End-term exam

(BME-205)

Q-1 (i)

Ans 1 (i) Following mechanical properties of metal.

1) Strength → Strength is the mechanical property that enables a metal to resist deformation load. Strong material withstand higher load.
   - Ex, Hard metals as Iron, copper have greater strength.

2) Elasticity → It is ability of an object or material to resume its normal shape after being stretched or compressed by load.
   - Ex, Rubber, Heat treated springs

3) Plasticity → Ability to go under permanent deformation without rupture.
   - Ex, Materials as Clay, lead etc are plastic at room temp, and steel plastic when at bright red-heat.

4) Hardness → Resistance to penetrating or bending. Also, resist scratching, abrasion, cutting or penetration.
   - Ex Metals as iron, copper are really hard to cut at room temp.

5) Toughness → Property to enable to withstand shock or impact.
   - Ex Manganese steal, wrought iron, mild steel etc.

6) Brittleness → Property of material enabling withstand from permanent deformation. Tend to break rather than bend under shock.
- Ex, Cast iron, glass are brittle materials.

7) Stiffness → Mechanical property, resisting to elastic deformation or deflection, High degree of stiffness
- Ex, loose wet clay has low stiffness as it change shape with few pounds of pressure.

8) Ductility → Property to drawn into thin wires.
- Ex - Mild steel, copper, aluminium.

9) Malleability → Property to permit it to be hammered or rolled into sheets of other sizes and shapes
- Ex → Aluminium, copper, tin, lead etc.

10) Cohesion → Solid body by virtue of which they resist from broken into fragments

11) Impact Strength → Ability of metal to resist suddenly applied loads.

12) Fatigue → Long effect of repeated straining action causing strain or break.

13) Creep → Slow and progressive deformation of material like
Ex. by viscous flow, or by high temperature [sensitive material like rubber/plastic]

Q-1(ii)

Ans 1(ii) Sand Casting → It is also known as Sand moulding Casting is a casting tool manufacturing process that involves base of a sand mould. It is used to create metal products and components in a variety of sizes and shapes.

It keep its popularity into perspective, about 60% are ~~about~~ ~~casting~~ products made by Sand Casting.

~~Pro~~ Process → 1) Place mold pattern in sand.
2) Set up the casting process
3) Remove the mold pattern
4) Pour ~~it~~ molten metal into mold cavity
5) Wait for metal to Cavity
6) Break open Mold to Remove the metal casting

Type of Allowance in casting.

1) Shrinkage Casting → During Cooling of material, this material get shrink, then volume is reduced or dimension is changed. This lead to object in casting.
2) Machining Allowance → The extra dimension provided on the casting and it will be removed by machining after the casting has been completed.
3) Draft Allowance → Making Vertical surfaces after pattern into inclined surface is called Draft Allowance

4) Shank Allowance → To maintain the required size of the casting, the original size of the pattern has to be reduced by an amount.

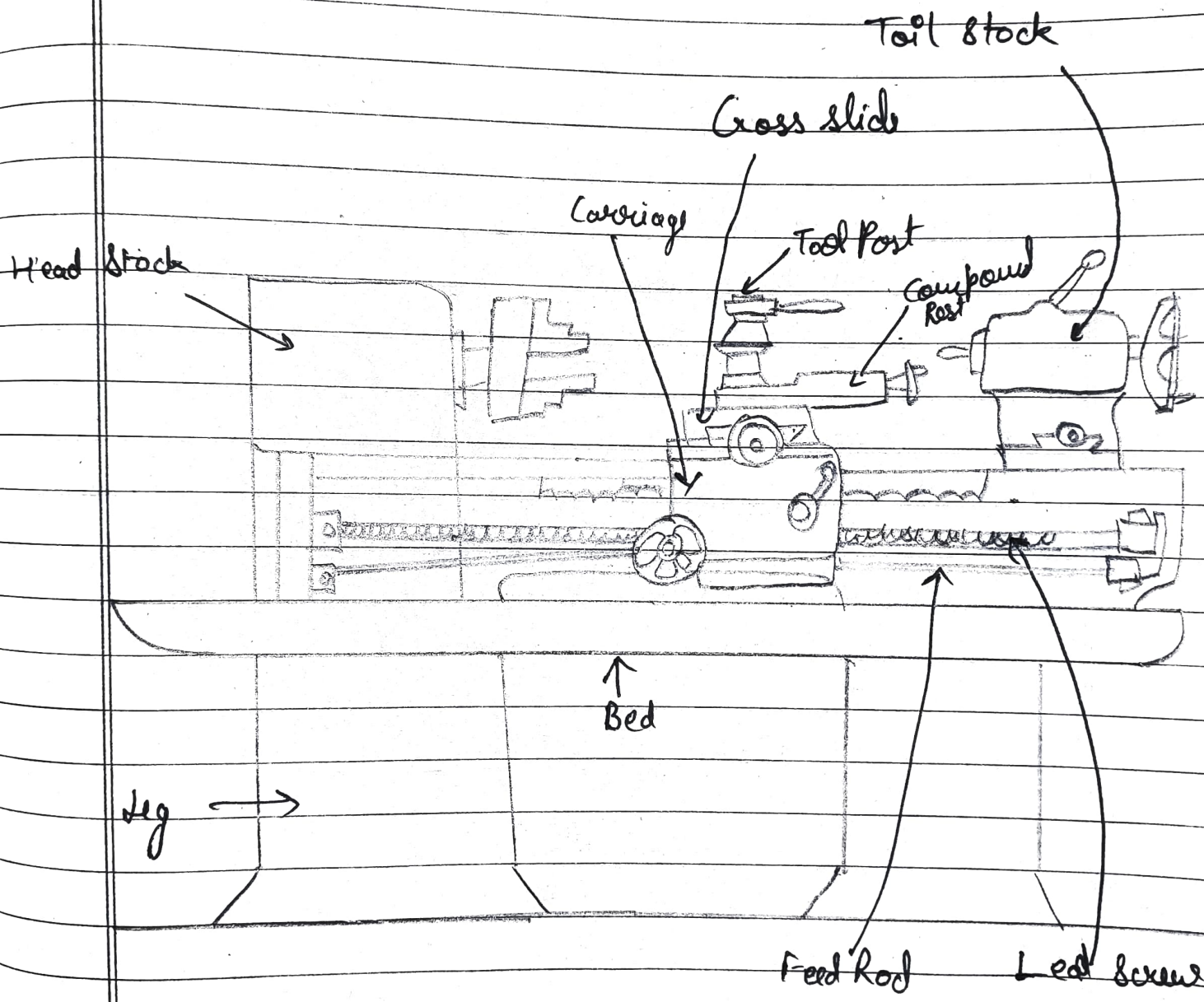
5) Distortion Allowance → To get vertical legs of U shaped the original pattern has to be bend inverse so that during solidification, the legs are bending outwards and becoming vertical legs.

Q2 (i)

Ans 2(i) Working of a lathe machine

The lathe is a machine tool which holds the work piece between two rigid and strong support allowed centers or in a check or face plate which revolves. The cutting tool is rigidly held and supported in a tool post which is fed against the revolving work.

Lathe machine is one of the most important machine tools which is used in the metal working industry it operates on the principle of a rotating workpiece & a fixed cutting tool. The cutting tool is fed into the work piece which rotates about its own axis causing the work piece to form the desired shape. The cutting tool may also be fed at an angle relative to the axis of work for machining tapes and angles.


Tail Stock
Cross slide
Carriage
Tool Post
Compound Rest
Head Stock
Bed
Leg
Feed Rod
Lead Screw

Q-2 (ii)
Qus 2(ii)

Given,

$T_1 = 316\,K$

$T_2 = 596\,K$

assuming $\gamma = 1.4$ for air,

Let $r = \frac{V_1}{V_2}$ [Compression ratio]

For isentropic Compression,

$$\frac{T_1}{T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1} \Rightarrow \frac{T_1}{T_2} \left(\frac{1}{r}\right)^{\gamma-1}$$

$$\Rightarrow \frac{316}{596} = \left(\frac{1}{r}\right)^{1.4-1}$$

$$\left(\frac{316}{596}\right)^{\frac{1}{0.4}} = 1/r$$

$$= 0.2046 = 1/r$$

$$= \boxed{r = 4.885}$$ [$\because$ we obtain compression ratio as 4.885]

Air standard efficiency

$$\eta = \frac{T_2 - T_1}{T_2} = 1 - \frac{1}{(r)^{\gamma-1}}$$

$$\eta = 1 - \frac{1}{(4.885)^{1.4-1}} = 0.469 \Rightarrow \boxed{46.9\%}$$

$\therefore$ we obtain air standard efficiency as 46.9%

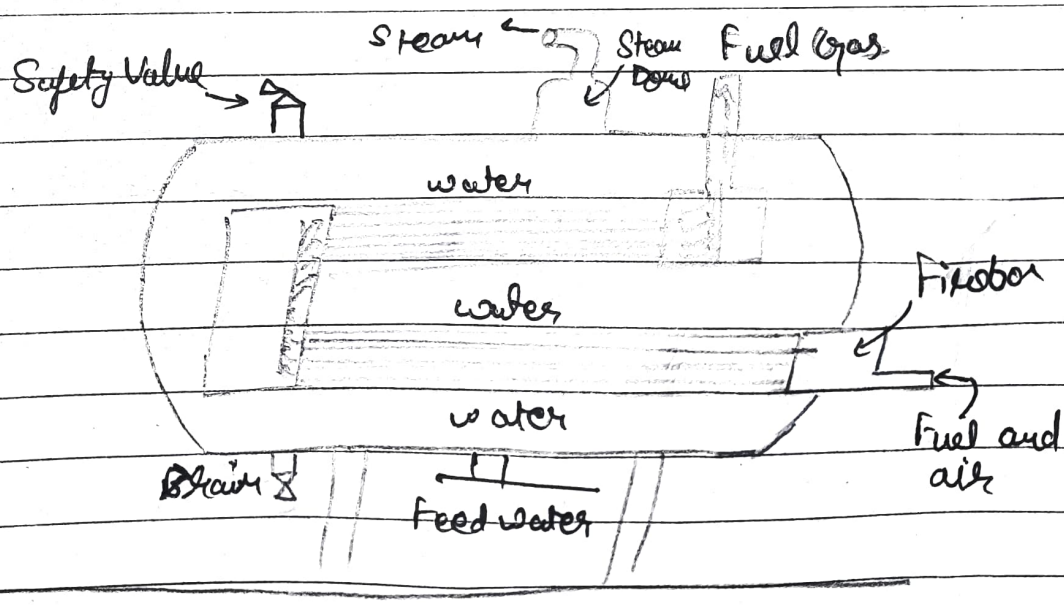
Q3(i)
Ans3(i) Boiler is a closed vessel in which water or other liquid is heated, steam or vapour is generated, steam is super-heated, or any combination thereof, under pressure or vaccum, for use external to itself, by the direct application of energy from the ~~combination~~ combustion of fuels, from electricity or nuclear energy.

Types (i) Major :-

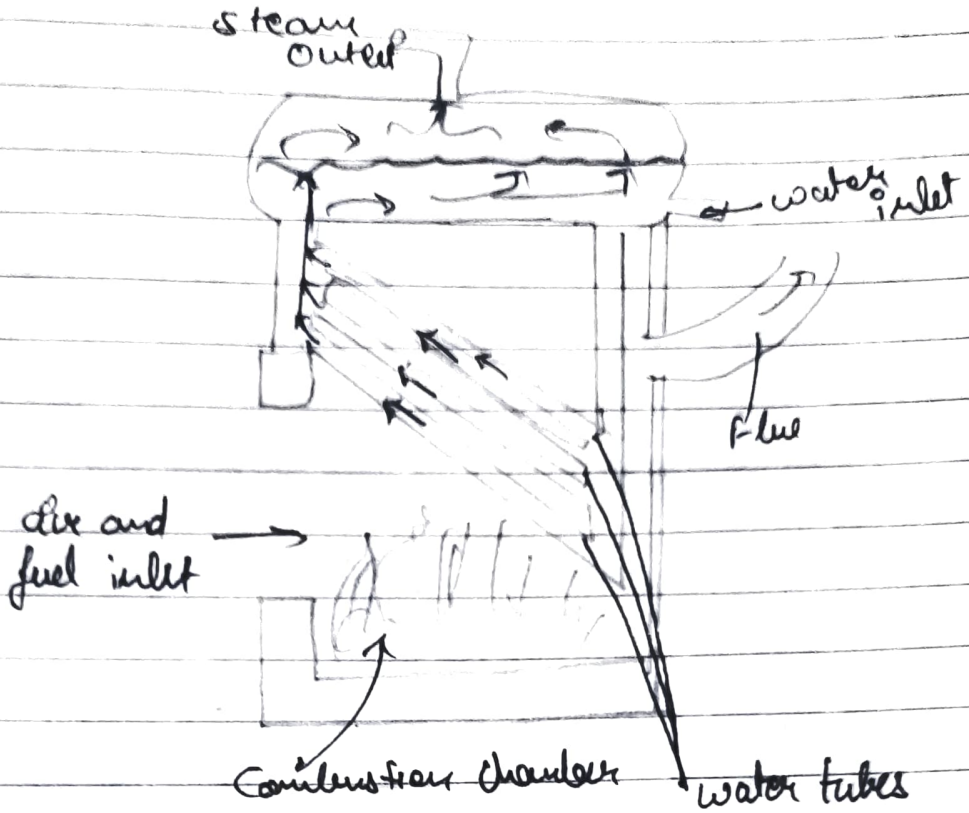
According to the contents in the tubes

a) Fire tube Boiler

↳ Fire / hot gases present inside tubes and water surrounds tubes. Heat is conducted through walls of tube, ex simple vertical boiler, cochran boiler, lancastiere boiler etc.



b) Water tube Boiler: Here water is in tubes and fire surrounds tubes
Example, La- Mary boiler, Benson boiler, Stirling etc.



Minor types.

2 According to position of furnace
a) Single tube Boiler
b) Multitubular Boiler.

3 According to position of furnace
a) Internally fired Boiler
b) Externally fired Boiler.

4 According to axis of shell
a) Vertical Boiler
b) Horizontal Boiler

5 According to Methods of Circulation of water
a) Natural b) Artificial circulation method.

6 According to use
a) Stationary Boiler b) Mobile Boiler.

Q:3 (ii)
Ans 3 (ii)

	TWO STROKE	FOUR STROKES
•1	One Revolution of the Crankshaft during one power stroke	•1 Two revolution of Crankshaft in one Power stroke.
•2	Generates High Torque	•2 Generates less torque
•3	Uses port for fuel's outlet and inlet	•3 Uses Valves for fuel
•4	Engine has lesser thermal efficiency	•4 Has Higher thermal efficiency
•5	Larger Power to weight - Ratio	•5 lesser Power to weight Ratio
•6	More smoke ; less efficiency	•6 less smoke ; more efficiency
•7	Requires more lubricating oil as some Oil burns with fuel	•7 Requires less lubricating oil.
•8	Due to poor lubrication more wear and tear occoues	•8 Less wear and tear occours
•9	Cheaper engines, simple for manufacturing purposes.	•9 Engines are expensive due to lubrication and valves are tough to manufacture
•10	Engines are basically lighter and are noisy	•10 Heavier because of fly wheel's heaviness

Q.4(i)
Ans 4(i) Comparision ratio, $r = 13$
cut off % = 8%

Now,

$$\text{cut off \%} = \frac{P-1}{r-1}$$

$$\frac{8}{100} = \frac{P-1}{13-1}$$

$\therefore P = 1.96$

Air standard efficiency,

$$\eta = 1 - \frac{1}{\gamma (r)^{\gamma-1}} \left[\frac{P^{\gamma}-1}{P-1} \right]$$

$$\therefore \eta = 1 - \frac{1}{(1.4)(13)^{1.4-1}} \left[\frac{(1.96)^{1.4}-1}{1.96-1} \right]$$

$\therefore \eta = 0.582$ or **58.2%**

Q.4(ii)
Ans 4(ii) Forging is the working of metal into a useful shape by hammering or pressuring.

→ Classification

- By equipment
  - a) Forging hammer → Two types are used, Board hammer and Power hammer. It provide rapid impact blows to the surface of metal. Dies are into two halves, lower fixed and another moves up and down with TUP.

good for mass production.

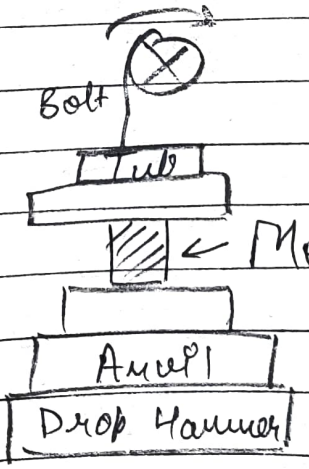
b) Press forging.

Hydraulic press forging ⇒ Use of Hydraulic Press, give continuous forging at a slower rate
→ Better property, expensive, deep penetration.

Mechanical press forging → Crank press translates rotary motion to linear of press slide.
More press like squez.

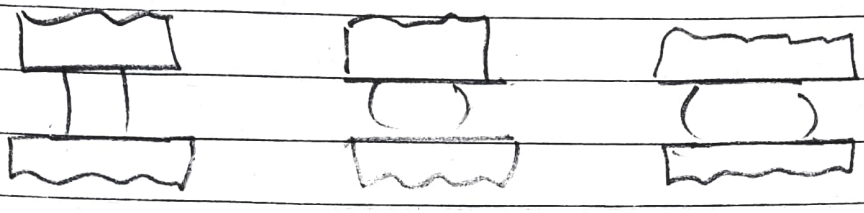
- By process
  a) open die → carried b/w flat dies or dies of very simple shape.
  Usely in large objects or no of parts are small.

  b) Closed die forging → The workpiece is deformed in two halves which carry impressions of desired final shape.

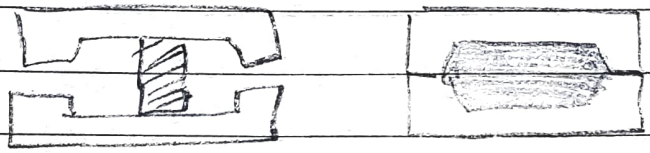


Forging Hammer

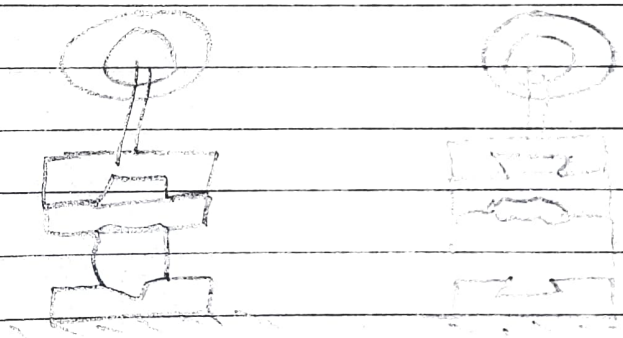
Normally used for smaller components.



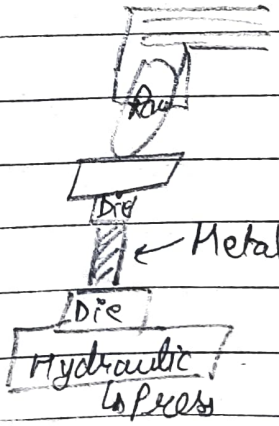
↳ open die forging.



↳ closed die forging



↳ Mechanical Press forging



↳ Hydraulic Press Forging.

OSC)
dus Si)

Gas welding → Metal joining process end pieces to be joined are fused at their interface by producing coalescence with one or more gas

Oxacytelene gas welding is often used to join steel. Mixture of gas burns asistance flame.

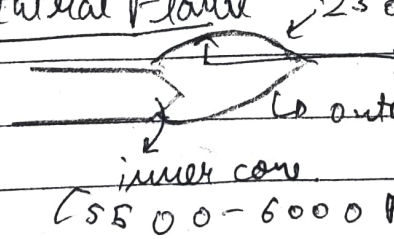
Types of flames.

Neutral flame → Primary flame, zone, a hotter and lighter, and cooler darker outer zone. Inna flame is clean. This is lowest part of flame

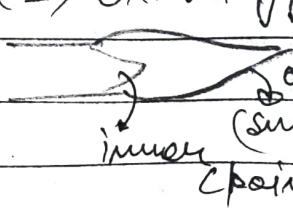
Carborizing flame → Not all the gases are burned. Has three zones, cooler than neutral Deposit soot in work piece.

Oxidising flame → Caused by increasing oxygen from a neutral flame. Because excess oxygen, Flame is hotter than any other.
Used for bronze and brass work.

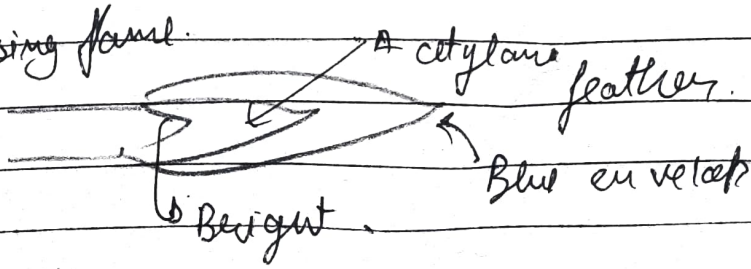
(1) Neutral flame



(2) Oxidising flame.



(3) Carborising flame.



Q5(ii)

Ans 5(ii) Boiler draught is defined as the difference between absolute gas pressure at any point in a flow passage and the ambient (same elevation) atmospheric pressure. Draught is achieved a small pressure difference which causes the flow of air or gas to take place. It is measured in millimeter of water.

The draught is one of the most essential systems of thermal power plant which support the required quantity of air for combustion and removes the burnt products from the system. To move the air through the fuel bed and to produce a flow of hot gases through the boiler economiser, preheater and chimney require a difference of pressure.

* Classification of Boiler Draught.

a) Natural or Chimney Draught: In this case the amount of draught directly depends on the height of chimney. It is produced due to the difference in densities between the column of hot gases in the chimney and a similar column of cold air outside the chimney.

b) Artificial Draught → Bigger power plants, the draught order of 25-350 mm of H_2O column is required. For producing this much draught, the chimney height has to be increased, which is neither convenient nor economical. Also, since the draught depends upon the climate conditions, some mechanical equipments are used for producing

the required draught and the draught so produced is called artificial draught

It has 4 types.

① Forced Draught → Here, Blower is installed at base, air is passed through furnace, flues, economizer, air-preheater and to the stack.

② Induced Draught → Blower / Induced Draught fan located near base, Air sucked in system, the flue gases generated after the combustion are drawn through the system and after recovering heat then exhausted.

③ Balanced Draught → Combination of forced and induced draught. Forced draught overcomes resistance of the fuel bed therefore sufficient air is supplied to the fuel bed for proper combustion

④ Steam Jet Draught → In this system a small portion of generated steam exhausts through a nozzle and the kinetic energy of the jet of high-velocity steam drags the air or flue gases in the boiler system.