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ABSTRACT

This Operator's Manual is a supplement to a self-instructional course prepared for the United States Environmental Protection Agency. This publication is the Boiler Room Handbook for operating and maintaining the boiler and the boiler room. As the student completes this handbook, he is putting together a manual for running his own boiler. The handbook contains correct instrument and control settings, a listing of spare parts to be kept on hand, names and model numbers of parts plus fuel oil suppliers and service contractors. A troubleshooting reference and glossary conclude this manual. (BT)

Air Pollution Training Institute Self-Instructional Course SI-466

Supplement A Operator's Manual, Boiler Room Operations and Maintenance

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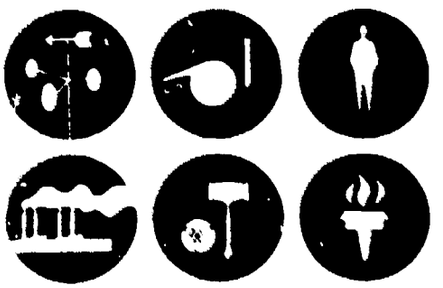

United States
Environmental Protection Agency
Office of Air and Water Programs

Training Manual
Self-Instructional Course SI-466

Air Pollution Training Institute

United States
Environmental Protection Agency
Contract No. 68-02-0321
David Sage, Inc.
New York City, New York

SUPPLEMENT A
Operators Manual
Boiler Room Operations
and Maintenance

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Prepared for the
United States Environmental Protection Agency
Office of Air and Water Programs
Control Programs Development Division
Air Pollution Training Institute

US | EPA

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CONTROL PROGRAMS DEVELOPMENT DIVISION
OFFICE OF AIR AND WATER PROGRAMS

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Francis J. King
Chief, Air Pollution Training Institute

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or (2) they may order only the five Boiler Operation books;
or (3) they may order only the two Incinerator Operation books. All books are punched for insertion into standard three-ring notebook binders.
All books are available in either English or Spanish editions.

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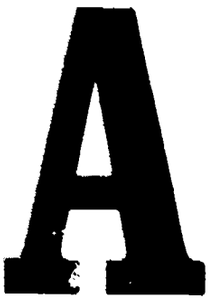


THIS IS SUPPLEMENT A
OPERATOR'S MANUAL, BOILER ROOM
OPERATIONS AND MAINTENANCE

Additional units of this self-instructional course are:

PART ONE
The Basics of Preventing Air
Pollution Emissions from Boilers

PART TWO
The Basics of Boiler Operation
and Maintenance

PART THREE
Troubleshooting, Section One
Boilers: Correcting Oil Temperature

PART FOUR
Troubleshooting, Section Two
Boilers: Flame Reading

PART FIVE
The Incinerator: Section One
Basic Parts and Fundamentals

PART SIX
The Incinerator: Section Two
Maintenance and Troubleshooting

BOILER ROOM HANDBOOK

OPERATING AND MAINTENANCE MANUAL
FOR THE BOILER AND BOILER ROOM

AT

_____

Building

_____

Street

_____

Borough Zip

Prepared By

_____

Boiler Operator

_____

Date

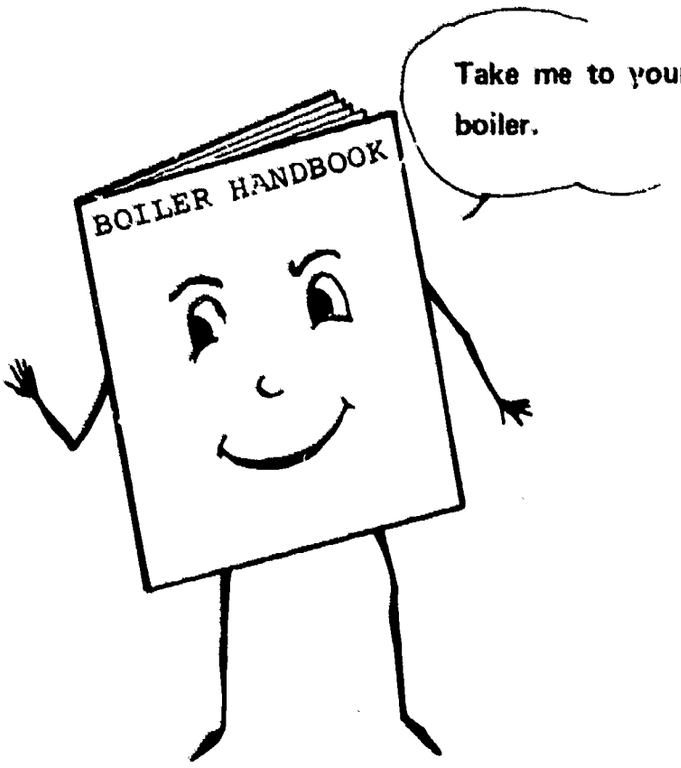
TAKE THIS BOOK INTO YOUR BOILER ROOM

Get a pencil and a piece of chalk. As you follow the instructions given on each page, you will be putting together a manual for running your boiler. It will contain lists of:

- correct instrument readings and control settings
- spare parts you should keep on hand
- names and model numbers of parts of your boiler system to use when ordering parts or calling service
- fuel oil suppliers, service contractors and others whom you many need from time-to-time

These lists will be different for each boiler room. That's why only you can fill out your own manual in your own boiler room. As you do it, make allowances for the fact that no two boiler rooms are alike. Yours may be very different from the diagrams shown here. That's OK. The important thing is to make sure you know where everything is and to get the information you need to do your job right.

Now, turn the page and begin.



BASIC INFORMATION

The two things in the box are required by law to be posted in your boiler room.

1. Burner Manufacturers' Instruction Card
2. City Upgrading Certificate

Look around your boiler room and answer the questions below:

1. List the Manufacturers' Instruction Cards which are posted in your boiler room: _____

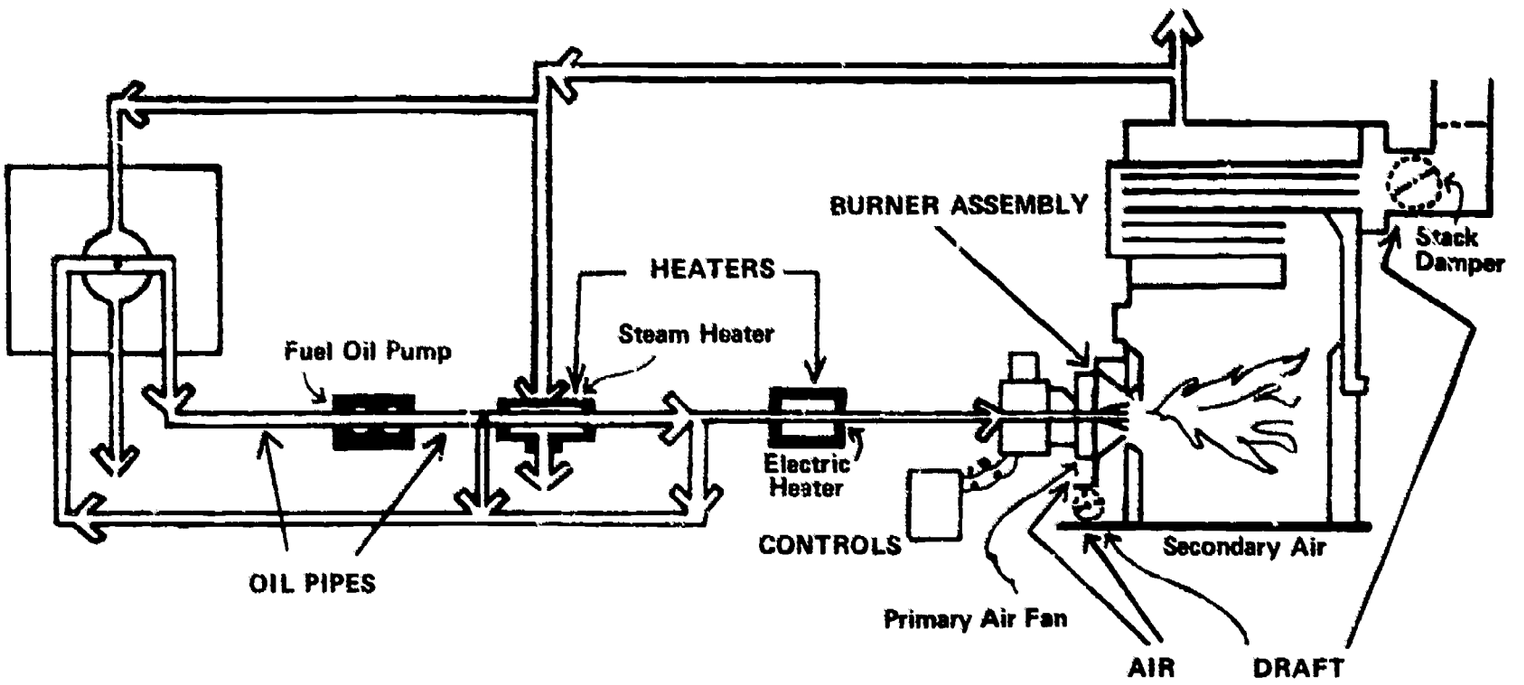
2. Where is the City Certificate which shows that your boiler has been upgraded? _____

3. Does the electrical source to your boiler have fuses or circuit breakers? _____

   If fuses – write the number of fuses and size in amps here. _____

4. Where is your remote control switch? _____

Go on to the next page.


BURNER ASSEMBLY
Stack Damper
HEATERS
Steam Heater
Fuel Oil Pump
Electric Heater
CONTROLS
Secondary Air
OIL PIPES
Primary Air Fan
AIR
DRAFT

SOME BASIC PARTS

Five major parts of a typical system are shown on this diagram. Using it for reference, take the chalk and mark the following numbers on your boiler system (if you can't find any part, skip it and go on to the next one):

FIRST find the OIL PIPES:

Write a 1 anywhere on the oil supply pipe leading from the fuel tank to the heaters.

Write a 2 anywhere on the pipe leading from the electric heater to the burner.

NEXT find your OIL HEATERS:

Write a 3 on your Steam Heater or Hot Water Oil Heater

Write a 4 on your Electric Heater

NEXT you will mark the AIR delivering parts:

Write a 5 on your Primary Air Fan Casing.

Write a 6 on the Windbox (Secondary Air).

Write a 7 on the breeching as close to the stack damper as you can reach.

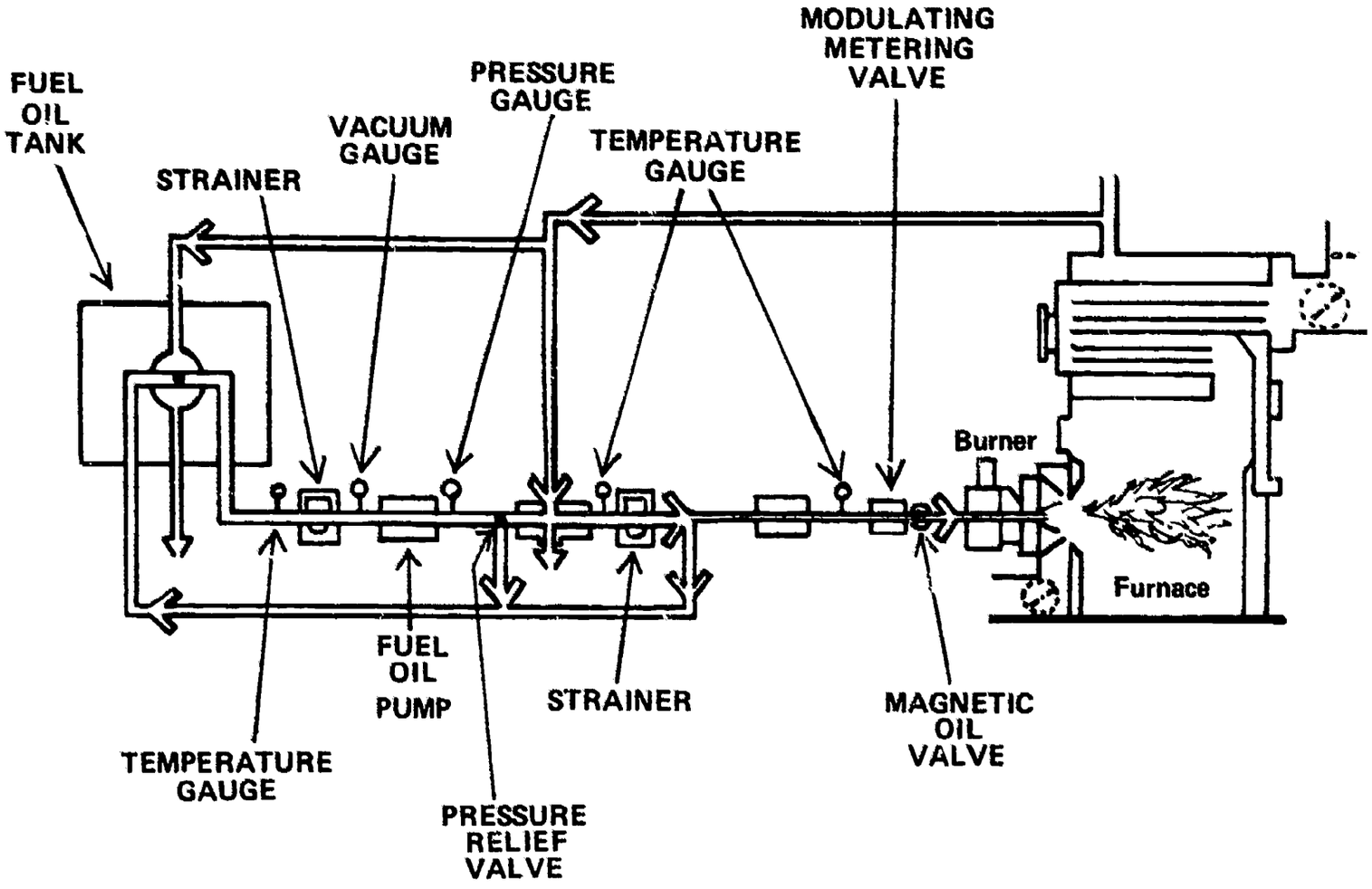
NEXT find your CONTROL BOARD:

Write an 8 on your Control Board.

LAST go to your BURNER ASSEMBLY:

Write a 9 on the front plate of the burner.

Go on to the next page.



CIRCULATING THE OIL

To complete this page, find parts on your boiler system that have to do with MOVING THE OIL.

Above is a general diagram.

Find each of the parts below on the diagram, then locate it in your boiler room. Put a check in the box before each part when you find it. Then, answer the questions about it.

☐ FUEL OIL TANK

1. How many gallons does your tank hold? _____
2. What is a five-day supply for you in winter? _____

☐ FUEL OIL PUMP

1. What is the make and model number of your pump? _____
2. What is the belt size for it? _____

☐ TEMPERATURE GAUGES ON OIL LINES

Complete this chart for the number of temperature gauges that you have:

NO OF. GAUGES	LOCATION	CAN REPLACE? (yes/no)	MAKE
1			
2			
3			
4			
5			

☐ VACUUM GAUGE

☐ PRESSURE

Complete this chart for these gauges:

	NORMAL RANGE	REPLACEMENT SPECS.
VACUUM GAUGE		
PRESSURE GAUGE		

☐ OIL STRAINERS

1. How many strainers do you have? _____
2. Are they single or double basket? _____
3. Do you know the make and model number? _____

☐ PRESSURE RELIEF VALVE

☐ MODULATING METERING VALVE

☐ MAGNETIC OIL VALVE

Complete this chart for these valves:

	LOCATED? (yes/no)	DO YOU ADJUST THIS? (yes/no)
PRESSURE RELIEF VALVE		
MODULATING METERING VALVE		
MAGNETIC OIL VALVE		

Go on to the next page.

HEATING THE OIL

These pages will help you locate boiler parts which HEAT your oil.

FIRST – CHECK OFF THE OIL HEATERS BELOW WHICH YOU HAVE ON YOUR SYSTEM:

___ 1. Steam Heater
___ 2. Hot Water Oil Heater
___ 3. Electric Heater

COMPLETE ONLY THE PAGES FOR THE HEATERS YOU HAVE.

If you have a Steam Heater, complete page 15.
If you have a Hot Water Oil Heater, complete page 17.
If you have an Electric Heater, complete page 19.

{ Remember, you will have to do this in your own boiler room.

CIRCLE THE PAGES BELOW WHICH YOU WILL COMPLETE.

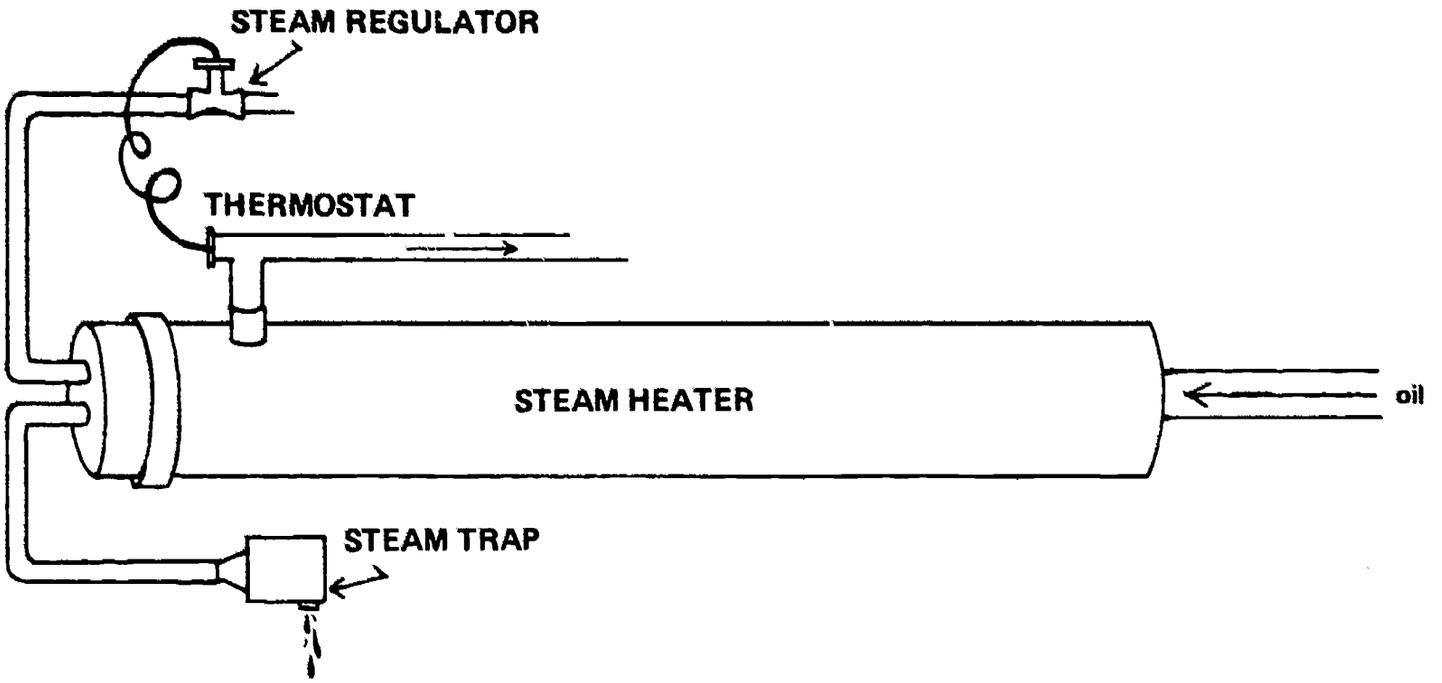
15 17 19

COMPLETE THE PAGES YOU HAVE CIRCLED. When you have finished, go on to page 20-21.

REMEMBER: Heater thermostat settings depend on what kind of oil you are burning.

STEAM HEATER

Complete this page only if you have a Steam Heater. Use this general diagram to do the work below.



PUT A CHECK IN THE BOX BEFORE EACH ITEM WHEN YOU FIND IT ON YOUR SYSTEM. THEN, ANSWER THE QUESTIONS.

☐ STEAM HEATER

1. What is the make and model number of your heater? _____

☐ THERMOSTAT

1. At what temperature should your steam heater thermostat be set? _____

☐ STEAM REGULATOR

1. Is the set screw on your steam regulator tight? _____

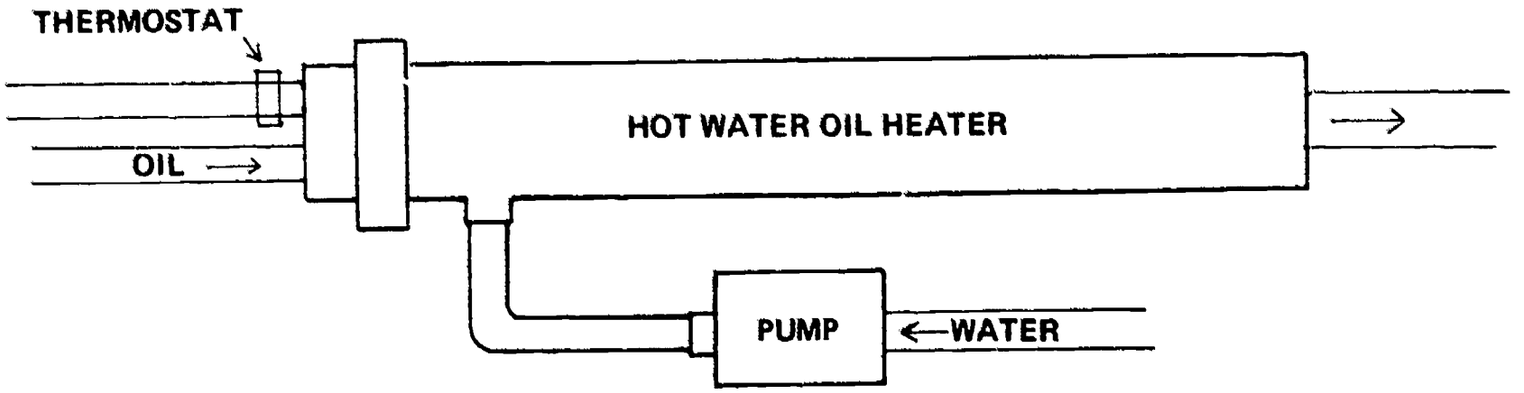
☐ STEAM TRAP

1. Is there any water (condensation) coming out of your steam trap now? _____

If you have a Hot Water or Electric Oil Heater, go on to those pages.

HOT WATER OIL HEATER

Complete this page only if you have a Hot Water Oil Heater. Use this general diagram for reference.



PUT A CHECK IN THE BOX BEFORE EACH ITEM AFTER YOU FIND IT ON YOUR SYSTEM. THEN, ANSWER THE QUESTIONS.

☐ HOT WATER OIL HEATER

1. What is the make and model number of your heater? _____

☐ THERMOSTAT

1. At what temperature should your Hot Water Oil Heater Thermostat be set? _____

☐ PUMP SERVING THIS HEATER

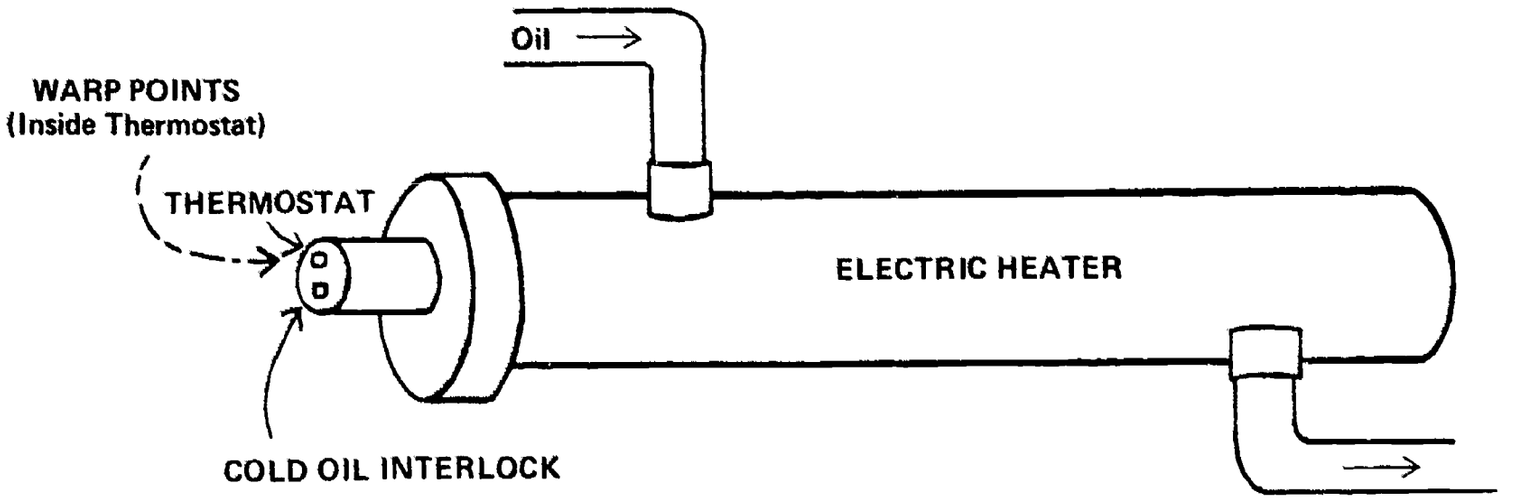
1. Is there a separate pump for this heater? _____
2. If so, what is the make and model number? _____
3. If so, list the size of any belt on it. _____
4. What is the size of the motor (HP) for this pump? _____

CIRCLE any part or question above that you cannot find or answer. Ask your instructor about these at the next class session.

If you have an Electric Heater, go on to the next page.

ELECTRIC HEATER

Complete this page only if you have an Electric Heater. Use this general diagram as reference.



PUT A CHECK IN THE BOX BEFORE EACH ITEM AFTER YOU HAVE FOUND IT ON YOUR SYSTEM. THEN, ANSWER THE QUESTIONS.

☐ ELECTRIC HEATER

Complete this chart for your Electric Heater:

	MAKE	MODEL NUMBER	WATTAGE
ELECTRIC HEATER			

☐ THERMOSTAT

1. At what temperature should your electric heater thermostat be set? (atomizing temperature) _____

☐ COLD OIL INTERLOCK

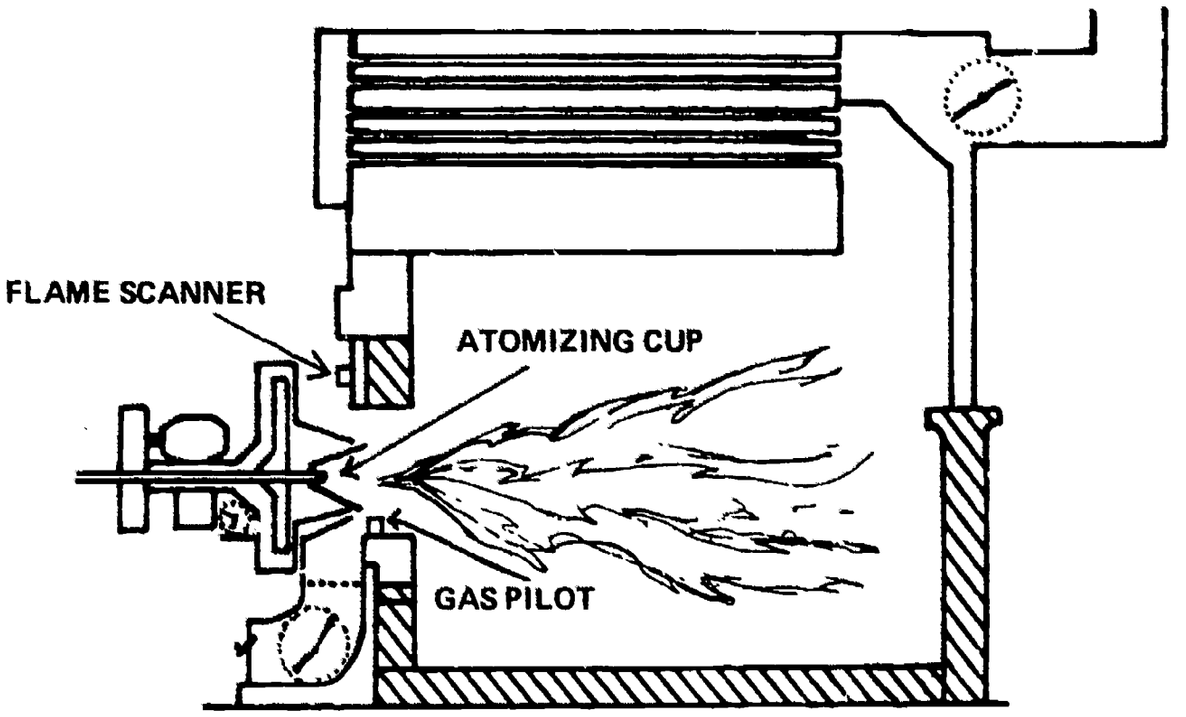
1. At what temperature should your cold oil interlock be set? (15° below thermostat setting) _____

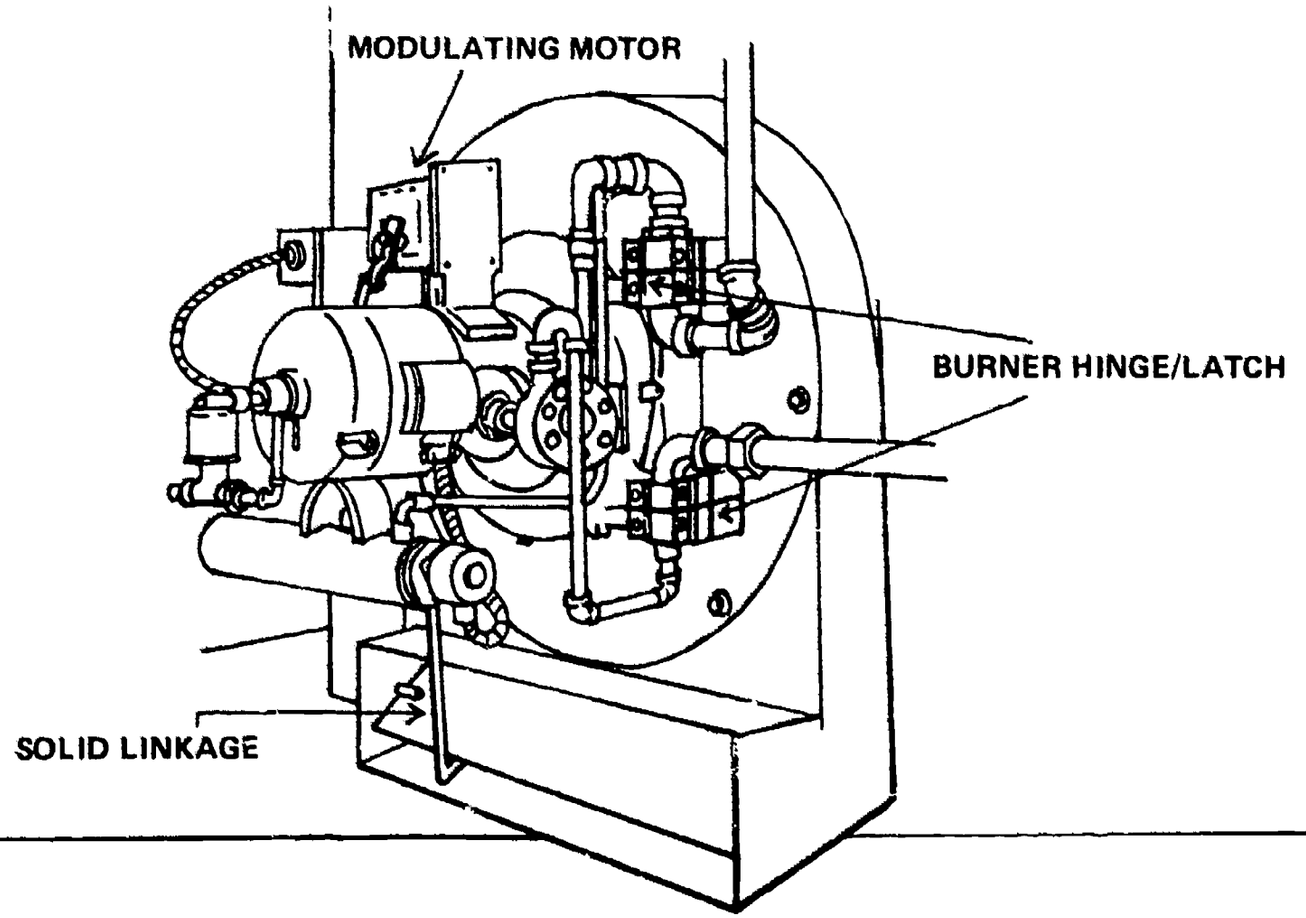
☐ WARP POINTS (inside thermostat)

1. If you change these, what are the specs? _____

Go on to the next page.

BURNER ASSEMBLY





BURNER ASSEMBLY

On this page you will locate the basic parts of your burner assembly. Refer to the diagrams on the opposite page.

PUT A CHECK IN THE BOX BEFORE EACH PART WHEN YOU FIND IT ON YOUR SYSTEM. THEN, ANSWER THE QUESTIONS.

☐ GAS PILOT

1. What is your pilot electrode size? _____

☐ BURNER

1. Look on your burner main-plate to find the make and model number. _____
2. What is your burner motor size (HP) ? _____
3. What are the belt sizes? _____
4. Do you have a lube oil indicator or must you look in the reservoir? _____

☐ MODULATING MOTOR

1. What is the make and model number? _____

☐ ATOMIZING CUP

1. What is the make and size? (If not given, measure cup opening and side length.) _____

☐ SOLID LINKAGE

1. Are settings permanently marked on the burner plate or do you mark them? _____

☐ FLAME SCANNER

1. What type do you have: A. Lead Sulphide
   B. Ultra-Violet Ray
   C. Flame Rod
   D. Photo-Cell _____
2. What is the make and model number? _____

☐ BURNER HINGE/LATCH

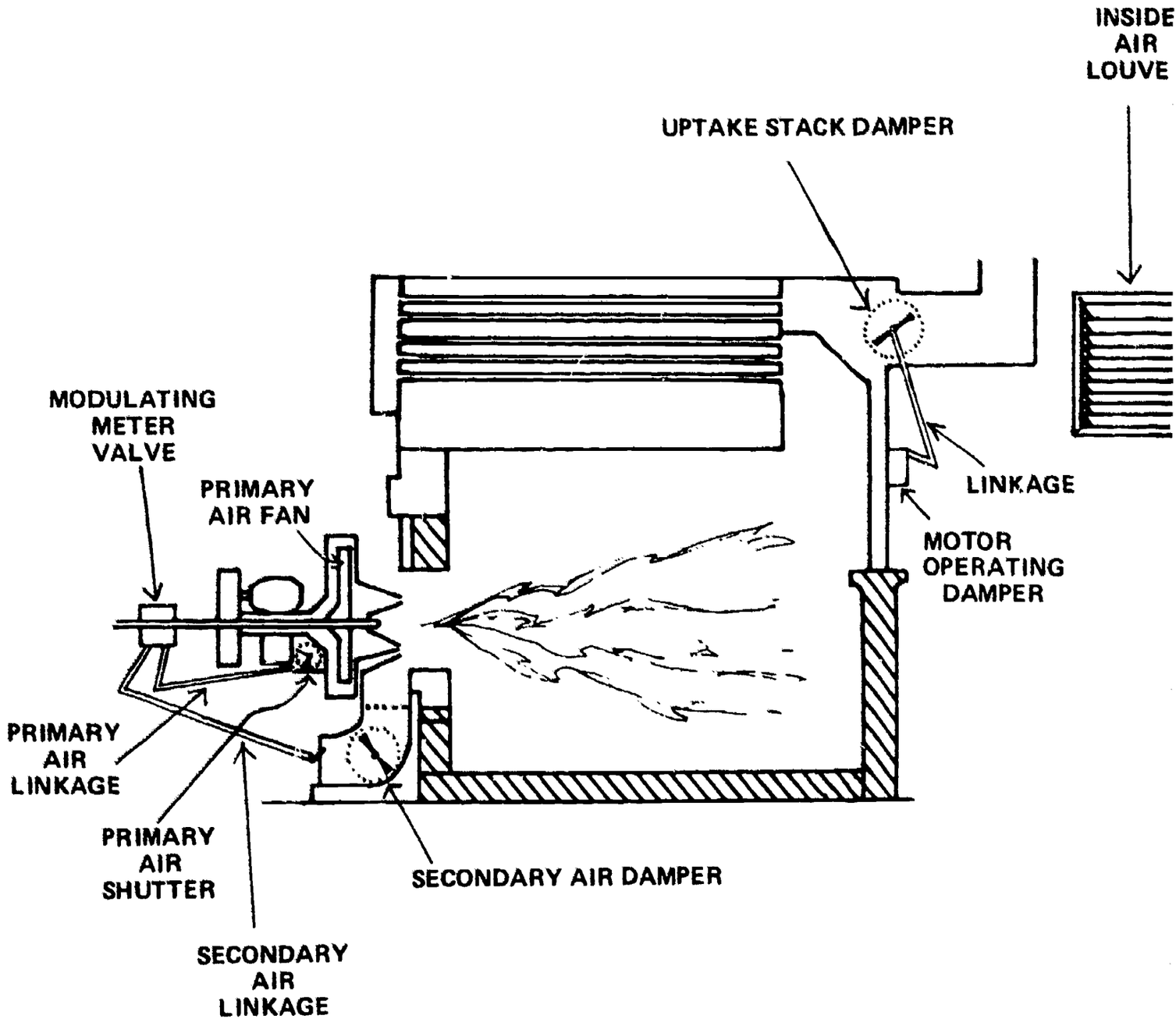
1. How many twist plugs or "dogs" must be disconnected to open your boiler? _____

☐ COVER FOR BURNER OPENING

1. Where is this kept when your burner is operating? _____

Go on to the next page.

DRAFT SYSTEM



DRAFT SYSTEM

Here you will locate parts of your system which provide air to the burner. Use the diagrams on the opposite page.

PUT A CHECK IN THE BOX BEFORE EACH PART WHEN YOU LOCATE IT ON YOUR SYSTEM. THEN, ANSWER THE QUESTIONS.

☐ FRESH AIR INTAKE INTO BOILER ROOM

1. How many windows or fixed louvers does your boiler room have? _____

☐ PRIMARY AIR SHUTTER, FAN, LINKAGE

1. Is the opening to the shutter clear? _____
2. What is the fan belt size? _____
3. Does the fan seem to be in good working order? _____

☐ SECONDARY AIR DAMPER, LINKAGE

1. Does the damper move freely? _____
2. Does the linkage move freely? _____
3. Is the linkage in the right position? _____

☐ UPTAKE DAMPER IN STACK, LINKAGE

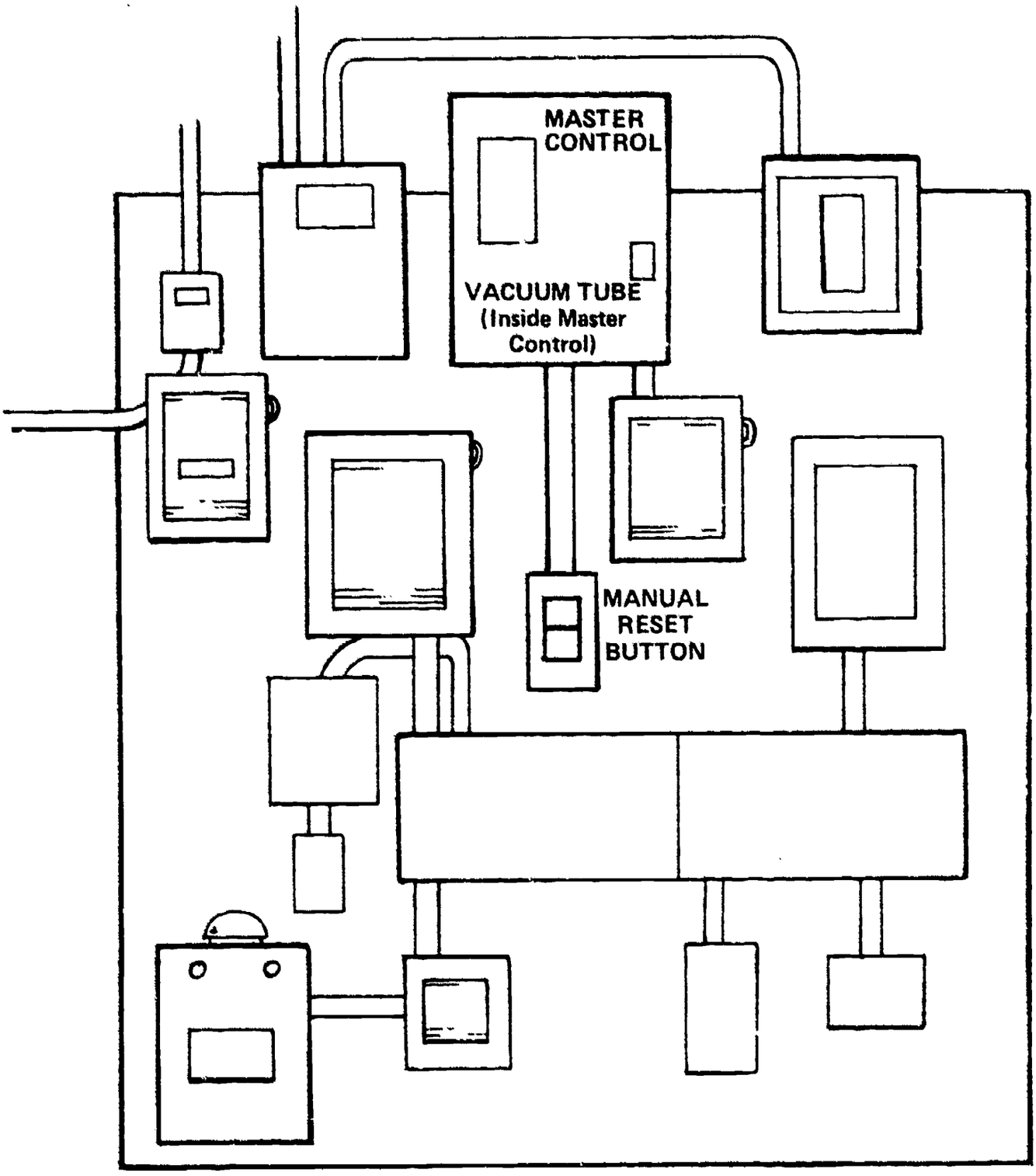
1. Is your damper automatic or manually set? _____
2. Does this linkage move freely? _____

☐ MOTOR OPERATING DRAFT DAMPER

1. What is the make and model number of this motor? _____

Go on to the next page.

CONTROLS


MASTER
CONTROL
VACUUM TUBE
(Inside Master
Control)
MANUAL
RESET
BUTTON

CONTROLS

This page and the next are concerned with basic boiler controls. This page (with the opposite diagram) includes controls that usually appear on the Control Board.

PUT A CHECK IN THE BOX BEFORE EACH PART WHEN YOU LOCATE IT ON YOUR SYSTEM. THEN, ANSWER THE QUESTIONS.

☐ CONTROL BOARD

Where is your Control Board? _____

☐ MASTER CONTROL SWITCH

Where is your Master Control Switch located? _____

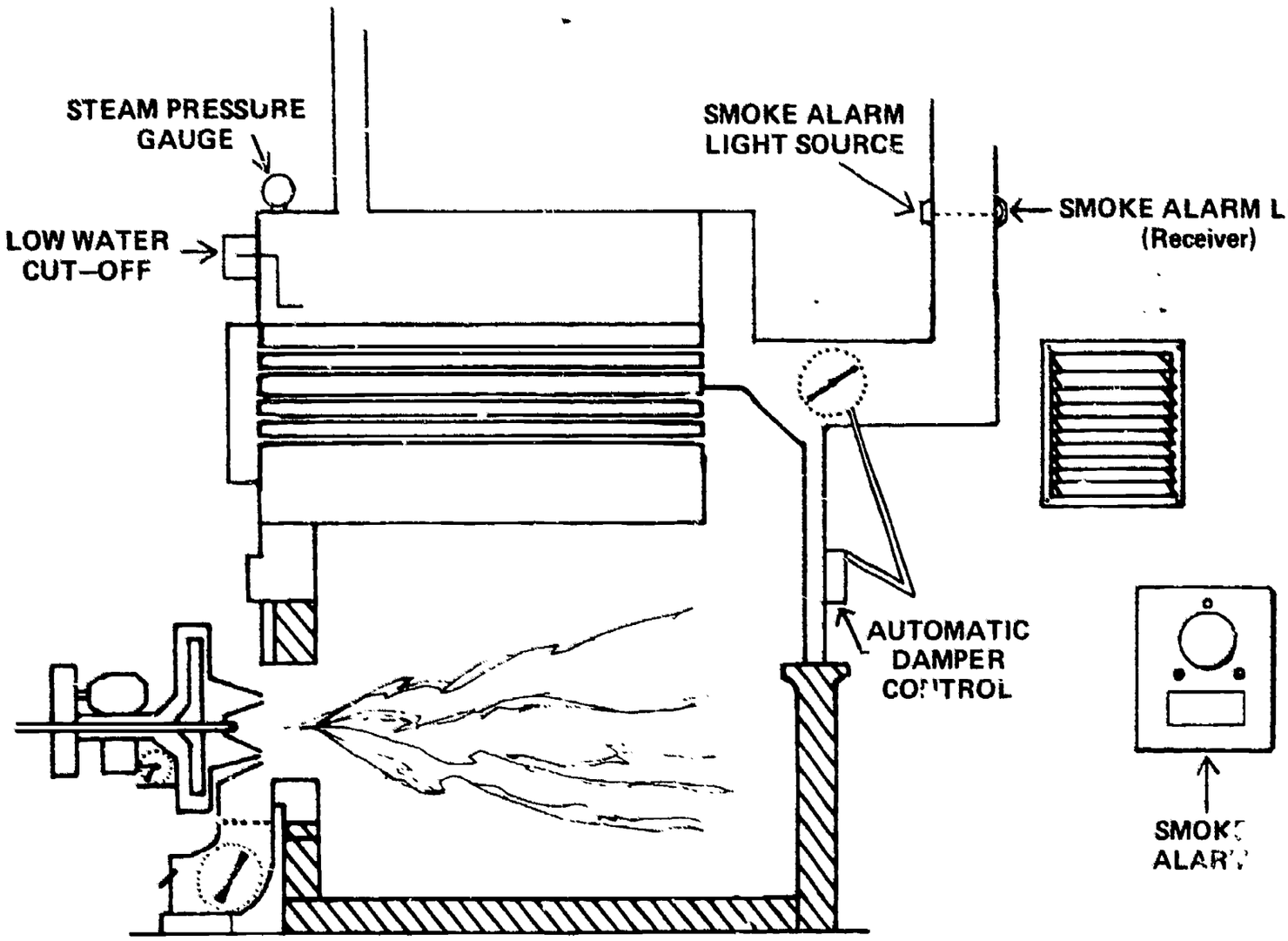
☐ VACUUM TUBE (inside Master Control)

What type of Vacuum Tube does your system use? _____

☐ MANUAL RESET BUTTON

What color is your Manual Reset Button? _____

Go on to the next page.


STEAM PRESSURE GAUGE
SMOKE ALARM LIGHT SOURCE
SMOKE ALARM LE
(Receiver)
LOW WATER CUT–OFF
AUTOMATIC DAMPER CONTROL
SMOK
ALAR

CONTROLS (continued)

These controls will be located on and around your boiler.

PUT A CHECK IN THE BOX BEFORE EACH PART AS YOU FIND IT ON YOUR SYSTEM. THEN, ANSWER THE QUESTIONS.

☐ LOW WATER CUT–OFF

How often do you clean your low water cut-off? _____

☐ STEAM PRESSURE GAUGE ON BOILER

If you have one, what is the correct pressure reading on your boiler? _____

☐ AUTOMATIC DAMPER CONTROL (on boilers of 25 gallons per hour or more)

Do you have an automatic damper control? _____

☐ SMOKE ALARM

What kind of smoke alarm do you have (light, bell, etc.)? _____

☐ SMOKE ALARM SENSOR (light source)

Where is your smoke alarm light source located? _____ _____

☐ SMOKE ALARM SENSOR (receiver, lens)

Can your smoke alarm lens be reached for cleaning? _____

Go on to the next page.

IMPORTANT TELEPHONE NUMBERS

Complete this list of "who to call" for future reference:

	NAME AND ADDRESS (Where Appropriate)	TELEPHONE
SUPERVISOR		
BOILER SERVICE – BREAKDOWN (Boiler Mechanic)		
BOILER SERVICE –CLEANING		
FUEL OIL DELIVERY		
LOCAL HARDWARE STORE		
FIRE DEPARTMENT		
CON EDISON		
DEPT. OF WATER SUPPLY, GAS & ELECTRICITY		

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BASIC MAINTENANCE SUPPLIES

Here is a basic list of general supplies:

1. Broom
2. Dust Pan
3. Wooden Stick
4. Clean Cleaning Rags
5. Metal Scraper
6. Wrenches
7. Allen Wrenches
8. Pliers
9. Screwdrivers
10. Flashlight
11. Dipstick or Sounding Tape
12. Solvent (kerosene)
13. Heavy Cloth or Canvas
14. Heavy Duty Extension Cord
15. Disposal Can for Oily Rags
16. Equipment Manuals:

    _____
    _____
    _____
    _____
    _____

If you manually clean boiler tubes:

17. Vacuum Lance
18. Fibre Boiler Tube Brushes

List here the supplies from the top of this page which you do not have on hand and need to get:

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

REFERENCE SPECIFICATIONS

On the next two pages are charts which will give you easy access to information when you need it. If you have completed all of the pages before this one, you already have what you need.

FILL OUT THE CHARTS ON THE NEXT TWO PAGES where they apply to your system.

Get the information from pages 7-31 in this Handbook.

SUPPLIES/REORDERING

ITEM	SPECIFICATIONS (Model No., Type, (Size, Wattage, etc)	SPARES TO HAVE ON HAND	COMPANY (Supplier) TELEPHONE NUMBER
ATOMIZING CUP		1	
BELTS FOR:			
Burner Motor		1	
Fuel Oil Pump		1	
Modulating Motor		1	
Primary Air Fan		1	
Other			
BULBS, LIGHTING		1 For every 5 bulbs in use	
FUEL OIL – #6	Burning Temperature:	5 days supply	
FUSES FOR:			
Boiler Plant Electric Cir uits		2 of each	
Other			
GAUGES:			
Pressure Gauge		1	
Temperature Gauge		1	
Vacuum Gauge		1	
GAS PILOT – ELECTRODE	Size:	1	
LUBE OIL	Grade:		
OIL STRAINERS		1	
VACUUM TUBE (Master Control)		1	
WARP POINTS		1 set	

APPROPRIATE RANGE OR READINGS FOR THIS SYSTEM	
	Reading/Range
Vacuum Gauge	
Pressure Gauge	
Steam Pressure Gauge (on boiler)	
Thermostat – Steam or Hot Water Oil Heater	
Thermostat – Electric Heater	
Atomizing Temperature	

EQUIPMENT SPECIFICATIONS		
	Make	Model Number
Atomizing Cup		
Burner		
Flame Scanner		
Heaters:		
Electric Heater		
Steam/Hot Water Oil		
Motors:		
Burner Motor		
Draft Damper Motor		
Modulating Motor		
Other		
Oil Strainers		
Pumps:		
Fuel Oil Pump		
Other		

OPERATION AND MAINTENANCE

On the next two pages are the operation and maintenance tasks which you have learned.

You do not have to do anything on these pages. Use them for future reference.

OPERATION AND MAINTENANCE SUMMARY

BOILER ROOM CLEAN–UP

Doors must lock
Oil slicks gone
Gauges easy to read

Tools put away
Air intakes clean
Garbage cleaned up

DAILY CHECKS

1. FUEL in the tank
2. WATER in the boiler
3. OIL TEMPERATURE – heater settings OK

FREQUENT CLEANING

1. SMOKE ALARM LENS
2. ATOMIZING CUP

Getting Ready

1. Disconnect twist plugs and linkage
2. Open latch
3. Swing burner out
4. Cover burner opening

Cleaning The Cup

1. Clean cup with rag and solvent
2. Remove deposits with wooden stick
3. Spin cup to check for wobble.
4. Check cup surface and edge for nicks

Other Checks

1. Clean fuel nozzle
2. Clean air cone around cup.

STARTING A COLD BOILER

Getting Ready

1. Check oil pressure gauge
2. Turn on fuel oil pump
3. Turn on electric heater

Check Burner

1. Inspect cup, clean if necessary
2. Swing burner into place
3. Reset linkage, lock in burner

After Start Checks

1. Flame
2. Oil Temperature
3. Oil Pressure

WEEKLY MAINTENANCE

1. CLEAN OIL STRAINERS

Single Basket

1. Turn off oil valve
2. Shut down boiler
3. Remove basket & clean
4. Replace basket
5. Open oil valve
6. Start boiler

Double Basket

1. Switch oil to empty basket
2. Remove dirty basket & clean
3. Replace basket

2. LUBRICATE WHERE NEEDED

MONTHLY MAINTENANCE

1. CLEAN BOILER TUBES

TROUBLESHOOTING REFERENCE

In this section are TROUBLESHOOTING TABLES which tell you exactly WHAT TO DO WHEN YOU GET SMOKE.

These pages will be completed with Troubleshooting, Parts III and IV.

Then, use them as reference if your smoke alarm goes off.

TROUBLESHOOTING SUMMARY - GENERAL

CORRECTING OIL TEMPERATURE:

TROUBLESHOOTING CHECKS FOR:	ELECTRIC HEATER	HOT WATER OIL HEATER	STEAM HEATER
COLD OIL	1. Heater Switch on 2. Circuit Breakers closed 3. Oil Thermostat set and working 4. Heating Element working	1. Oil Thermostat 2. Pump - Motor	1. Steam Pressure Gauge - Boiler - 2 psi 2. Oil Thermostat 3. Steam Trap 4. Steam Regulator
OIL TOO HOT	1. Oil Thermostat 2. Warp Points	1. Oil Thermostat	1. Oil Thermostat 2. Steam Regulator

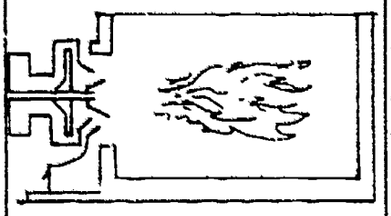
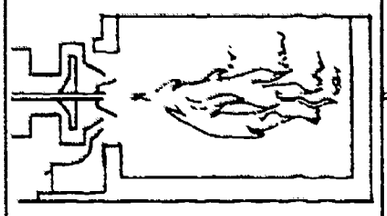
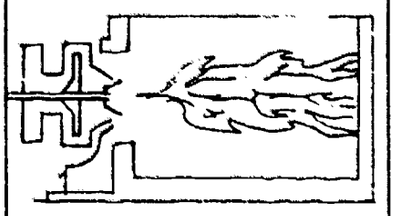
TROUBLESHOOTING THIS PARTICULAR SYSTEM

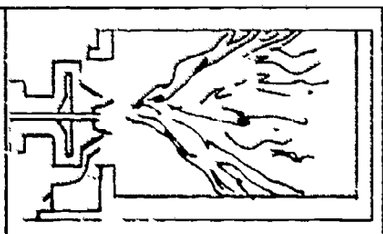
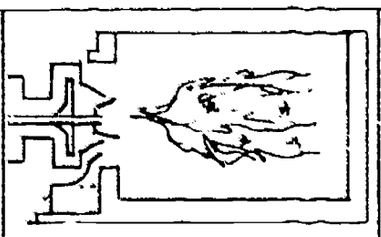
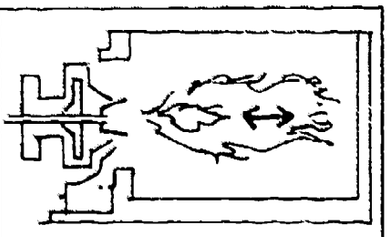
CORRECTING OIL TEMPERATURE:

TROUBLESHOOTING CHECKS FOR:	HEATERS ON THIS SYSTEM		
COLD OIL			
OIL TOO HOT			

TROUBLESHOOTING SUMMARY - GENERAL

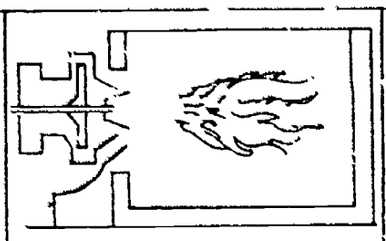
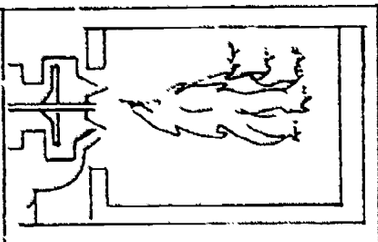
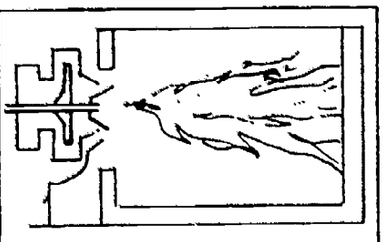
FLAME READING: Based on normal oil flow.

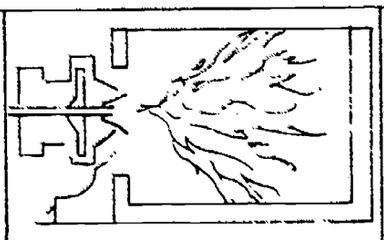
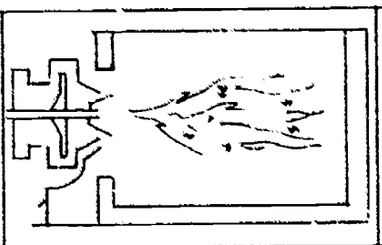
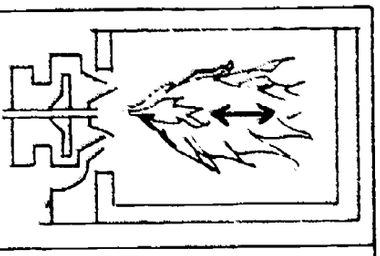
INCORRECT FLAME			
HOW INCORRECT	FLAME AWAY FROM BURNER	SMOKY FLAME	FLAME TOO LONG
POSSIBLE CAUSE	Too much Primary Air	Not enough air	Too much oil Incorrect cup position
CHECKS TO MAKE	Primary Air shutter, linkage, fan	Primary Air shutter, linkage Secondary Air Windbox, linkage Stack Damper	Oil Valves Burner Cup

INCORRECT FLAME			
HOW INCORRECT	FLAME TOO WIDE	SPARKY FLAME	PULSATING FLAME
POSSIBLE CAUSE	Too little primary air; Incorrect cup position	Oversized bits of oil and carbon	Oil amount incorrect Uneven oil flow Too little air
CHECKS TO MAKE	Primary Air shutter, linkage, fan Burner Cup	Cup - Clean, possible adjustment	Oil Temperature Oil Pressure Air Supplies

TROUBLESHOOTING THIS PARTICULAR SYSTEM

FLAME READING: Based on normal oil flow.

INCORRECT FLAME			
HOW INCORRECT	FLAME AWAY FROM BURNER	SMOKY FLAME	FLAME TOO LONG
POSSIBLE CAUSE(S)			
CHECKS TO MAKE			

INCORRECT FLAME			
HOW INCORRECT	FLAME TOO WIDE	SPARKY FLAME	PULSATING FLAME
POSSIBLE CAUSES(S)			
CHECKS TO MAKE			

GLOSSARY

On the following pages is a short glossary of words that apply to your boiler. This is for future reference. YOU DON'T HAVE TO DO ANYTHING ON THESE PAGES.

If you ever want to check on what a word means that has to do with the boiler, look here for its meaning.

GLOSSARY

(A) ATOMIZE	To break into tiny bits or mist.
ATOMIZING CUP	Cone in the burner assembly which spins the oil into a mist for burning.
(B) BOILER FIRETUBES	Tubes through which the heat from the furnace flows to heat the water in the boiler.
BREECHING	Connection (channel or pipe) from boiler to stack.
BTU	British Thermo Unit; the amount of heat necessary to raise the temperature of 1 lb. of water 1° F at or near maximum density.
BURNER COVER	Cover which should be used over burner opening when burner is swung out (venturi cover). Failure to cover opening might cause refractory to be damaged from cold air shock.
BURNER CUP	Atomizing cup; cup which spins the oil into a fine mist for burning.
BURNER HINGE	Joint(s) on which the burner can be swung away from the main boiler assembly.
BURNER MOTOR	Motor providing the power to spin the atomizing cup.
(C) CHECK VALVES	A valve permitting oil to flow in one direction only; used to prevent oil from returning to the tank when the pump shuts down.
CIRCUIT BREAKER	Device for the automatic interruption of an electrical circuit when a problem occurs.
COMBUSTION	Burning; the interaction of oil with oxygen in air accompanied by a well defined flame releasing heat.
CONDENSATE	Water formed by cooling steam.

(D) DAMPER	Device which checks or regulates the draft (air) flow.
DIAPHRAM	Flat disk of metal or rubber which bends in response to pressure changes.
DIPSTICK	Long stick used to measure the depth of a liquid.
DRAFT	Air flow caused by chimney effect or by a blower (fan).
DRAFT CONTROLS	Ways of regulating the air flow.
(E) EMISSION	Undesirable combustion products such as smoke, soot, SO_2 etc.
(F) FAN CASING	The fan cover which permits access to the fan.
FIREBOX	The furnace; where combustion takes place.
FLAME ROD	Sensor inserted in the flame to establish and monitor proper ignition.
FLAME SCANNER	Sensor to establish or monitor proper ignition based on presence of ultra-violet rays; purple peeper.
FLASH POINT	Temperature (determined by laboratory test) which indicates the fire safety of the fuel.
FLUE GAS	Products of burning fuel.
FLUE GAS TEMPERATURE	Temperature of gases as they leave the boiler.
FUEL NOZZLE	Fitting at the end of the oil supply line which distributes the oil into the cup.
(G) GRAVITY (specific)	The comparison of the ratio of the weight of a gallon of oil to a gallon of water; measured in degrees API (American Petroleum Institute); low gravity indicates heavy oil.

(H) HEATERS	Equipment which raises the oil to the required temperature for pumping, flow, and burning; boiler systems are equipped with an electric heater and a steam or hot water oil heater.
(I) IGNITION	The act of lighting fuel; light-off.
IMPINGEMENT	When flame touches refractories so as to impair combustion.
(J) JUMPER	Means for cutting an electrical control out of the circuit.
(L) LATCH-OUT SWITCH	Safety switch; device which protects the boiler by shutting down the system in the event of flame failure.
LOUVERS	Movable, multiple panels for controling air flow.
LOW WATER CUT-OFF	Automatically shuts off the burner when the water in the boiler is too low.
(M) MAGNETIC OIL VALVE	Control which starts and stops oil from entering the atomizing cup.
MASTER CONTROLLER (programmer, Projector Relay)	Device on the main panel board which starts and stops the burner safely.
METERING VALVE	Automatic oil flow valve connected to the Primary and Secondary air dampers so that burner operation can be modulated.
MODULATING MOTOR	Motor that drives the linkages to oil and air valves.
MODULATION	Automatic matching of the burner oil input with the correct air flow to meet the heating demands of the building.

(O) OIL PRESSURE	The force required to move the oil.
OIL PRESSURE GAUGE	Instrument used to measure oil pressure.
OIL TEMPERATURE INTERLOCK	Thermostatic control set to prevent the burner from operating until the oil reaches the proper viscosity for good combustion.
OIL TRANSFER PUMP	Motor driven pump providing the pressure required to move oil from the tank to the burner.
(P) PARTICULATES	Any solid or liquid (other than water) which is so small as to be capable of being carried by the wind or suspended in air.
PHOTO CELL	The sensor which proves the presence of a flame, thus insuring a safe light-off.
PILOT	A gas burner used to light the main oil burner.
POST-PURGE	Continuing burner fan operation after the flame is shut off in order to clean any residual oil or gas vapors remaining in the boiler.
POUR POINT	Measure of the effect of temperature on the ability of oil to flow; is measured by cooling the oil until it just moves.
PRE-PURGE	Burner fan operation before ignition to insure absence of combustion vapors in the boiler.
PRESSURE RELIEF VALVE	Valve set at a pressure to permit the oil to return to the tank when not needed to meet the burner need.
PRIMARY AIR SHUTTER	Adjustable, automatic means of controling the primary air to the burner.
PSI	Pounds per Square Inch — a unit of pressure.
PULSATING	Rhythmic changing of the flame shape.

(R) RATIO	The relation of one substance to another; in boilers the relation of the right amount of air to the right amount of oil is the proper air/oil ratio.
REFRACTORY	Special brick lining for the firebox in the boiler.
RELAY	Part of control system used to transfer electrical impulses.
RESET	Generally refers to the main overriding safety control valve; must be manually turned back on in the event of automatic shutdown.
RESIDUAL	Refinery term for the end product of oil processing; descriptive word for #6 oil.
RINGELMANN CHART	Chart used to measure the severity of air pollution by how dark the smoke is.
ROTARY CUP	Polished brass cone in burner which spins to atomize the oil.
(S) SAFETY CONTROL SENSORS	Parts of the safety system located in the firebox and used to prove the existence of flames.
SCHEMATIC DIAGRAM	A diagram drawn to show the proper order and relation of things rather than how they actually look.
SECONDARY AIR	Air supply around the burner flame from the windbox.
SECONDARY AIR DAMPER	Damper on the windbox usually in the form of louvers to control secondary air flow.
SEDIMENT	Undesirable residues in oil.
SEQUENTIAL DRAFT CONTROLLER	A regulator in the breeching which adjusts stack draft.
SMOKE ALARM	Device in the breeching which responds to smoke by setting off an alarm.

SOLVENT	Organic liquid used for cleaning; usually kerosene or Stoddard's solvent.
SPINNING CUP	The atomizing cone in the burner.
STRAINERS	Large and fine mesh sieves in the oil lines which remove residue.
SUCTION BELL	Device in the storage tank where a limited amount of oil is heated for pumping.
(T) TRIAL FOR IGNITION	Time period provided to complete the ignition cycle; normally about 10 seconds. If ignition does not take place within this time, the boiler shuts down (some systems permit a second trial).
(V) VACUUM GAUGE	An oil pressure gauge on the oil line (on inlet side of pump) which indicates clogging of oil line.
VISCOSITY	A measure of the ability of oil to flow.
(W) WINDBOX	A louvered cover designed to permit modulation of the secondary air flow.