



Sustainable Solution
Provider in Energy &
Environment
welcomes you to
National Workshop on
Operation & Maintenance
NPC,VIZAG

Boiler Maintenance & Safeties

Boiler Maintenance

What is the need to maintain a boiler?

How do we maintain a boiler?

The Need:

- 1.To ensure 100% safe to operate the boiler.
 - 2.To ensure 100% availability for the Production Requirement.
 - 3.To ensure the boiler runs at its Best efficiency.
 - 4.To ensure the operation to be cost effective.
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How do we maintain a boiler?



How.....

Requirements

1. Corrects Inputs

- a. Quality of Water-Feed water & Boiler Water
- b. Quality of Fuel
- c. Input Voltage

2. Quality of Combustion

3. Operation

- a. Right Manpower (Certified Operator)
- b. Good Engineering Practices-Regular Servicing, Log book etc.

Feed Water Quality

BFW NORMS AS PER IS 10392-1982.

Parameter	0-20 (kg/cm²)	20-40 (kg/cm²)	Purpose
pH	8.5-9.5	8.5-9.5	Corrosion Control
Oxygen	ND	ND	Pitting Control
Total Hardness	<10	ND	Scaling Control
Organics	ND	ND	Foam Control

Boiler Water Quality

BOILER WATER NORMS AS PER IS 10392-1982

Parameter	0-20 (kg/cm ²)	20-40 (kg/cm ²)	Purpose
pH	11-12	11-12	Corrosion
Total Hardness	ND	ND	Scale
Total Alkalinity (20% of TDS)	700	400	Foam
Phenolphthalin Alkalinity (10% of TDS)	350	200	Foam
Silica (40% Caustic Alkaly)	140	80	Scale
TDS	3500	2000	Corrosion
Phosphates	20-40	10-30	Corrosion
Sulphite	30-50	20-40	Oxygen
Hydrazine	0.1	0.1-0.5	Oxygen

Effects of Bad water Quality



**Heavy scales formed in
Water tubes in a water tube Boiler.**

**Caused due to very high
Hardness**

**Leads to damage of the
tubes**

Effects of Bad water Quality



Dosing System



➤ It is a requirement to maintain the Feed water qualities, mainly to take care of the following.

a. Oxygen Scavenger.

b. pH Booster

c. Corrosion Inhibitor (Antiscalant)

Different Kinds of Fuels



Solid Fuels:

Husk, coal, Wood, Groundnutshell, Bagasse, Briquettes, De oiled Cake etc.

Liquid Fuels:

Furnace Oil, LDO, HSD, LSHS etc

Gaseous Fuels:

Natural Gas, Bio gas, Hydrogen Gas etc.

Fuel Major Properties



1. Calorific Value
 2. Moisture
 3. Sulphur
 4. Ash content
 5. Free of unwanted solid impurities
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Typical Composition of Fuel



Fuels	C	H2	S	N	O2	H2O	ASH	NCV
Husk	36.14	3.7	0.08	0.46	29.34	8.92	19.4	3100
Coal	44.03	3.1	0.32	0.82	4.77	3.84	43.13	3800
wood	45.6	3.96	0.07	0.45	37.45	9.33	3.14	4400
Furnace Oil	84	11	3.5	-	-	1	0.5	9650
HSD	85.5	14	0.5	-	-	-	-	10500
Natural Gas	66	23	-	-	-	1.5	-	8850

Combustion



3 T's of Combustion

1. Time-Residence time of the fuel to burn.
2. Temperature-The Fuel needs to be fired at the right temperature.
3. Turbulence-For the better mixing & Combustion.

Indicators of Good Combustion

1. O₂ level will be 3-4 %
 2. CO₂ will be 12-13%
 3. Flue gas temperature-180 to 230DegC (Desirable)
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To Achieve the 3T's of Combustion

Solid Fuel:

1. Fuel Size.
2. Bed Particle size (For FBC)
3. Proportionate Combustion Air.
4. Furnace pressure. (-2 to -5mm of Water Column)
5. Furnace Temperature.
6. Secondary Air for the Volatiles.

Liquid & Gas Fuel:

1. Free of Impurities. (Proper Filtration system)
 2. Fuel temperature (Oil)
 3. Fuel Pressure (Oil)
 4. Proper Atomisation of the fuel (Pressure Jet, SAB, Rotary Cup-Oil)
 5. Proportionate Combustion Air.
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Efficiencies

1. Combustion Efficiency-It is the efficiency of the Burner/Furnace to burn the fuel effectively.
2. Thermal Efficiency-It is efficiency of the heat transfer in the Boiler.
3. Overall System Efficiency-It is the system efficiency of the boiler (which will be equal to the Fuel to Steam Ratio).

For every 1% of increase in Efficiency will save more than 1% of the Fuel Quantity.

On commercial side, for a 5TPH FBC boiler, will have a savings of app Rs.3.6L per year.

(Considering Husk@Rs.3000/Ton with GCV of 3100Kcal/Kg)

Safeties in Boiler



1.Mechanical Safety (Solid,Oil,Gas)

- a.Safety Valve
- b.Fusible Plug.
- c.Explosion Proof Door

2.Electrical Safety

Electrical Safeties	Oil	Gas	Solid
Low Water Level	YES	YES	YES
Flame Failue	YES	YES	NO
Boiler Steam Pressure High	YES	YES	YES
Combustion Air pressure Low	YES	YES	NO
Flue gas temperature High	YES	YES	YES
Fuel oil Temperature Low	YES	NO	NO
Inlet Gas Pressure High	NO	YES	NO
VPS(Valve Proving System)	NO	YES	NO
Furnace Temperature High	NO	NO	YES
Furnace Pressure High	NO	NO	YES

Good Engineering Practice



1. Qualified / Certified Operator.
 2. Maintenance.
 3. Data Management-History Card, Logbook etc
 4. House keeping.
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MAINTENANCE OF OIL FIRED BOILERS

Daily Maintenance



1. Check feed water quality.
 2. Give blow down at regular intervals (approx. twice in a shift).
 3. Blow down the Mobrey level switch and gauge glass.
 4. Clean the gauge glass externally.
 5. Clean the fuel filters and strainers.
 6. Drain slightly the oil line bucket filter.
 7. Nozzle cleaning.
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Weekly Maintenance



1. Check the working of low level & extra low level alarm by reducing the water level.
 2. Ensure proper lubrication of all moving parts.
 3. Clean the flame sensor and viewing glass.
 4. Check the conditions of door seals.
 5. Check that there are no variations in the fuel pressure as compared with that at commissioning time.
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Monthly Maintenance



1. Clean electrical contacts of all relays and tighten loose connections if any. Rough emery paper should not be used for cleaning contacts.
 2. Check water pump gaskets and non-return valve.
 3. Lubricate the modulation motor linkages.
 4. Clean the burner nozzle and ignition electrodes.
 5. Check and clean, if necessary, the furnace.
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Quarterly Maintenance



- 1.Clean blower fan blades.
 - 2.Drain and clean water service / deaerator tank and fill it with soft / DM water.
 - 3.Clean the fuel filters / strainers.
 - 4.Drain and clean fuel service tank.
 - 5.Open and clean out doors of boiler and super heater. Remove collected soot deposits.
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Half Yearly Maintenance



1. Check all valves for leakage; lap them if found leaking.
2. Lubricate bearings of water pumps.
3. Check the sealing of Manhole head holes, and clean out door of smoke box.
4. Clean the inner and outer face of the sight glass.

NOTE : Under no circumstances should a door be left with gas leak around the seal as this would damage the door.

Yearly Maintenance



1. Clean the smoke tubes with the help of wire brush.
 2. Clean the combustion chamber of boiler and, super heater. However quality of fuel and burner efficiency will determine the frequency of cleaning this.
 3. Lubricate the motors. Burner should be over hauled at least once a year & regulated to ensure perfect combustion.
 4. Check the door refractory for any damage. Repair as necessary.
 5. Clean the water side of the boiler thoroughly. De-scaling, if required, should be carried out as given in the section on “De-scaling”.
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Maintenance of Oil fired Boiler



- 1.Modulation assembly and damper servicing.
 - 2.Burner assembly, nozzle & flame sensor cleaning.
 - 3.Fuel pumps alignment.
 - 4.FO day tank and feed water tank cleaning.
 - 5.All fuel & water line filters and strainers cleaning.
 - 6.Monitoring O2% & CO2%.
 - 7.All safety interlocks checking.
 - 8.Cleaning of Fire tubes.
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MAINTENANCE OF SOLID FUEL FIRED BOILERS

Daily Maintenance



1. Check softness of water by carrying out Q-test as described in Operation section of manual.
 2. Give blow down at regular intervals depending on the feed water analysis.
 3. Blow down the Mobrey Level Switch.
 4. Blow down the gauge glasses.
 5. Check fly ash and ensure timely ash removal.
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Weekly Maintenance



1. Regenerate water softener, more than once a week, if found necessary, depending on the quality of raw water. In some cases, even daily regeneration may be necessary.
 2. Check the working of feed water pre-heater/deaerator tank, if provided.
 3. Ensure that the gauge glasses are clean from inside and outside so that the water level is clearly visible in the gauge glasses.
 4. Check the working of Mobrey Level Switch. Ensure that the minimum and maximum water levels are properly controlled.
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Weekly Maintenance

1. Check the working of Low water cut off switch mounted on the boiler. Open the boiler blow down valve. When the water level reaches approximate 20 mm in the gauge glass, there should be an audio-visual alarm.
 2. Check the working of safety valves. Close the main steam stop valve and other valves of the boiler and allows the steam pressure to increase. The safety valves should open at the set pressure and the steam pressure on the boiler should drop on opening of the safety valves.
 3. Check, if necessary and tighten all the foundation bolts
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Monthly Maintenance



1. Drain the soft water service tank. Clean it from inside and refill it with soft water.
 2. Tighten stuffing box of water pump, if necessary.
 3. Clean silver contacts of relays with carbon tetra chloride or with paper, if required. Rough emery paper should never be used.
 4. Tighten screws connecting wires to terminal strips, various relays, motors, controls, etc.
 5. Ease the steam safety valves and reset.
 6. Check and replace oil in gear boxes.
 7. Check the condition of grate bars and replace damaged ones if any.
 8. Clean the Fire tubes.
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Quarterly Maintenance



- 1.Drain and clean the feed water storage tank.
 - 2.Clean the ID and FD fan blades.
 - 3.Lubricate the bearings of water pump, ID and FD fans.
 - 4.Check Fuel Size as per Boiler requirement
 - 5.Check Fuel feeding system
 - 6.Check Sand/Bed Material Size (FBC)
 - 7.Check the condition of the bed air nozzles for over heating (FBC).
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Half yearly Maintenance



1. Check the condition of refractory wall of the combustion chamber.
 2. Check all valves for leakage and lap them, if necessary, with lapping paste.
 3. Check the ducts and other joints for infiltration of fresh air.
 4. Check the quantity of resin inside the water softener and top it up, if necessary. (Reason for loss of resin is the carry-over of resin with back wash water hence due care should be taken while backwashes).
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Yearly Maintenance



1. Check and repair the insulation lining of boiler, if required.
 2. Clean various tanks and paint them.
 3. Clean inside of the flue gas outlet.
 4. Grease electric motors.
 5. Check the membrane panel, its headers and tubes from outside for cleanliness and clean if necessary.
 6. Check the boiler tubes for cleanliness from inside and de-scale if required. Descaling to be done chemically.
 7. Carry out hydraulic test.
 8. Check the condition of impellers and replace them if necessary.
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FLUE GAS CIRCUIT



- 1.Cleaning of tube internal in Flue Gas Side with wire brush
 - 2.Cleaning of Pressure Part in the water side by De scaling.
 - 3.Check All Rotary equipment's like Blower, Fans For Vibration/Erosion/Balancing
 - 4.Check Air / Flue Gas Duct leakages and arrest the leakages if any
 - 5.Furnace Refractory visual check & Flame test to identify refractory leaks.
 - 6.Check all Rotary Air Lock Valves (RAV) for Air ingress. Blade wear out
 - 7.Check Air Pre-heater Tubes for leaks & Chocking
 - 8.Check Dust Collector internals like vanes, tubes for any erosion
 - 9.Check Water Pre Heater for leaks & chocking
 - 10.Check Grate bars /Bed Nozzle for damages
 - 11.Check fire doors for damages
 - 12.Check Smoke tube Spiral & sleeve condition.
 - 13.Check ID fan impeller for erosion
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Data Management



1. Log Book
 2. History Card
 3. Spares Inventory.
 4. Calibration Data of Instruments.
 5. Fuel Analysis Reports.
 6. Water Analysis Reports.
 7. Maintenance Records.
 8. IBR Certificates.
 9. Boiler Drawings
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SPECIAL SERVICES PROVIDED BY THERMAX FOR BOILERS & HEATERS



1.DIAGNOTHERM

2.RLA (Remaining Life Assessment)

3.SERVICE PLUS (Annual Service Contracts)

4.SMART SERVE

DIAGNOTHERM



- 1.It is a comprehensive health check up study for boilers & heaters which are in operation for longer duration & needs expertise advice for safe & healthy operation.
 - 2.In depth log book study for 3- 6 month operation of equipment.
 - 3.Detailed check of safeties & interlocks
 - 4.Efficiency check of the equipment as applicable.
 - 5.Find out improvement areas which can either make operation safe or help improve fuel efficiency
 - 6.Detailed report with recommendation
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RLA (Remaining Life Assessment)



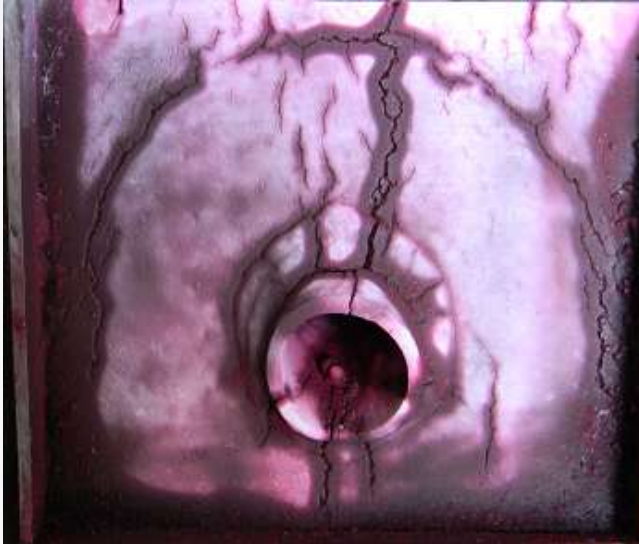
- ▶ It is detailed scientific study for assessing the existing condition & life of a boiler / heater & hence confirming its safe operation in future.
 - ▶ Also Life Extension Program of an equipment as it follows a scientific procedure to identify any flaws developed in an equipment & suggesting the remedies for the same.
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Methodology of RLA



- 1.Destructive & Non Destructive Tests.
 - 2.Metallurgical Tests.
 - 3.Review of Operational parameters.
 - 4.Review of Water treatment records.
 - 5.Final assessment.
 - 6.Suggestions for Repairs/revamp / replacement & redesign for safe operation of equipment's as well as for efficiency enhancement.
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Snapshots of the activity



Dye Penetration test

Snapshots of the activity



Ultrasonic Flaw Detection

Snapshots of the activity



THICKNESS MEASUREMENT

Snapshots of the activity



Hardness Testing

Snapshots of the activity



Magnetic Particle Inspection

Snapshots of the activity



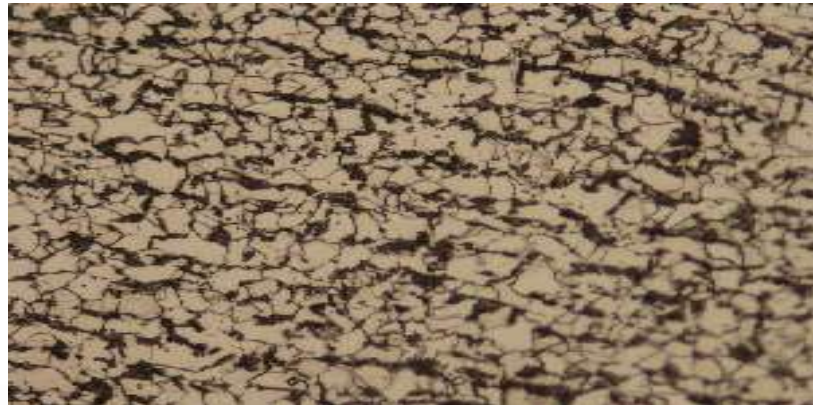
In-situ Metallography

Snapshots of the activity

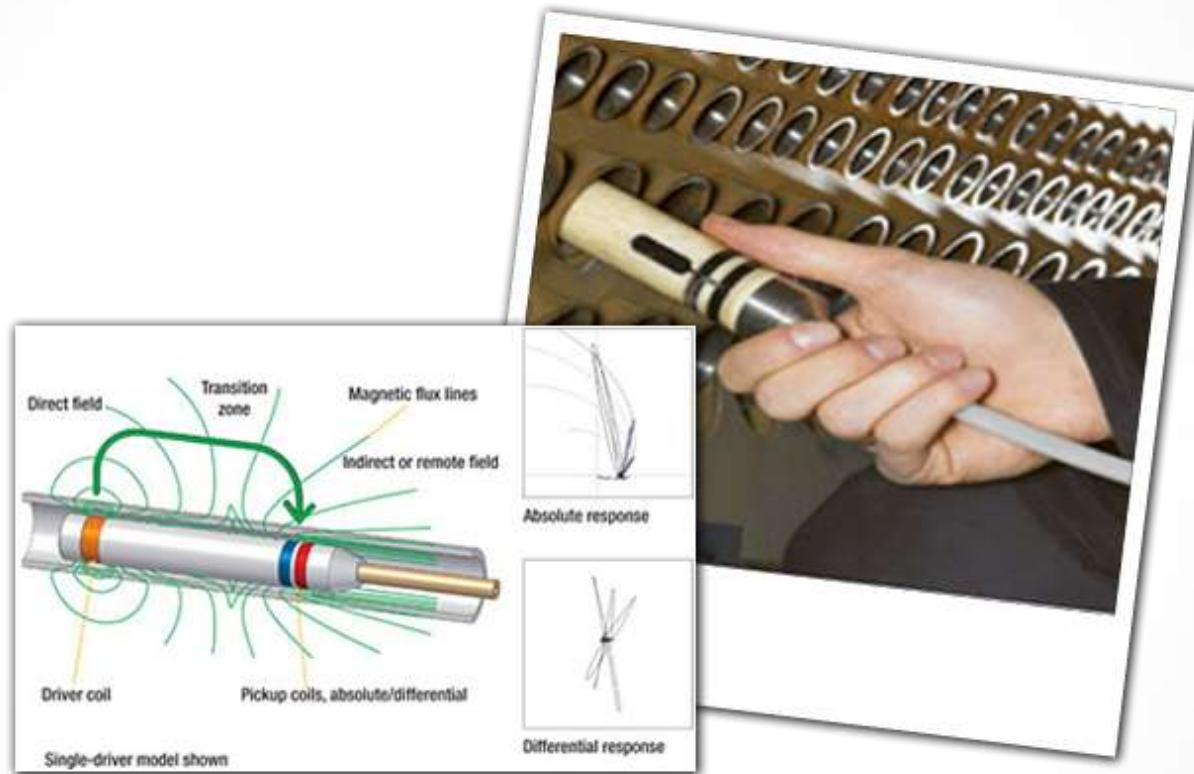


METALLOGRAPHY-

1. Metallography of materials is useful in predicting the internal degradation of material affecting its properties.
2. The tool determines abuse of overheating & damage received ,



Snapshots of the activity



Remote Field Electromagnetic Test

BENEFITS OF RLA



- 1.Extends the safe life of unit & gives confidence to the user for safe usage of boilers.
 - 2.Refreshes & renovates the boiler to ensure minimum interruption to process.
 - 3.Develops program for planned replacement of boiler parts & minimize production loss.
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We offer our services for ...



- 1.Small & Medium, Shell & Coil type IBR / Non IBR boilers – Capacity 50 Kg/hr to 30000 Kg/ hr.
 - 2.Thermic fluid Heaters – 0.01 to 20 MKcal / hr
 - 3.Pressure Vessels
 - 4.Economizers & Super heaters
 - 5.Pipelines
 - 6.Heat Exchangers
-

Who does the Life Assessment / Condition Assessment



1. Qualified & Competent team driven by competent and experienced Metallurgist with vast exposure to Indian/International Boiler & Heater field.

2. Certified Level 2/3 technicians/Inspectors to carry out/supervise NDT Tests -

- Dye Penetrant Test
 - Magnetic Particle Inspection
 - In situ Metallography
 - Ultrasonic Thickness measurement
 - Corrosion Assessment
 - Boroscopic inspection
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SERVICE PLUS (Annual Service Contracts)



1.It is a special service package offered by ***Thermax*** for up time of utility equipment's such as boilers / heaters to get the consistent output at desired efficiency.

2.It is a flexible package & offers various services based on the type & capacity of equipment, automation, combustion system, etc installed on the equipment.

BENEFITS FOR SERVICE PLUS



- 1.It consists of Preventive maintenance visits & Overhauling visits to guide on healthy and safe operation of the Unit.
 - 2.Flue gas analysis for O₂, CO₂ & CO contents and Excess Air.
 - 3.Performance load trail.
 - 4.Efficiency Trial Reports as per BS 845 Part I.
- Suggestions for efficiency improvements.
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SMART SERVE



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- 1.Highly experience service when needed
 - 2.Assist in restarting old equipment
 - 3.Specialized services to ensure your boiler & heater get professional service hands & you want quality services .
 - 4.When your boiler / heater has major breakdown & you don't know how to repair / rectify the problem.
Want to find the root cause of failure through FTA & take corrective action.
 - 5.Fuel conversion jobs & re commissioning.
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**WITH BEST COMPLIMENTS
FROM**

THANK YOU