WESMAN THERMAL

WESMAN

COMBUSTION SYSTEMS

OPERATION, EFFICIENCY, IMPROVEMENT AND MAINTENANCE

Tushar Shah
Manager (Sales & Service)
Wesman Thermal Engineering Processes Pvt Ltd

WESMAN AT A GLANCE

WESMAN THERMAL

- **Six decades of leadership** in Furnaces, Foundry equipment, Combustion equipment
- **ISO 9001 certified** parent company and factory
- Six group companies, Thirteen branches and factory, with **total 300 employees**
- Collaborations and JVs with **global leaders**
- The **preferred choice** of customers in all segments

INTERNATIONAL PARTNERS

WESMAN THERMAL

tenova
LOI WESMAN

LOI THERMPROCESS GMBH
Hydrogen annealing, roller hearth, walking beam, aluminium melting and holding furnaces

IBS
Industrial-Burner-Systems

IBS INDUSTRIAL BURNER SYSTEMS GMBH
Gas burners, recuperative burners, regenerative burners, process Burners, combustion controls

FMS

FOUNDRY MACHINERY & SPARES
No-bake and chemically bonded sand equipment, thermal and attrition sand reclamation systems, turnkey no-bake sand plants

SIMPSON TECHNOLOGIES INC
Green sand mixers, coolers, controls, sand testing equipment

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GLOBAL AND LOCAL REACH

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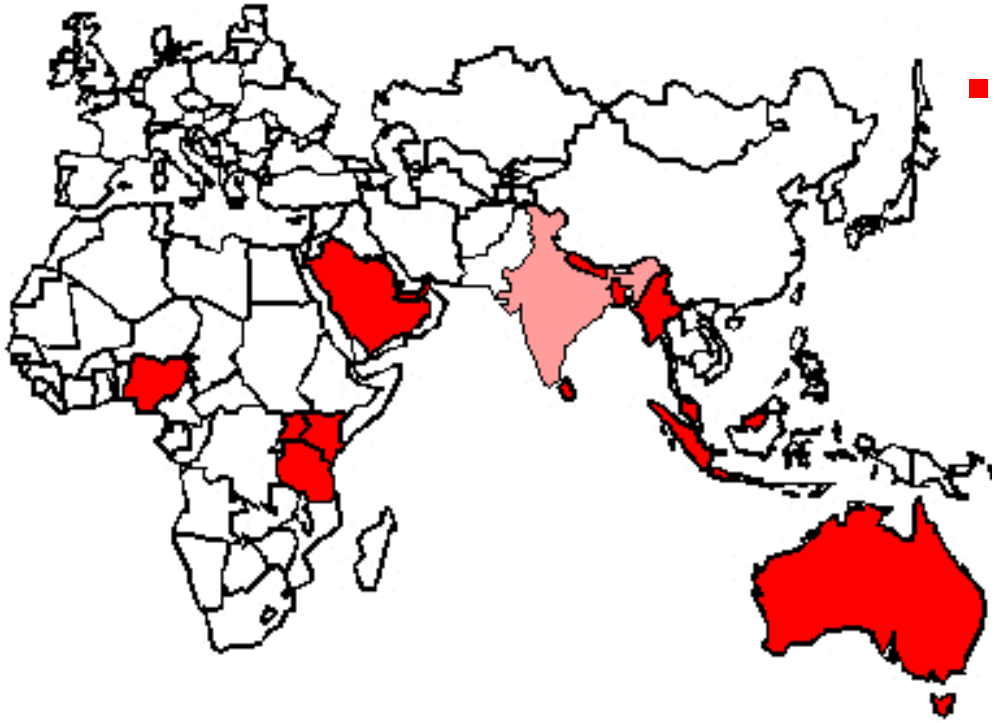

- Exporting to ASEAN, SAARC, Middle East and African markets

- National presence via network of regional offices staffed by trained and experienced professionals

MAJOR CUSTOMERS IN INDIA

WESMAN THERMAL

ADVANTAGES OF USING FUEL WITH PROPER COMBUSTION EQUIPMENT

TUSHAR SHAH
WESMAN THERMAL ENGINEERING PROCESSES PVT LTD

COMBUSTION

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WHAT IS COMBUSTION ?

- Combustion is a rapid combination of oxygen with fuel resulting in release of heat and light.
- Oxygen (O_2) is one of the most common elements on the earth making up 20.9% of our air.
- Carbon, Hydrogen and Sulphur in the fuel combine with oxygen in the air to form Carbon Dioxide, Water Vapour, and Sulphur Dioxdide and releasing the heat

Carbon + Oxygen – Carbon Dioxide + Heat
Hydrogen + Oxygen – Water + Heat
Sulphur + Oxygen – SO_2 + Heat

COMBUSTION

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- Under Certain Conditions Carbon may also combine with Oxygen to form Carbon Monoxide which result in the release of a smaller qty. of heat per pound of fuel.
- Carbon burned to CO_2 will produce more heat per pound of fuel than when CO or Smoke are produced.
- Each Kilogram of CO formed means **a loss of 5654 Kcal of heat**
- Carbon in gases or liquids appears as Hydrocarbon Compounds and if not burned properly the Hydrocarbon compounds may crack and producing soot. This soot Problem can be minimized by design of burner & Combustion chamber to provide adequate air & Turbulence.

COMBUSTION

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- Most of the 79% of air is nitrogen with traces of other elements. Nitrogen is considered to be a temperature reducing dilutant that must be present to obtain the oxygen required for combustion.
- Nitrogen reduces combustion efficiency by absorbing heat from the combustion of fuels and diluting the flue gases.
- This nitrogen also can combine with oxygen to produce oxides of nitrogen (NO_X) Which are Toxic Pollutants.

GOOD / PERFECT COMBUSTION :-

- Perfect combustion depends on exact amount of fuel and oxygen for burning so get the available heat in the fuel and nothing left over.
- Good Combustion requires
  - * Proper Proportioning of fuel and air
  - * Through mixing of fuel and air
  - * Initial and sustained ignition of mixer.
- Too much or too little fuel with the available combustion air may potentially result in unburned fuel and carbon monoxide generation.

Excess Fuel – Mixture is rich. Flame lengthy & Smokey

$2C + O_2 - 2CO + Heat$

$2CO + O_2 - 2CO2 + Heat$

This usually called incomplete combustion i.e some fuel combine with available oxygen and some fuel remains unburned.

- Excess Oxygen – Mixture is lean. Flame Short & bright.

  $C + 2O_2 - CO2 + O_2 + Heat$

  Too much excess air will result in heat and efficiency losses.

- **A very specific amount of O_2 is needed for the Perfect Comb.** and some additional air is required for ensuring complete comb.

PERFECT COMBUSTION

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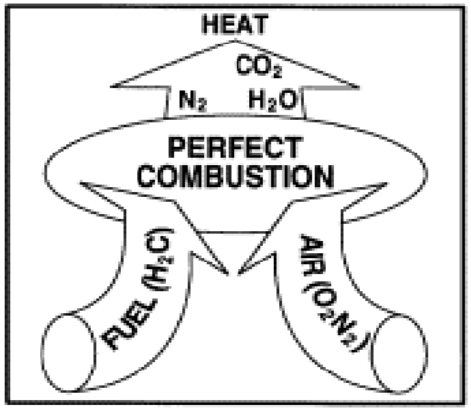
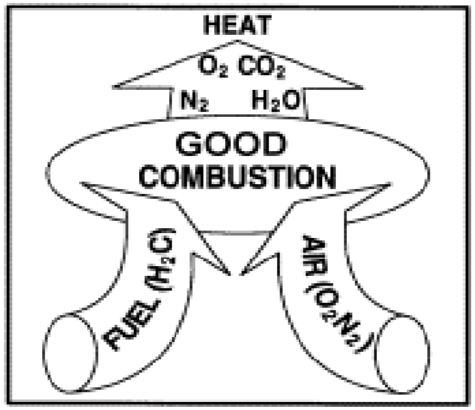
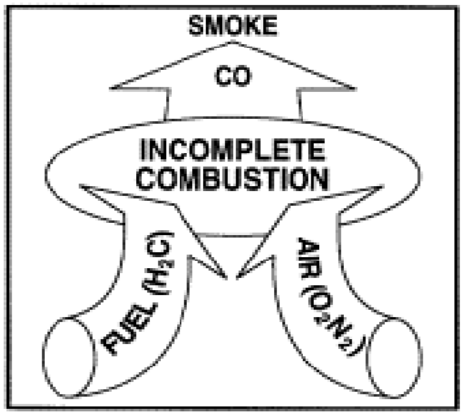
- Good Mixing is important so that mixture will be uniform throughout i.e every particle of fuel must contain a particle of air.
- Correct proportioning of Air & Fuel must be adhered in order to avoid any unburnt fuel.
- Normally 1 CFT of air releases 100 BTU of heat.
  e.g. 1 CFT of gas having gross CV of 1000 BTU requires 10 CFT of air to burn completely.







PERFECT COMBUSTION

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- Flue gas analysis is used to indicate the Air/Fuel ratio and the degree of completeness of combustion.

- In complete combustion CO_2 is maximum while there will be no CO, H2 & O2, By adjusting Air/Fuel ratio to obtain maximum CO_2 & Minimum of O2 the operator can set the burner close to the best fuel efficiency.

TYPES OF FUELS

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Solid Fuels

- Coal, Wood, Bagasse, Husk

Liquid Fuels

- Light Distillate LDO, HSD, Kerosene, Low Sulfur Heavy Stock (LSHS), Furnace Oil

Gaseous Fuels

- Natural Gas, LPG, Blast Furnace Gas, Coke Oven Gas, Biogas, Producer Gas

TYPES OF BURNERS

Based on fuel

- Oil burners
- Gas burners
- Oil/ gas combination (dual-fuel) burners

Based on function

- Premix burner
- Nozzle mix burner

Based on construction

- Sealed burner
- Open register burner

TYPES OF BURNERS

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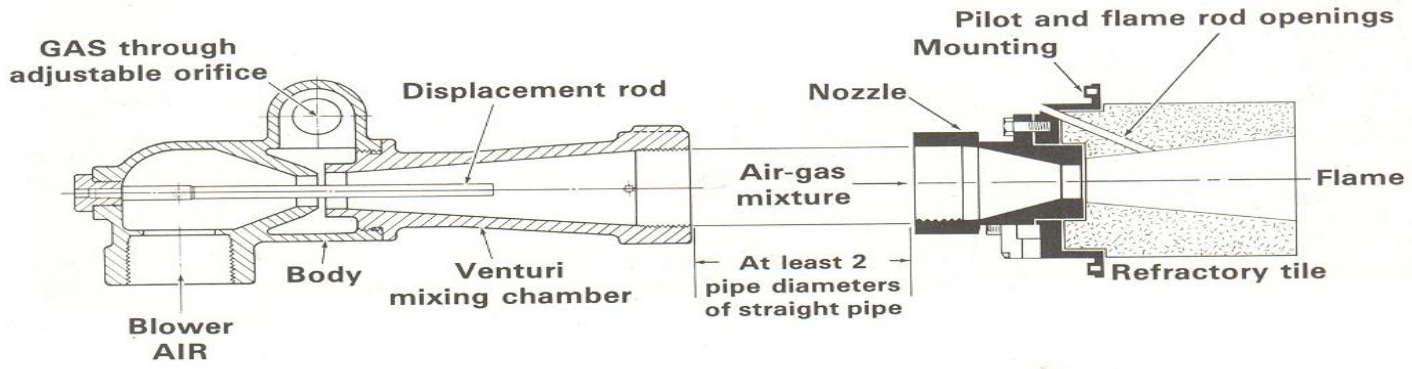
PREMIX BURNERS

- Suitable for gas as fuel
- Primary air and gas are mixed upstream from burner ports
- Uses inspirator and aspirator mixers, or mechanical mixer
- Nozzle serves only as holder to maintain flame in location
- **Example: Pilot burner 4011 and 4012, Aspirator 3065**



TYPES OF BURNERS

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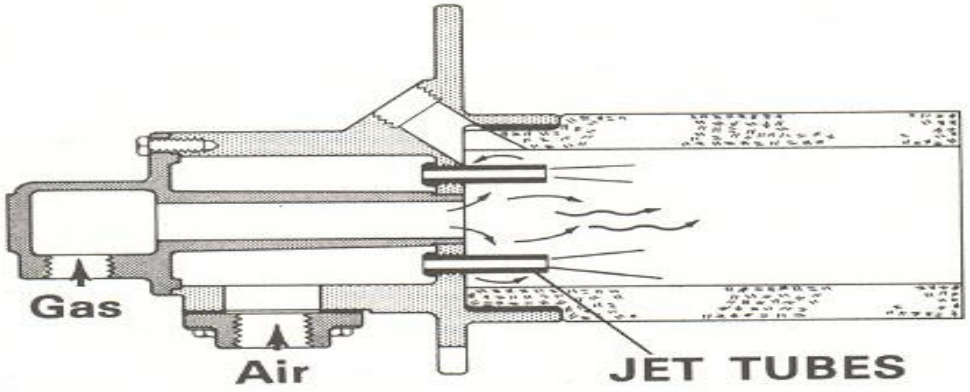
NOZZLE-MIX BURNER

- Primary air and fuel do not mix until they leave ports
- The two fluids are kept separate within the burner itself
- Nozzle orifices are designed to mix fluids as they leave
- **Example: 4422, 5514, 6514 etc**



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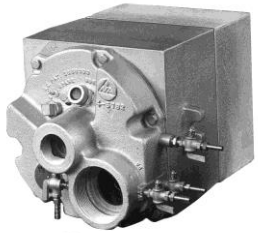
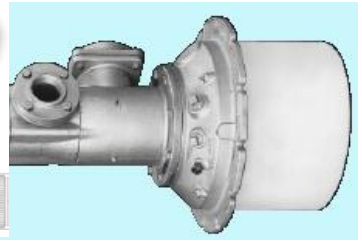
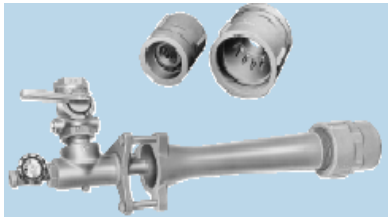
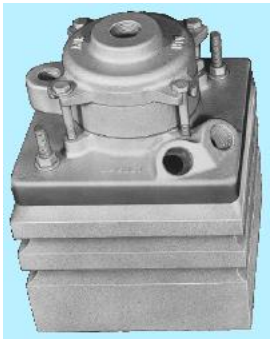
GAS BURNERS

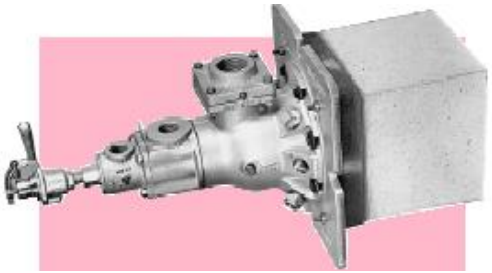


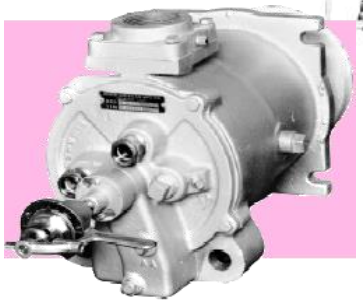




DUAL FUEL BURNERS






BURNER SELECTION

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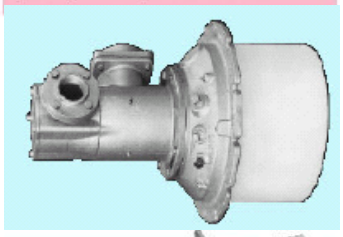
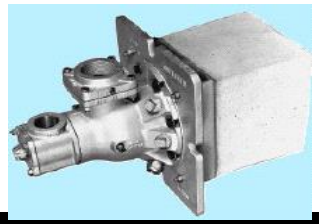
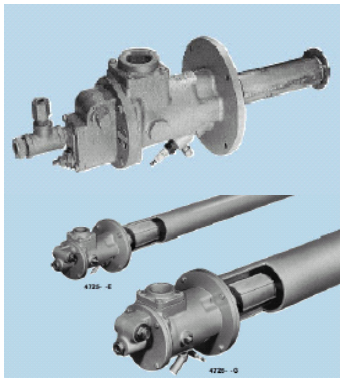
- Burner type should match heating process

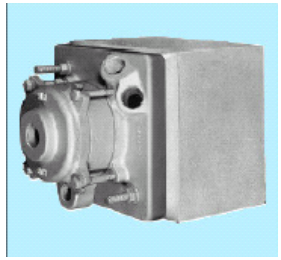


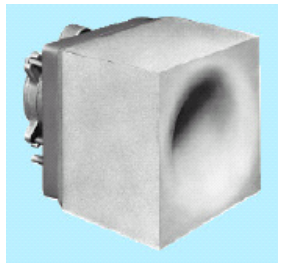


◀ Forward Flame Burners

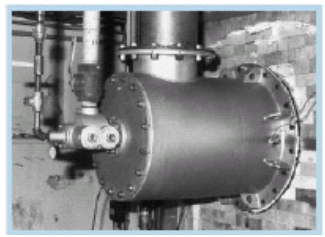


▲ Radiant Tube Burners





▲ Flat Flame Burners



▲ Magna Flame Burners

PURPOSE OF BURNER

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Primary Functions Of Burner

- Positioning the flame
- Maintaining flame stability
- Shaping the flame

Design Characteristics Of Burner

- Flame shape and length
- Combustion volume
- Flame stability
- Turn down ratio

FUNCTIONS OF COMBUSTION SYSTEMS

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A COMBUSTION SYSTEM NEEDS TO DO THE FOLLOWING

- **Initiate ignition** and maintain flame
- **Position and direct** flames at point of usage
- **Mix** fuel and air
- **Volatilize** liquid fuels
- **Proportion** air and fuel
- **Supply** air and fuel at required rates
- Perform all the above **safely**

FUNCTIONS OF COMBUSTION SYSTEMS

SELECTION OF COMBUSTION SYSTEMS

- Burner location should ensure **free travel of flame**
- Burner sizing with **best turndown**
- Burner sizing considering **air preheat temperature**

SELECTION OF BLOWER

- **Pressure and volume flow rate** should match requirement of burner
- Oversized blower may give rise to **pulsation**
- Blower should have **flat characteristic performance**
- **Inlet filters** to prevent unwanted depositions on impellers and consequent imbalances

INCREASING COMBUSTION EFFICIENCY

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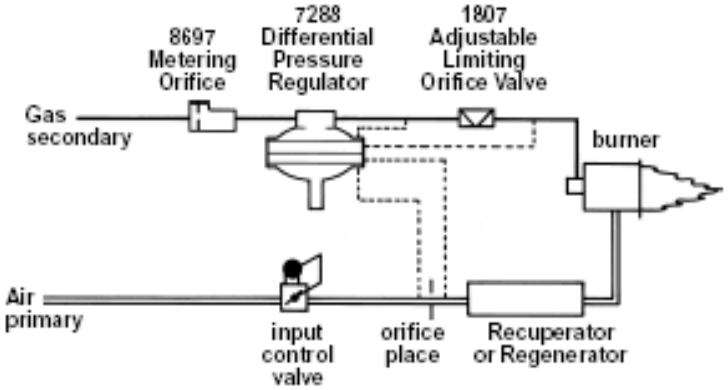
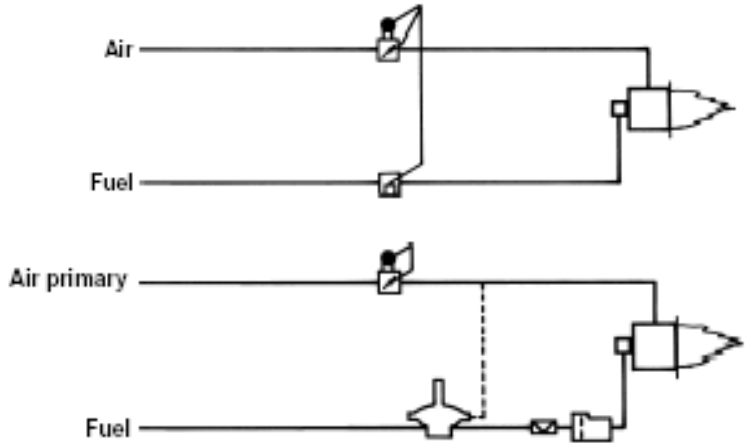
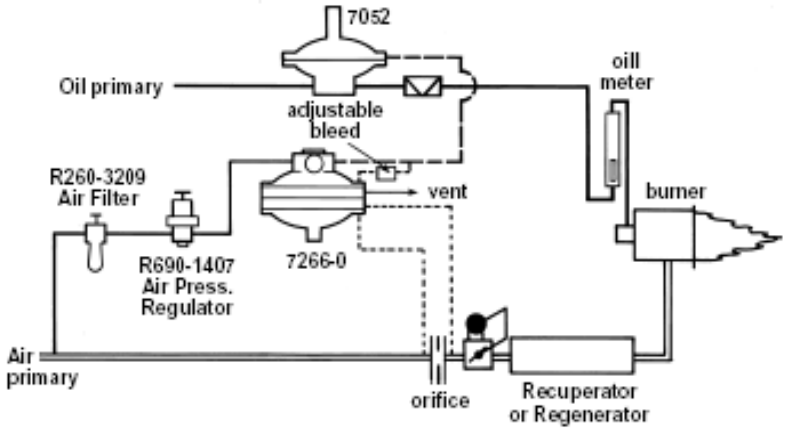
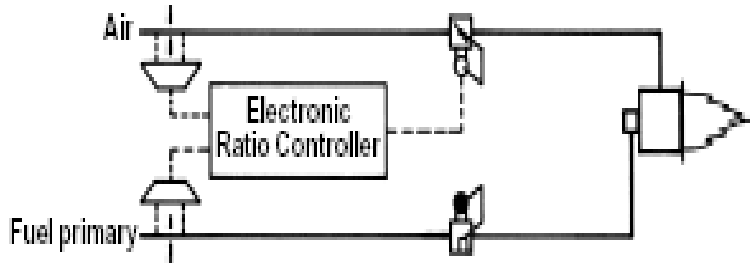
- Proper furnace design
- Maintaining proper air/fuel ratio









INCREASING COMBUSTION EFFICIENCY

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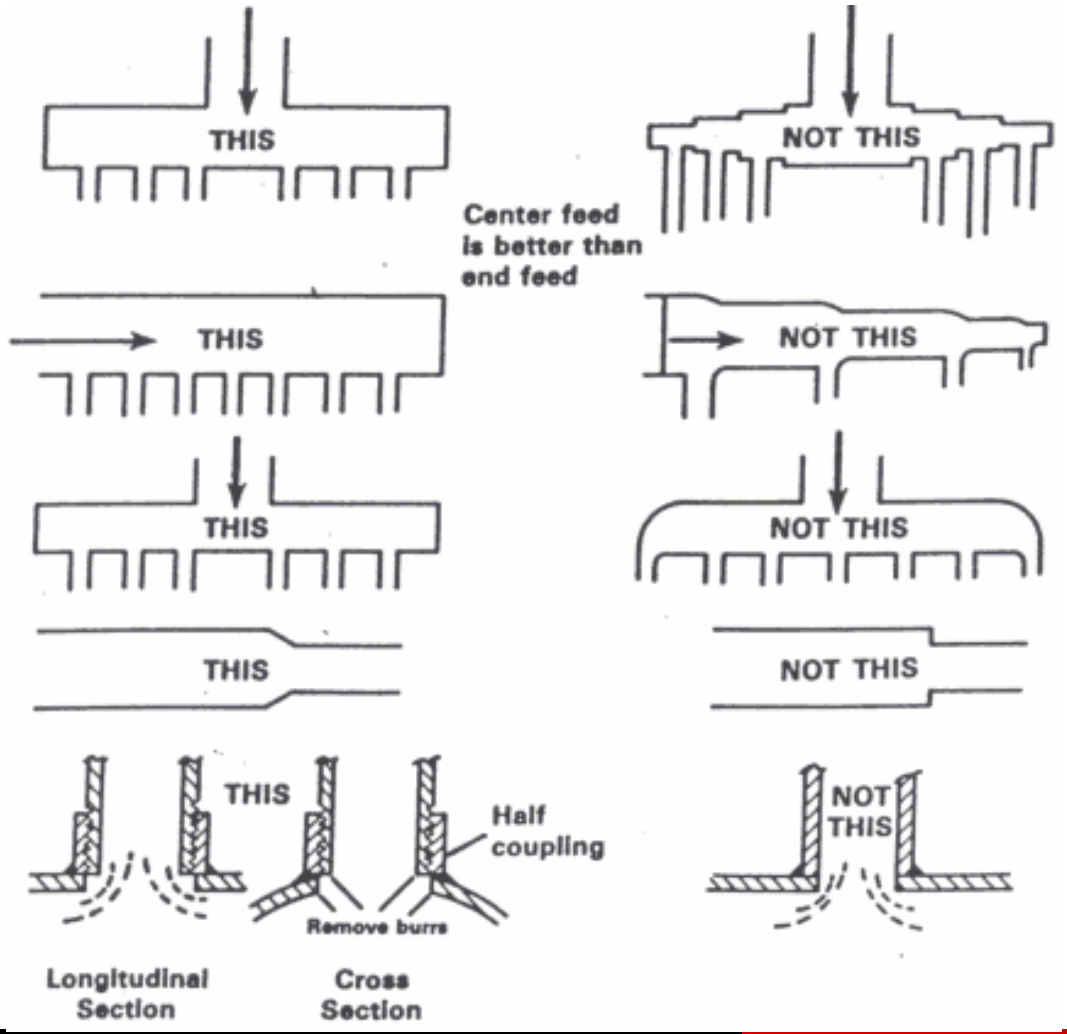
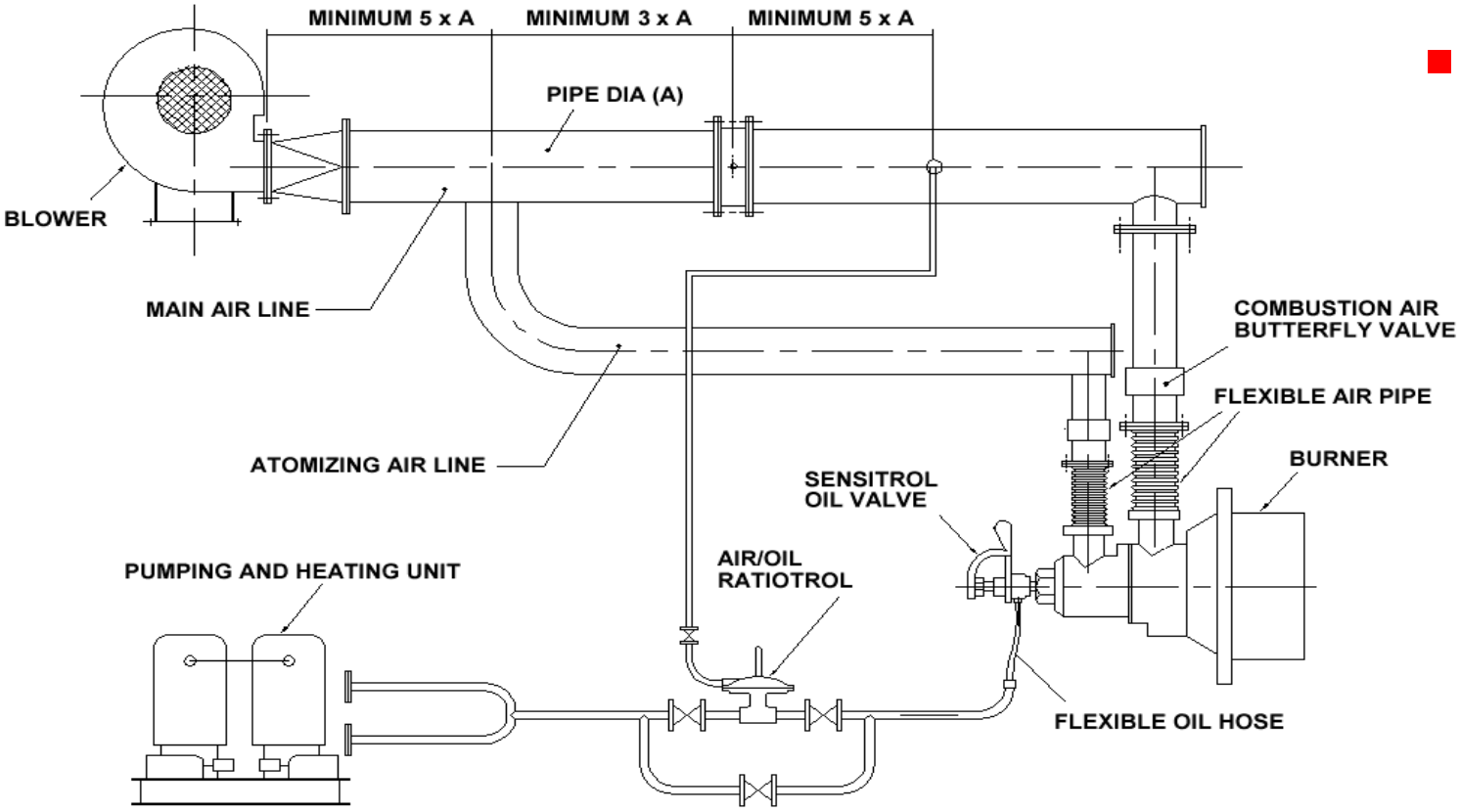
- Size of air pipe from blower should be as per manufacturer to ensure **exact flow at designed pressure**
- Size of air pipe from recuperator should be as per supplier. Preheated air pipe must be **bigger diameter** than cold air.
- Manifolds should be designed for **uniform flow distribution** and **minimum pressure loss**



DESIGN OF AIR DUCTING AND PIPING



- **Correct distances must be maintained** between blower and valves, and between valves and branching points.

INCREASING COMBUSTION EFFICIENCY

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- **Selection of proper oil preparation units**
  - Oil Pump capacity should match with consumption
  - Oil to be pumped to burner through a closed ring main
  - Oil pumps should be positive displacement type
  - Capacity of pump should be 2.5 to 3 times consumption
- **Black iron pipe to be used for oil piping**
  - GI pipe should not be used because of possibility of zinc flaking and sludge formation from reaction between the zinc and oil-borne sulphur
- **Two-stage heating pumping unit** in closed loop desirable

INCREASING COMBUSTION EFFICIENCY

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- Introduction of automatic temperature control
- Introduction of automatic furnace pressure control
- Use of recuperator or regenerator for waste heat recovery
- Proper maintenance of furnace linings
- Periodic packing of ceramic wool or fibers around burner tiles,
- Regular and Good maintenance of combustion equipment and instruments

MAINTENANCE OF DUAL-FUEL BURNERS

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- Periodic cleaning of burner oil nozzles
- Periodic cleaning of oil filters, blower filters and gas filters
- Stopping all fuel spillages and leakages
- Replacement of broken/worn out burner tiles
- Prompt replacement of worn out valves and instrumentation
- Periodic calibration of instrumentation
- Periodic checking and re-adjusting to preset values of air and fuel pressures at burners

COMBUSTION AIR BLOWERS

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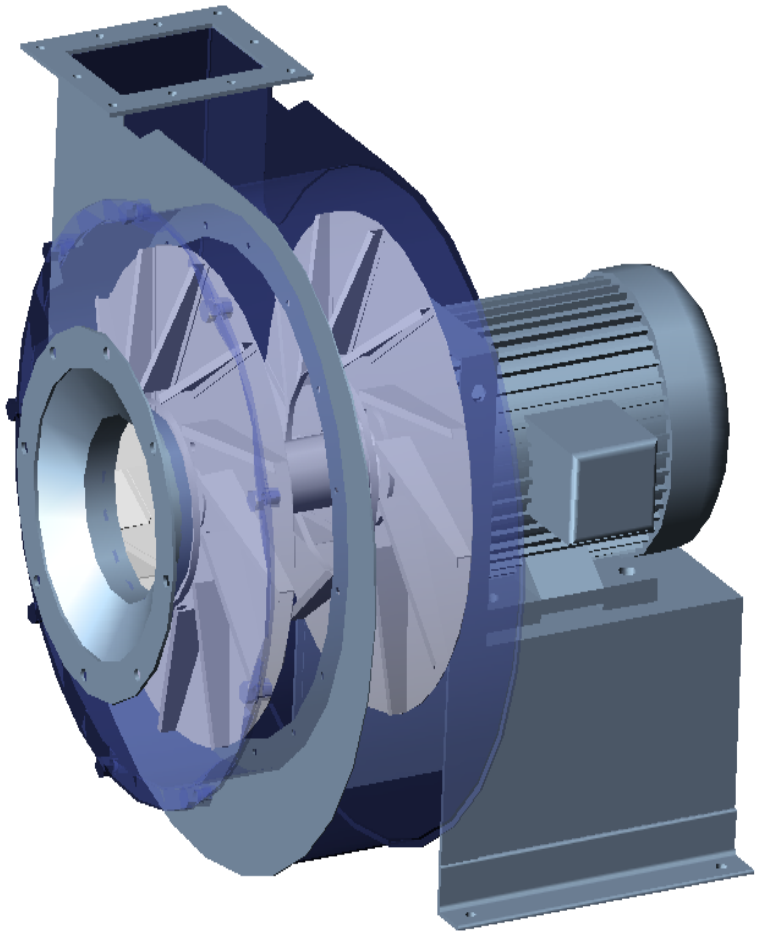
- **Flatline** combustion blowers deliver uniform pressure over range of air volumes

- Burners can operate over wide range of fuel throughput without compromising on pressure requirements

- Ensures optimum atomization, lower pollution, and of course higher profits from complete and more efficient combustion



COMBUSTION AIR BLOWERS

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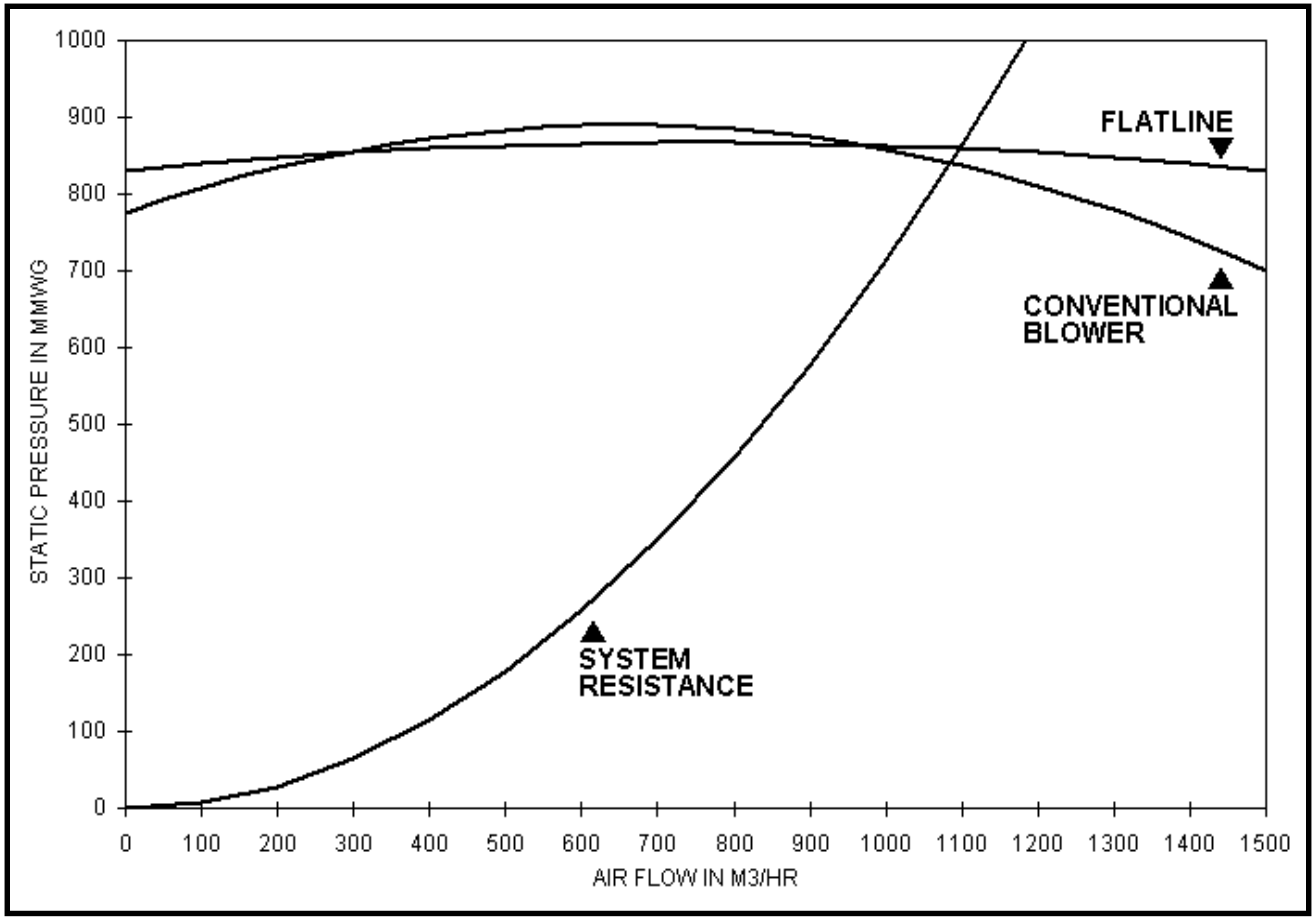
BLOWER PERFORMANCE



- Blower should have **flat line performance curve** to deliver air at constant pressure regardless of volume
- If some burners are turned on or off during operation, **air pressure to remaining burners** should not be affected

CONTROL VALVE TRAINS FOR GAS

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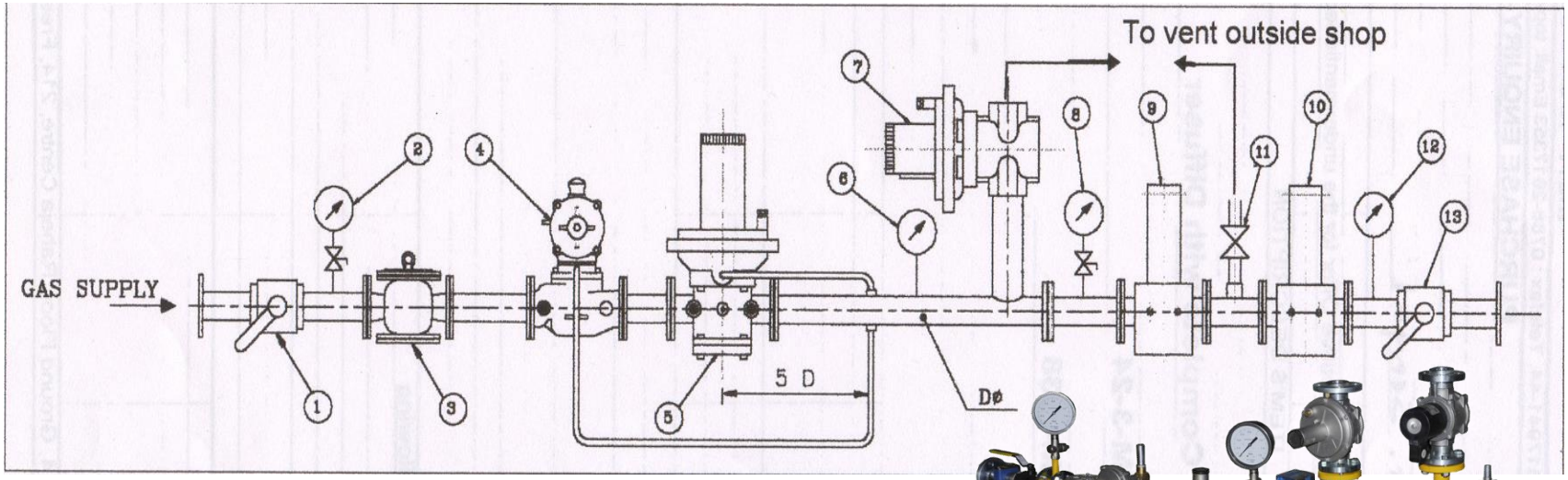

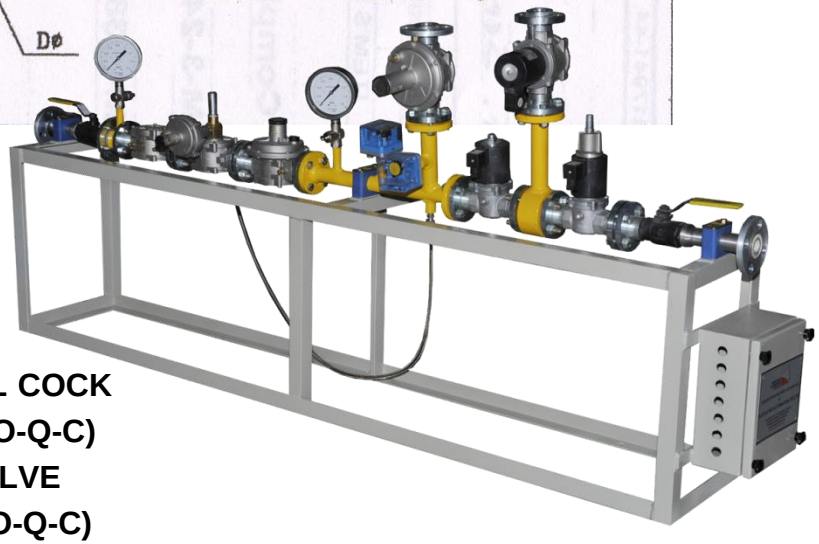

1	MANUAL SHUT-OFF VALVE	8	INLET PRESSURE GAUGE WITH MANUAL COCK
2	INLET PRESSURE GAUGE WITH MANUAL COCK	9	SOLENOID VALVE (Q-O-Q-C)
3	FILTER	10	MAGNETIC RELIEF VALVE
4	SLAM SHUT-OFF VALVE	11	SOLENOID VALVE (S-O-Q-C)
5	GOVERNER	12	HIGH PRESSURE SWITCH
6	LOW PRESSURE SWITCH	13	MANUAL SHUT OFF VALVE
7	SAFETY RELIEF VALVE		

OIL PREPARATION UNITS

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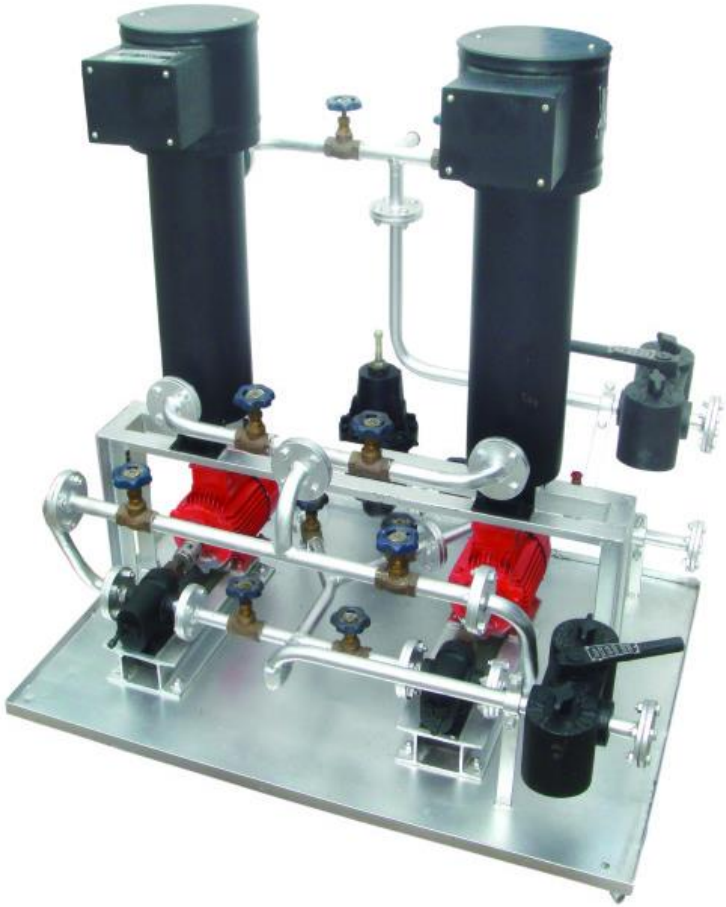
- Wesman Oil Pumping and Heating Units supply fuel oil at predetermined constant pressure and temperature

- SPH, DPH and DPDH models in 1/2”, 3/4”, and 1”

- Standard units used range from 1 kW to 75 kW

- Only pumping units are also available for light oil



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GAS ACCESSORIES

1807 LIMITING ORIFICE VALVE

Used for fine-tuning of gas flow to burner

8697 METERING ORIFICE VALVE

Used for measurement of gas flow in pipeline

7218 AIR-GAS RATIO REGULATOR

Regulates gas flow as per combustion air pressure

OIL ACCESSORIES

ERIES OIL SENSITROL OIL VALVE

Used for fine-tuning of Oil flow to burner

7052 SERIES AIR/OIL RATIOCONTROL VALVE

Regulates Oil Flow respect to combustion air pressure

ENERGY BALANCE IN A FURNACE

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The Energy Balance of an industrial furnace shows:

- **How much energy input was actually used** for the intended purpose i.e. to heat the charge
- **How much energy is lost**. This wasted heat will represent the energy saving that is theoretically possible
- **How the heat loss occurs**. Some heat will be lost to the surrounding through furnace wall, openings etc. The majority of the heat will be lost through the stack as the flue loss

ENERGY BALANCE IN A FURNACE

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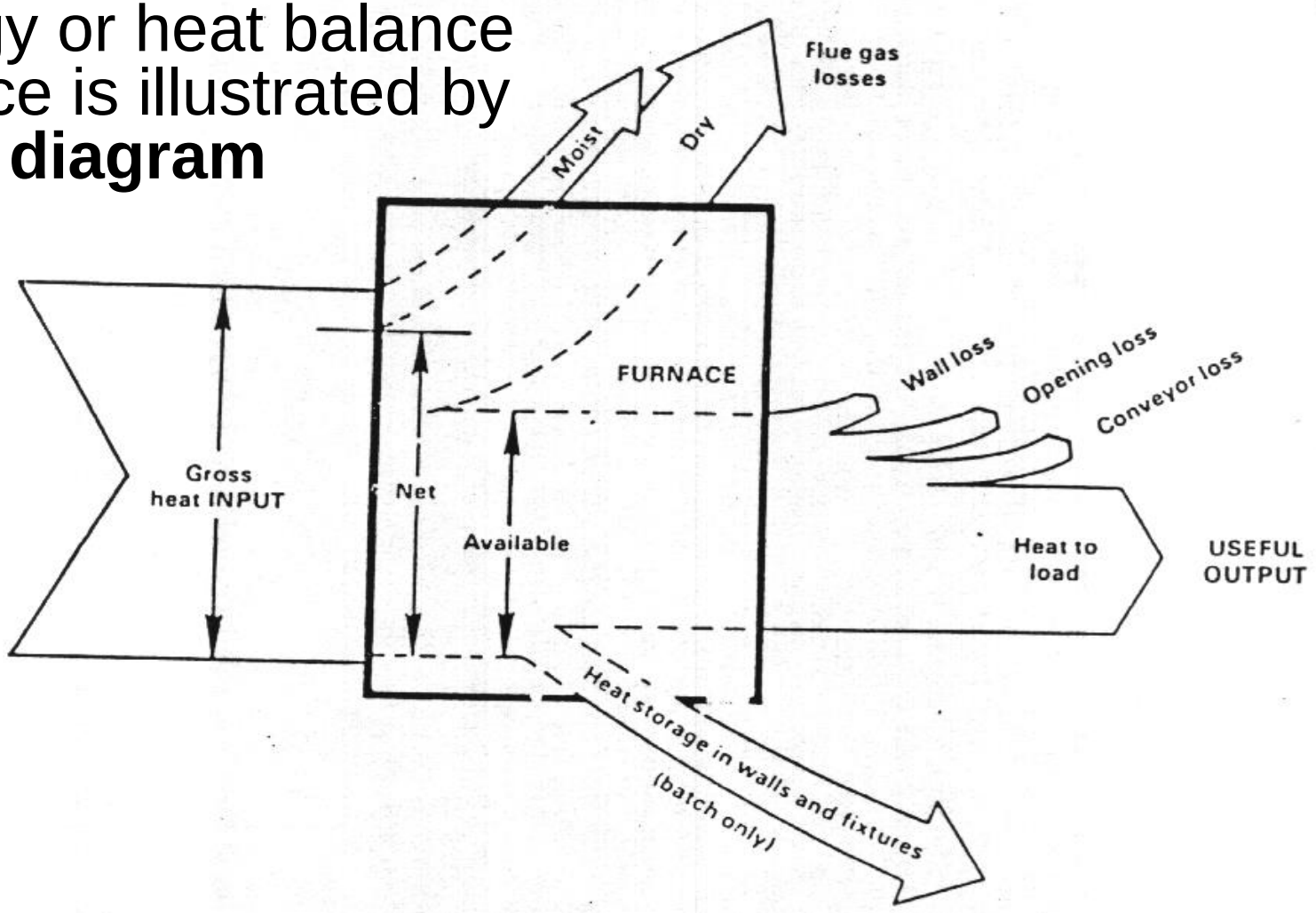
- The energy or heat balance of a furnace is illustrated by a **Sankey diagram**



WASTE HEAT RECOVERY FROM FLUE

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- The single largest source of heat loss in an industrial furnace is the **flue gas loss**
- **Flue loss** = Sensible heat that is carried away by **dry flue gas** (dry flue gas loss) + sensible and latent heat carried away by **water vapor** (moisture loss)
- **Available heat** = gross heat input - flue losses
- To improve thermal efficiency of a furnace waste heat in flue gases **should be recovered to maximum possible extent**

ILLUSTRATION OF EFFICIENCY

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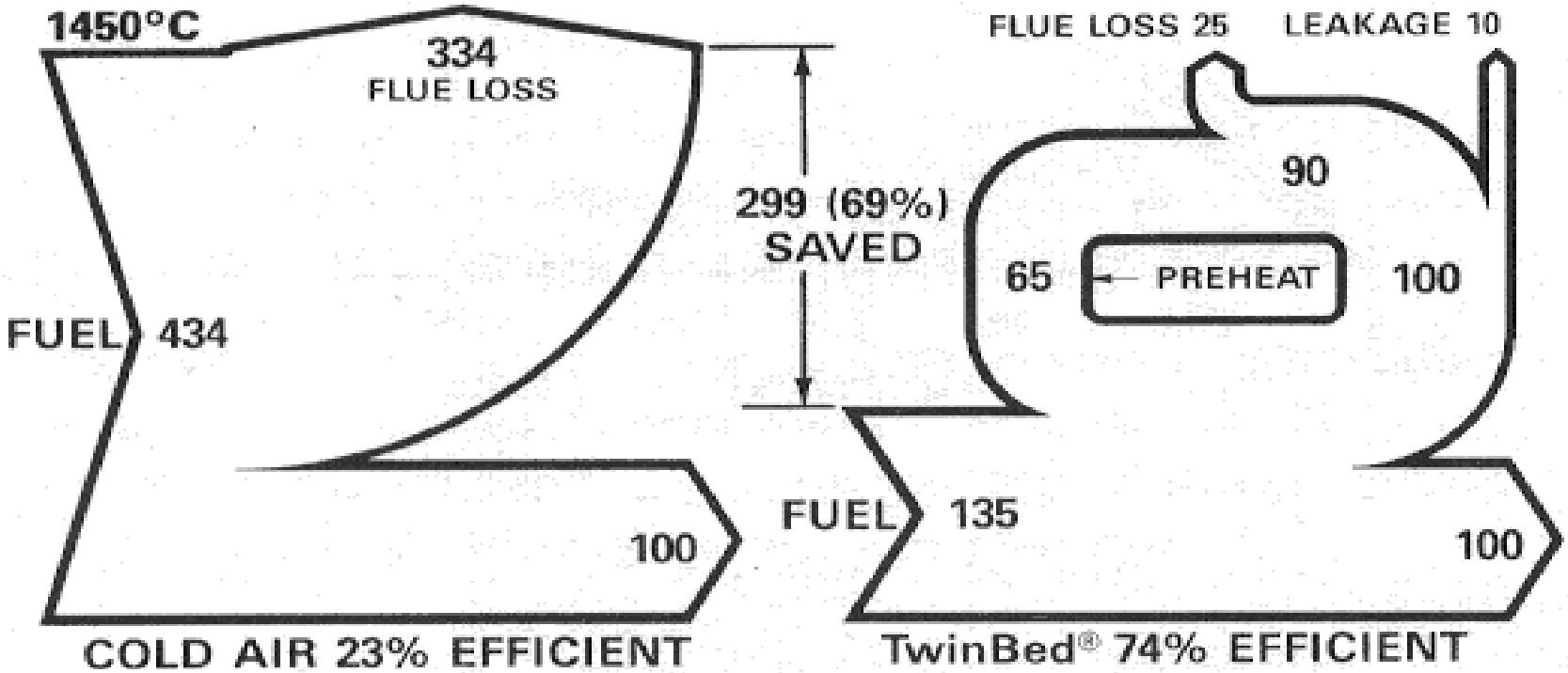
FLUE LOSS



RECLAMATION

INCREASING COMBUSTION EFFICIENCY

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- Preheating of combustion air is the most efficient recovery method

- This can be accomplished by using
  - Metallic recuperators
  - Ceramic recuperators
  - Regenerators

Inter Changeability of Fuels :

During the Interchangeability of Fuel following aspects are important.

- Equal Heat Input Rate
- Fluid Handling Capability of flues, burners & Control systems
- Burner Stability
- Heat release pattern
- Furnace atmosphere.

FURNACE INSTALLATION

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BHPV, VISHAKHAPATNAM ■
100 MT CAR BOTTOM FURNACE
FOR STRESS RELIEVING
OF PRESSURE VESSELS

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Bogie Hearth Furnace

FURNACE INSTALLATION

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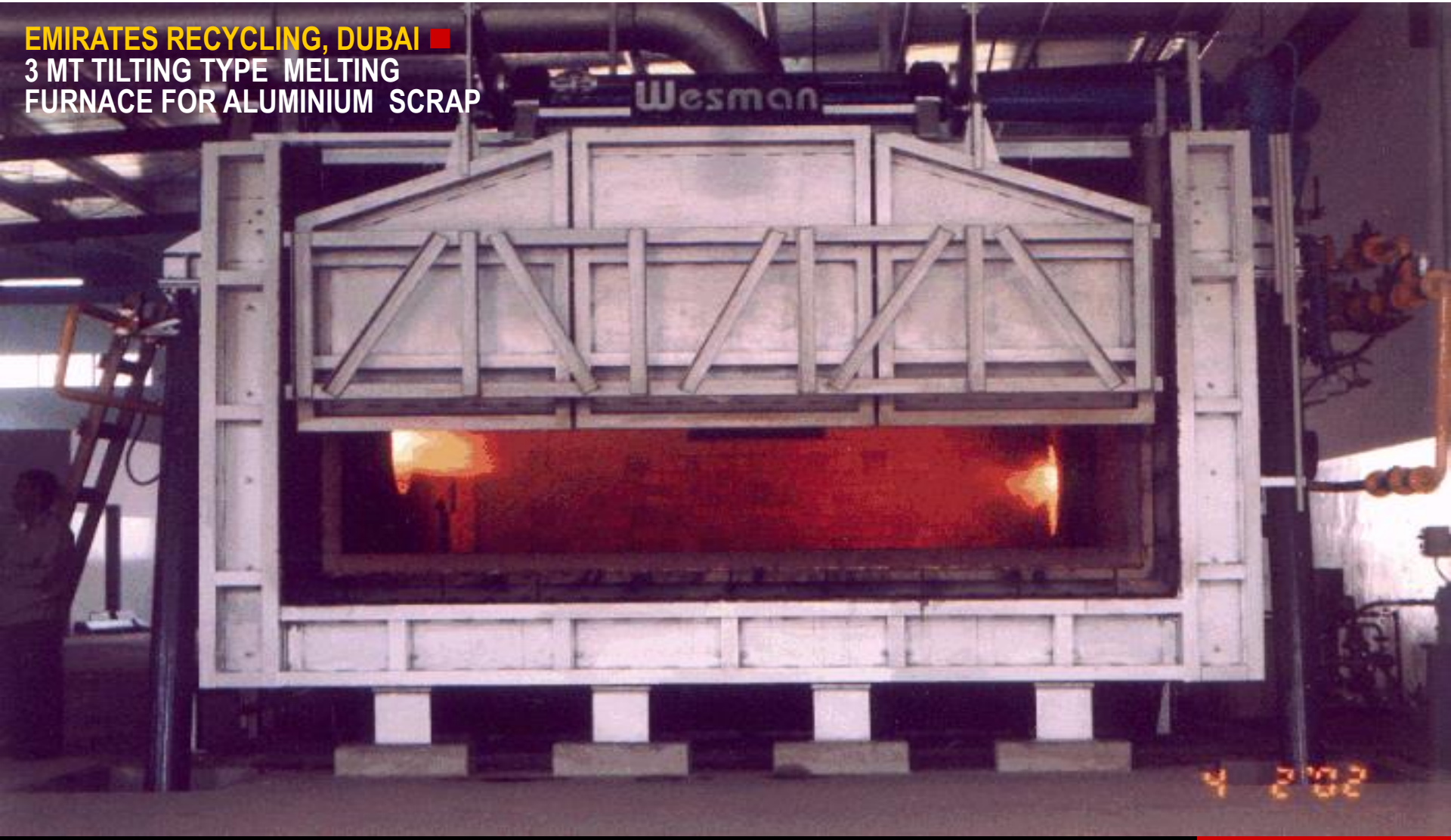

EMIRATES RECYCLING, DUBAI
3 MT TILTING TYPE MELTING FURNACE FOR ALUMINIUM SCRAP

FURNACE INSTALLATION

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Mackeil Ispat and Forging Ltd, Durgapur

- **Car bottom furnace for steel shaft hardening fired with CBM gas**

FURNACE INSTALLATION

WESMAN THERMAL

Mackeil Ispat and Forging Ltd, Durgapur

- **Car bottom furnace for steel shaft hardening fired with CBM gas**

EXAMPLE: INCORRECT AIR-FUEL RATIO

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GBC / GBS – Installation examples

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Bell type furnace

FURNACE INSTALLATION

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SE FORGE, VADODARA
30 MTPH ROTARY HEARTH FURNACE WITH 13 METRE EXTERNAL DIA

FURNACE INSTALLATION

WESMAN THERMAL

NHK SPRINGS, GURGAON
WALKING BEAM FURNACE
FOR CONTINUOUS
SPRING HEAT TREATMENT

FURNACE INSTALLATION

WESMAN THERMAL

ALUMTEK, IRAN

GAS FIRED CAR BOTTOM ALUMINIUM BILLET HOMOGENIZING FURNACE WITH COOLING ARRANGEMENT

FURNACE INSTALLATION

WESMAN THERMAL

KALU WORKS, MOMBASA, KENYA ■
REGENERATIVE BURNERS MODIFIED TO FIRE FURNACE OIL FITTED TO 25 MT ALUMINIUM MELTING FCE

WESMAN

THANK YOU FOR YOUR KIND ATTENTION