reports**

## **Required Information:**

### **Header:**

- Company information
- License numbers
- Date and time
- Weather conditions
- Customer information
- Equipment data

### **Work Performed:**

#### **1. Inspection Results:**

- Visual observations
- Measurements taken
- Problems found
- Safety concerns
- Recommendations

## **2. Maintenance Tasks:**

- Cleaning completed
- Adjustments made
- Parts replaced
- Tests performed
- Results achieved

## **3. Test Data:**

Test	Reading	Acceptable
Gas pressure	7.2" W.C.	Yes
Temperature rise	55°F	Yes
CO level	35 ppm	Yes
Draft	-0.03"	Yes

# Digital Documentation

## Advantages:



### Searchable records

Instantly find any service record, customer history, or equipment data with powerful search capabilities.



### Automatic backups

Cloud storage ensures records are never lost due to hardware failure or disaster.



### Photo integration

Attach photos of equipment conditions, problems, and completed work directly to service records.



### Signature capture

Digital signatures provide immediate customer approval and eliminate paperwork delays.



### Instant delivery

Email reports to customers immediately upon completion for better communication.



### Report generation

Automatically generate business reports, trend analysis, and performance metrics.

## Software Features:



**Customer management**



**Equipment tracking**



**Service history**



**Inventory control**



**Scheduling**



**Invoicing**



**Reporting**

## Implementation:

1. Choose platform
2. Import data
3. Train staff
4. Establish procedures
5. Regular backups
6. Security measures

# Legal Considerations

## Record Retention:

Document Type	Retention Period
Service records	7 years minimum
Safety tests	10 years
Incident reports	Permanent
Warranties	Life of warranty
Contracts	7 years after end
Training records	Employment + 5 years

## **Liability Protection:**

### **Detailed documentation**

Complete records of all work performed, conditions found, and recommendations made.

### **Photo evidence**

Visual documentation of equipment conditions before and after service.

### **Customer signatures**

Signed acknowledgment of work performed and recommendations provided.

### **Safety notifications**

Written documentation of all safety concerns communicated to customers.

### **Recommendation records**

Complete history of suggested repairs and customer decisions.

### **Follow-up attempts**

Documentation of all attempts to contact customers about critical issues.

## **Compliance Documentation:**

- Code compliance
- Permit records
- Inspection reports
- Certification copies
- Insurance records
- License documentation

## **20.2 Furnace Maintenance Procedures**

**Comprehensive furnace maintenance ensures safety, efficiency, and reliability.**



# **Annual Inspection Checklist**

A systematic approach ensures nothing is missed.

## **Pre-Inspection Setup:**

### **Safety Preparation:**

1. Customer notification
2. Area protection
3. Tool preparation
4. Safety equipment
5. Documentation ready
6. Test instruments

### **Initial System Check:**

- Current operation
- Thermostat settings
- Error codes
- Customer concerns
- Visual inspection
- Safety assessment

# Visual Inspection Points

## External Inspection:

Component	Check For
Cabinet	Rust, damage, labels
Venting	Corrosion, separation, slope
Gas piping	Leaks, support, protection
Electrical	Burn marks, loose wires
Condensate	Clogs, traps, drainage
Combustion air	Obstructions, sizing
Area	Clearances, combustibles

## **Internal Inspection:**

### **Access and Examine:**

#### **1. Burner Compartment:**

- Rust or corrosion
- Debris accumulation
- Burner condition
- Manifold integrity
- Gas valve condition

#### **2. Heat Exchanger:**

- Visible cracks
- Rust/scale
- Soot deposits
- Flame impingement
- Baffle condition

#### **3. Blower Compartment:**

- Wheel condition
- Motor mounts
- Belt condition
- Bearing wear
- Cleanliness

# Operational Testing

## Sequence Verification:

1. Initiate heat call
2. Observe inducer start
3. Verify pressure switch
4. Watch ignition
5. Confirm flame sense
6. Time blower start
7. Monitor operation
8. Check shutdown

## Performance Measurements:

Parameter	Specification	Actual
Temperature rise	40-70°F	
Gas pressure	7" W.C.	
Manifold pressure	3.5" W.C.	
Amp draws	Per nameplate	
CO levels	<100 ppm	

# Burner Cleaning and Adjustment

Clean burners ensure safe, efficient combustion.

## Burner Removal

### Procedure:

#### 1. Shutdown:

- Turn off gas
- Turn off power
- Allow cooling
- Lock out/tag out

#### 2. Disassembly:

- Remove manifold screws
- Disconnect gas valve
- Remove igniter
- Extract burners
- Note orientation

## Common Burner Types:

Type	Characteristics
In-shot	Individual tubes
Ribbon	Continuous strip
Mono-port	Single orifice
Multi-port	Multiple openings

# Cleaning Procedures

## Methods:

### Mechanical Cleaning:

- Wire brush (brass)
- Compressed air
- Vacuum extraction
- Pick/scraper
- Avoid damage

### Chemical Cleaning:

- Mild detergent
- Degreasing solution
- Rinse thoroughly
- Dry completely
- No residue

### Areas to Clean:

1. Burner ports
2. Venturi throat
3. Primary air openings
4. Crossover channels
5. Igniter area
6. Flame sensor location

### Inspection During Cleaning:

- Cracks or splits
- Rust through
- Warping
- Port erosion
- Crossover damage

# Adjustment Procedures

## Primary Air Adjustment:

### Process:

1. Install burners
2. Light burners
3. Observe flame
4. Adjust shutters
5. Achieve blue flame
6. Minimize yellow tips
7. Ensure stability
8. Lock adjustment

### Optimal Flame Characteristics:

Characteristic	Proper	Improper
Color	Blue	Yellow
Tips	Slight yellow OK	Excessive yellow
Stability	Steady	Lifting/flashback
Sound	Soft roar	Loud/resonant
Distribution	Even	Uneven

## **Manifold Pressure:**

- Connect manometer
- Fire burners
- Read pressure
- Compare to spec
- Adjust if needed
- Document reading

# Heat Exchanger Inspection

Critical for safety and carbon monoxide prevention.

## Inspection Methods

### Visual Inspection:

### Tools Required:

- Flashlight
- Mirror
- Camera/borescope
- Smoke generator
- CO detector

### Procedure:

1. Remove burners
2. Inspect from bottom
3. Check from top
4. Look for daylight
5. Check for rust/scale
6. Note any cracks
7. Document findings

### Common Failure Points:

Location	Cause
Crimp areas	Stress concentration
Welds	Manufacturing defect
Bends	Metal fatigue
Fire side	Flame impingement
Water side	Condensation

## **Advanced Testing**

### **Smoke Test:**

1. Seal registers
2. Introduce smoke
3. Run blower only
4. Check for leaks
5. Document results

### **Dye Penetrant:**

- Spray on surface
- Allow penetration
- Wipe excess
- Apply developer
- Cracks visible

### **Tracer Gas:**

- Expensive method
- Very accurate
- Professional equipment
- Definitive results
- Documentation provided

# **Failure Criteria**

## **Must Condemn:**

- Visible cracks
- Holes/perforations
- Severe rust through
- Separated seams
- Evidence of CO

## **May Monitor:**

- Surface rust
- Minor scale
- Discoloration
- Small dimples
- Age considerations

## **Red Tag Procedures:**

1. Shut down immediately
2. Disconnect gas
3. Tag equipment
4. Notify customer
5. Document thoroughly
6. Provide options

# Blower Maintenance

Proper air flow is essential for comfort and efficiency.

## Motor Service

### Motor Types:

Type	Maintenance
PSC	Lubricate, check capacitor
ECM	Check module, connections
Shaded pole	Lubricate if possible
Belt drive	Lubricate, adjust belt

## **Lubrication:**

### **Procedure:**

1. Locate oil ports
2. Clean area
3. Add proper oil
4. 3-5 drops typical
5. Don't over-oil
6. Run motor
7. Check for leaks

### **Oil Specifications:**

- SAE 20 non-detergent
- Electric motor oil
- No automotive oil
- No WD-40
- Annual service

# Wheel Cleaning

## Importance:

- Reduced airflow 25-50%
- Increased amp draw
- Reduced efficiency
- Noise increase
- Premature failure

## Cleaning Methods:

### 1. In-Place:

- Vacuum carefully
- Brush gently
- Compressed air
- Shop vac

### 2. Removal:

- Better cleaning
- Complete access
- Balance check
- Bearing inspection

## Procedure:

1. Remove wheel
2. Soak if needed
3. Brush clean
4. Rinse/dry
5. Check balance
6. Reinstall
7. Test operation

# Belt Maintenance

## Inspection:

Check	Good	Replace
Cracks	None	Any visible
Glazing	Matte finish	Shiny
Fraying	None	Edges worn
Tension	1/2" deflection	Loose/tight

## Adjustment:

1. Check deflection
2. Loosen motor mount
3. Adjust position
4. Tension properly
5. Align pulleys
6. Tighten mounts
7. Recheck

# Filter Replacement Schedules

Filters are the first line of defense for system protection.

## Filter Types and Intervals

### Standard Filters:

Type	MERV	Replace Interval
Fiberglass	1-4	Monthly
Pleated	5-8	3 months
Extended	9-12	6 months
HEPA	13-16	Annual
Electronic	N/A	Clean quarterly

### Factors Affecting Frequency:

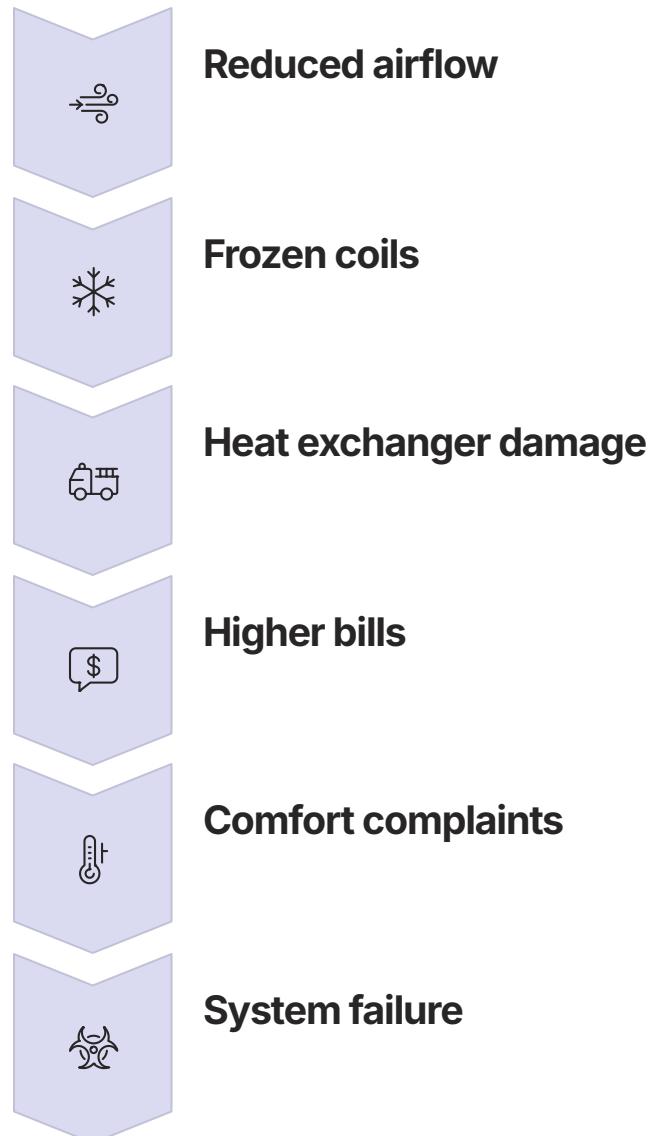
- Pets in home
- Occupancy
- Outdoor air quality
- Construction nearby
- Smokers
- Home activities

# Customer Education

## Teaching Points:

1. Filter location
2. Direction arrow
3. Size notation
4. Quality options
5. Change frequency
6. Impact of dirty filter

## Consequences of Neglect:



## Filter Program Setup:

- Automatic delivery
- Email reminders
- Seasonal changes
- Bulk purchasing
- Service inclusion

# **Control Testing**

Controls coordinate all furnace operations.

## **Safety Control Testing**

### **Limit Switches:**

#### **Test Procedure:**

- Block return air
- Monitor temperature
- Should trip at rating
- Verify shutdown
- Clear blockage
- Auto reset
- Document

### **Pressure Switches:**

1. Check tubing
2. Test with manometer
3. Verify set point
4. Clean ports
5. Test contacts
6. Document results

## **Flame Sensor:**

- Measure microamps
- Clean if  $<3 \mu\text{A}$
- Replace if  $<2 \mu\text{A}$
- Check position
- Verify ground
- Test wire

## **Operating Control Tests**

### **Thermostat:**

<b>Test</b>	<b>Procedure</b>
Calibration	Compare to thermometer
Anticipator	Check setting
Switching	Test all functions
Programming	Verify schedule
Batteries	Replace annual

## **Gas Valve:**

- Input voltage
- Coil resistance
- Pressure regulation
- Safety shutoff
- Leak test

## **Control Board:**

- LED indicators
- Fault codes
- Input/output test
- Timing verification
- Safety circuit

# Combustion Analysis

Essential for safety and efficiency optimization.

## Test Procedure

### Equipment Setup:

1. Analyzer preparation
2. Calibration check
3. Probe installation
4. Seal penetration
5. Run 10 minutes
6. Take readings

### Measurements Required:

Parameter	Target	Action Level
O <sub>2</sub>	6-9%	Adjust if outside
CO	<50 ppm	>100 requires action
CO <sub>2</sub>	8.5-10%	Indicates efficiency
Stack temp	350-450°F	High needs cleaning
Efficiency	>78%	<75% needs service

## **Adjustments:**

### **If CO High:**

1. Increase primary air
2. Clean burners
3. Check gas pressure
4. Verify venting
5. Retest

### **If Efficiency Low:**

1. Clean heat exchanger
2. Adjust gas pressure
3. Check temperature rise
4. Service burners
5. Retest

## **Documentation:**

- Print results
- Customer copy
- File copy
- Note adjustments
- Schedule follow-up

# Safety Device Testing

Never compromise on safety device functionality.

## Required Safety Tests

### Rollout Switch:

- Manual reset type
- Very high temperature
- Multiple locations
- Test with jumper removal
- Never bypass

### Inducer Proving:

- Pressure switch operation
- Proper vacuum level
- Tubing clear
- Contacts reliable
- Safety circuit complete

### Ignition Safety:

- Trial for ignition timing
- Flame failure response
- Lockout function
- Reset procedure
- No gas leaks

# Documentation Requirements

## Test Results:

Safety Device	Test Method	Result	Pass/Fail
Primary limit	Temperature test	Opens at 180°F	Pass
Rollout	Continuity	Open (tripped)	Reset/Pass
Pressure switch	Vacuum test	-0.65" W.C.	Pass
Flame sensor	Microamp test	4.2 µA	Pass
Gas valve	Shutoff test	Closes complete	Pass

## Follow-Up:

- Any failed safety = priority repair
- Document customer notification
- Red tag if necessary
- Schedule repair
- Verify completion

# Module 20 Complete

You have completed comprehensive training in maintenance and service procedures for gas heating equipment. Continue to Module 21 for advanced troubleshooting and diagnostic techniques.

- Key Takeaway:** Professional maintenance requires systematic procedures, proper documentation, clear communication, and unwavering commitment to safety. Regular maintenance is not optional—it's essential for protecting customers and building successful careers in the gas fitting industry.