We Make Steam
High Efficiency Oil and Gas Fired Packaged Boilers
We Make Steam

Steam is the major source of thermal energy for process industry. Steam accounts for 5% to 40% of total processing cost based on the type of industry segment.

Our combined knowledge in combustion and steam engineering helps us build solutions for the complete steam system, beyond boilers.

For over 70 years, we have partnered Industry in providing solutions in steam generation, control instrumentation, energy conservation and environmental monitoring. Our teams of the finest engineers are dedicated to serve process industry across diverse sectors. World class manufacturing facilities and technology enables us to deliver quality solutions globally.

Our unique complimentary expertise in steam engineering and process control enables us to engineer customised systems that improve manufacturing processes, conserve energy and are environmentally sustainable.

Fuel cost forms a significant proportion of the cost of steam. Selection of the right boiler ensures high uptime with lowest cost of ownership.

### Energy Saving Potential in the Boiler House

- **Improving feedwater tank management 10%**
- **Improving thermal efficiency 8%**
- **Improving operation and maintenance practices 5%**
- **Improving combustion efficiency 10%**
- **Turndown 4%**
- **Excess Air 6%**
- **Insulation 4%**
- **Stack Temperature 4%**

### Cost of Ownership

- **Capital cost 30%**
- **Water cost 5%**
- **Maintenance cost 10%**
- **Electricity cost 15%**
- **Fuel Cost 40%**

### Gaps Between Rated and Indirect Efficiency

- **Gas Fired Boiler**
  - Direct: 83%
  - Indirect: 85%
  - Rated: 95%
- **Oil Fired Boiler**
  - Direct: 78%
  - Indirect: 85%
  - Rated: 92%
The Steam and Condensate Loop

**Product Key**

**Steam Generation**
- Oil fired boiler
- Chimney

**Heat Recovery Solutions**
- Heat recovery systems

**Steam Distribution**
- Forbes Marshall Moisture Separator
- Forbes Marshall Cast Strainers
- Piston Valves
- Forbes Marshall Air Vent
- Forbes Marshall Disk Check Valves
- Forbes Marshall Pipeline Conector
- Forbes Marshall Universal Thermodynamic Trap
- Forbes Marshall Universal Inverted Bucket Trap
- Compact Module Thermodynamic Trap
- Forbes Marshall Air Eliminators
- Clean Steam Safety Valve
- Clean Steam Moisture Separator
- Ball Valves
- Forbes Marshall Safety Relief Valve
- Desuperheater
- Forbes Marshall Pressure Gauges
- Forbes Marshall Temperature Gauge

**Process Control Efficiency**
- Single Orifice Float Trap
- Compact Module Two Orifice Float Trap
- Sample Cooler
- Forbes Marshall Pilot Operated Pressure Reducing Valve
- Forbes Marshall Piston Actuated Valves
- Forbes Marshall Sensor Chamber
- Forbes Marshall Control Valves
- Clean Steam Valve
- Clean Steam Pressure Reducing Valve
- Steam Operated Pumping Trap
- HeatMax
- Level Control System
- Moisture Control System

**Metering and Monitoring Systems**
- Electromagnetic Flowmeters
- Orifice Type Steam Flowmeter
- Boiler Efficiency Monitoring System
- Vortex Steam Flowmeter
- Vortex Steam Flowmeter
- Opacity Monitoring

**Condensate and Flash Steam Recovery**
- Utility Automation System
- Condensate Contamination Detection System
- Thermocompressor System
- Pressure Powered Pump Packaged Unit
- Forbes Marshall Flash Vessel
- Forbes Marshall View Glass
- FlashJet Pump

**Utility Key**
- Steam
- Condensate
- Flash steam
- Product / process fluid
- Hot / cold water
- Boiler feedwater
- Water vapour / process fluid vapour

**Icon Key**
- Reliability
- Energy Efficiency
- Environmental Awareness
- Productivity
- Ease of Operation
Complete Solutions in Steam Generation

- Dynamax and Minimax
- Minimax Modular

- Marshall B
- Modular B

- Marshall C
- Marshall C Modular

- Waste Heat Recovery
- Burners
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Efficiency</strong></td>
<td>Boiler and burner perfect match&lt;br&gt;Dual insulation&lt;br&gt;Online efficiency monitoring system&lt;br&gt;Oxygen trim control&lt;br&gt;Truly wet back construction&lt;br&gt;Heat recovery unit - variable 'Q' technology&lt;br&gt;Burner technology - ECR</td>
</tr>
<tr>
<td><strong>Combustion and Turndown Ratio</strong></td>
<td>Turndown of 1:4 on oil and 1:6 on gas&lt;br&gt;Electronically modulated air to fuel ratio control&lt;br&gt;Suitable for oils with high level of CCR and moisture&lt;br&gt;Electronic compound regulation burners, fuel saving by 2-3%&lt;br&gt;Ratiotronics for gas modulation</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>Twin water level controllers&lt;br&gt;SafetyMax for safety redundancy&lt;br&gt;High sinking time&lt;br&gt;VPS (valve proving system) for gas firing</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>Compliance to environmental norms&lt;br&gt;Equipped with online SPM, Sox, and NOx monitoring system</td>
</tr>
<tr>
<td><strong>High Uptime</strong></td>
<td>Reliable components&lt;br&gt;- Zero leak piston valves&lt;br&gt;- Vertical multistage centrifugal feed water pump in SS construction.&lt;br&gt;- Complete instrumentation from Forbes Marshall&lt;br&gt;Digital fault detection system with data logging</td>
</tr>
<tr>
<td><strong>Ease of Installation</strong></td>
<td>Completely packaged construction&lt;br&gt;Skid mounted, no foundation&lt;br&gt;Monoblock burner, no foundation required&lt;br&gt;Packaged modular boiler house&lt;br&gt;Installation in 72 hours&lt;br&gt;Pre-wired and factory insulated with no site work</td>
</tr>
<tr>
<td><strong>Ease of Operation and Maintenance</strong></td>
<td>Fully automatic and unmanned operation.&lt;br&gt;Equipped with self-diagnostic systems for trouble shooting&lt;br&gt;Complete access for maintenance and cleaning&lt;br&gt;Automatic boiler blowdown control system</td>
</tr>
</tbody>
</table>
Dynamax and Minimax Boilers
Small in size, big on savings

Dynamax and Minimax boilers are compact, efficient oil and gas fired packaged boilers. These boilers offer substantial savings as compared to coil type boilers.

Minimax Modular
Minimax and Dynamax Boilers

Compact Unit: Skid-mounted, pre-wired, ready to steam boiler

Process Benefits: Dry, high quality steam, under fluctuating loads. This results in lower batch timings, higher production rate and better productivity.

Maintenance: Easy accessible parts, low sensitivity to feed water quality and low maintenance.

Minimax

Technical Data

<table>
<thead>
<tr>
<th>Steam Generation Capacity</th>
<th>Kg/hr</th>
<th>300</th>
<th>500</th>
<th>750</th>
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<tbody>
<tr>
<td>Transportation Weight</td>
<td>Kgs</td>
<td>1100</td>
<td>2595</td>
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<td>Operating Weight</td>
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<td>Overall Length</td>
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<td>Overall Width</td>
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<tr>
<td>Overall Height</td>
<td>mm</td>
<td>1350</td>
<td>2205</td>
<td>2205</td>
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<tr>
<td>Main Steam Stop Valve</td>
<td>NB</td>
<td>40</td>
<td>40</td>
<td>40</td>
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<tr>
<td>Blow Down Valve</td>
<td>NB</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Feed Water line</td>
<td>NB</td>
<td>25</td>
<td>25</td>
<td>25</td>
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<tr>
<td>Flue Gas Outlet Diameter</td>
<td>mm</td>
<td>125</td>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td>Flue gas Exhaust Volume</td>
<td>m³/hr</td>
<td>300</td>
<td>800</td>
<td>1200</td>
</tr>
<tr>
<td>Total Connected Load</td>
<td>kW</td>
<td>2.70</td>
<td>10.50</td>
<td>10.50</td>
</tr>
</tbody>
</table>

High pressure designs available on request.
Efficiency as per BS 845 part I on furnace oil at 10.55 kg/cm² on NCV basis.
For 300 kg/hr: 88% on NCV basis
For 500 - 750 kg/hr: 89% on NCV basis
Boilers designed as per EN/ ASME/ code available on request.
300 kg/hr available in 7 kg/cm² design pressure.
Comparison of Coil Type with Dynamax and Minimax Boilers

Shell Boiler

- 40,500 KCal/hr (from Condensate)
- Fuel - 45.60 kg/hr LDO
- Returned to Feedwater Tank
- Feedwater 75°C

Coil Boiler

- 4,77,000 KCal/hr (from Boiler)
- Fuel - 53 kg/hr LDO
- Returned to Feedwater Tank
- Feedwater 30°C

Process Requires only 450,000 KCal/hr

Performance Rating Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Dynamax / Minimax</th>
<th>Water Tube/ Vertical Boiler</th>
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</thead>
<tbody>
<tr>
<td>Response Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant loads</td>
<td>10</td>
<td>8</td>
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<tr>
<td>Fluctuating loads (Batch type)</td>
<td>10</td>
<td>6</td>
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<tr>
<td>Instantaneous loads</td>
<td>10</td>
<td>4</td>
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<tr>
<td>Steam Quality</td>
<td></td>
<td></td>
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<tr>
<td>Dryness, Cleanliness</td>
<td>10</td>
<td>3</td>
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<td>Efficiency</td>
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<td>Statutory Regulations</td>
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<tr>
<td>Water Quality</td>
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<td>7</td>
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<tr>
<td>Condensate return</td>
<td>10</td>
<td>0</td>
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<tr>
<td>Fuel Adaptability</td>
<td>10</td>
<td>7</td>
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<tr>
<td>Cost</td>
<td>8</td>
<td>10</td>
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</table>

Process Benefits

Response to fluctuating loads: High water holdup and steam space provide necessary thermal flywheel to respond to sudden surge loads of process and deliver dry steam.

Batch time: Dynamax and minimax boilers generate 98% dry saturated steam that ensures superior heat transfer and reduced batch time. Coil type boilers have dryness fraction of 60-80% which adversely affects productivity.

Product Quality: Most process plants require right quality of steam (pressure and dryness fraction) to ensure desired heating rates and gradients. Dynamax and Minimax boilers supply right quality of steam under varying process conditions.

Cost of Ownership

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dynamax / Minimax</th>
<th>Coil Type</th>
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<tr>
<td>Average life</td>
<td>18-20 years</td>
<td>7-8 years</td>
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<tr>
<td>Replacement of pressure parts</td>
<td>Rare</td>
<td>Every 3 years</td>
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<tr>
<td>Condensate return</td>
<td>100%</td>
<td>Nil</td>
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<tr>
<td>Scaling of downstream equipment</td>
<td>No (dry steam)</td>
<td>Yes (wet steam)</td>
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<tr>
<td>Efficiency</td>
<td>86%</td>
<td>65-76%*</td>
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</table>

* practical operating efficiency
Marshall B and Marshall C Boilers
Truly packaged, three pass, oil and gas fired boilers

Marshall B and Marshall C Boilers are truly packaged with minimum site work, designed for easy maintenance and operation with access to all working parts. Boilers are skid mounted and eliminate civil work.
<table>
<thead>
<tr>
<th>Steam Generation Capacity</th>
<th>Transportation Weight</th>
<th>Operating Weight</th>
<th>Overall Length</th>
<th>Overall Width</th>
<th>Overall Height</th>
<th>Main Steam Stop Valve</th>
<th>Blow Down Valve</th>
<th>Feed water line</th>
<th>Flue Gas Outlet Diameter</th>
<th>Flue Gas Exhaust Volume</th>
<th>Total Connected Load</th>
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<tbody>
<tr>
<td>Kg/hr</td>
<td>Kgs</td>
<td>Kgs</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>NB</td>
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</table>

**Industrial Application**
Packaged food, beverage and brewery, hospitality, tyre, oil and petrochemical, paper and corrugation board, textiles, pharmaceuticals, infrastructure

High pressure designs available on request.
Efficiency as per BS 845 Part 1 on furnace oil at 10.55 kg/cm² on NCV basis
Boilers designed as per EN / ASME code available on request
(Above data is for 10.55 kg/cm²)

**Standard Efficiency**
Oil : 89% without HRU / 92% with HRU
Gas : 89% without HRU / 95% with HRU

NCV
FO : 9650 Kcal/kg
NG : 8500 Kcal/sm³
HSD : 10500 Kcal/kg
Features and Benefits of Skid Mounted Marshall B and C Boilers

**Monoblock burner**
No civil work. Integrated combustion unit, blower, heating and pumping unit.

**High turndown**
Boiler and burner perfect match.

**Equipped with online efficiency monitoring**
Continuous monitoring and control for rated operational efficiencies.

**Skid mounted**
No civil foundation. Simple PCC.

**Pre-wired**
Pre-wired at factory, no site cabling.

**Pre-insulated**
Factory insulated and cladded for high quality and minimum radiation losses.

**High quality mounting and accessories**
Forbes Marshall make mountings and fittings
- Disc check valve
- Zero leak piston valve
- Full lift safety valve

**Single element drum control**
Reduced thermal stresses. Dry steam under fluctuating loads.

**Twin water level controller**
Superior operating dryness fraction of 98%. Minimises swell and shrink effect.

**Ease of maintenance**
Complete access to all parts without dismantling.

**Feedwater pump**
Vertical multi stage centrifugal pump with high reliability and low maintenance.

**Burners**
High turndown, low maintenance.

*Single element drum level control standard for 8.0 TPH and above boiler
*Piston valves glandless class VI shut off
Modular Boiler House
Packaged and ready to fire

Modular boiler house is not just a boiler but a complete boiler house that is ready to fire with integrated feedwater tank and oil tank. Completely equipped with all instrumentation and controls.
**Benefits of Modular Boiler over Standard Boiler**

- 20% more compact
- 15% savings in cost on site jobs
- 80% reduction in erection time

**Benefits of Modular Boiler over Conventional Boiler**

<table>
<thead>
<tr>
<th>Scope Description</th>
<th>Forbes Marshall Modular Boiler</th>
<th>Standard Boiler</th>
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</thead>
<tbody>
<tr>
<td><strong>Boiler with Burner</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FD Fan and oil pump</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Insulation and cladding of boiler</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Control panel for boiler</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Power and control cabling from control panel to boiler instruments</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Cable trays and supports</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Skid for boiler foundation</td>
<td>✓</td>
<td>*Civil</td>
</tr>
<tr>
<td><strong>Tanks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed water tank and day oil tank with inlet/outlet valves</td>
<td>✓</td>
<td>*Site fabricated</td>
</tr>
<tr>
<td>Thickness 5mm insulation and cladding of the tanks</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Tank Instrumentation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level indication and control for feed water deaerator head (SS304) Vent head, outflow heater for day oil tank, level gauge and level controller for day oil tank</td>
<td>✓</td>
<td>*Bought out</td>
</tr>
<tr>
<td><strong>Supports and Structure</strong></td>
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<td></td>
</tr>
<tr>
<td>Supports for feed water tank and day oil tank Platform, ladder, railing for the tanks Support for control panel and feed water and day oil piping Common skid for FWT and DOT</td>
<td>✓</td>
<td>*Site fabricated</td>
</tr>
<tr>
<td>Skid provided</td>
<td>Skid provided</td>
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<tr>
<td><strong>Interconnecting Piping</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interconnecting piping between FWT, DOT and boiler Strainers / isolation valve for FW pump suction Duplex filter</td>
<td>✓</td>
<td>*Site fabricated</td>
</tr>
</tbody>
</table>

*Extra cost will be incurred at site

<table>
<thead>
<tr>
<th>Boiler Capacity (Kg/hr)</th>
<th>500-750</th>
<th>1000-1100</th>
<th>1500-2000</th>
<th>2800</th>
<th>3000</th>
<th>3500</th>
<th>4000-4500</th>
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<tbody>
<tr>
<td>Boiler height</td>
<td>2200</td>
<td>2300</td>
<td>2500</td>
<td>3100</td>
<td>3100</td>
<td>3250</td>
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<td>3500</td>
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<tr>
<td>Boiler with tank height</td>
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<td>5900</td>
<td>6150</td>
<td>5650</td>
<td>5500</td>
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<td>6800</td>
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<tr>
<td>Width</td>
<td>2500</td>
<td>3000</td>
<td>3200</td>
<td>4200</td>
<td>4500</td>
<td>4800</td>
<td>5000</td>
<td>5200</td>
<td>5600</td>
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<tr>
<td>Length</td>
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<td>3900</td>
<td>4500</td>
<td>4500</td>
<td>5100</td>
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<td>6100</td>
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<tr>
<td>Capacity feed water tank</td>
<td>1800</td>
<td>2200</td>
<td>4000</td>
<td>6060</td>
<td>6280</td>
<td>7250</td>
<td>9155</td>
<td>10400</td>
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<tr>
<td>Capacity day oil tank</td>
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<td>700</td>
<td>1120</td>
<td>1580</td>
<td>1710</td>
<td>2000</td>
<td>2530</td>
<td>2820</td>
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</table>

High pressure designs available on request
Efficiency as per BS 845 part I on furnace oil at 10.55 kg/cm2 on NCV basis
Boilers designed as per EN/ ASME/ code available on request
Electronic Compound Regulation Burners

State of the Art Burner Technology for Efficient Combustion

Boiler and Burner Perfect Match

Ease of Setting LCD Display

Valve Proving System

Two Stage Ignition

Ease of Maintenance

Hinge Design

Ratiotronics

Auto Moisture Drain

Self Controlled Combustion Head
Electronic Progressive Modulation Burner

The quality of atomisation in multistage progressive modulating burners remains constant at varying loads.

Superior atomisation and enhanced turndown

- High turndown - 1:4
- Fully automatic complete load regulation through sequence programme
- Soot free burner. Superior atomisation minimum soot and smutting
- Fine atomisation
- Simple construction and ease of maintenance
EffiMax™
Efficiency Monitoring System

A complete solution that helps improve boiler efficiency and reduce steam cost.

<table>
<thead>
<tr>
<th>EffiMax System</th>
<th>Direct Efficiency</th>
<th>Indirect Efficiency</th>
<th>Blowdown Control</th>
<th>Trim Control</th>
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<td>4000</td>
<td>Provided</td>
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</tbody>
</table>

SafetyMax
The Forbes Marshall SafetyMax is a safety monitoring system for boilers. It inspects all the critical safety related instrumentation and gives one complete picture of the safety of the boiler operation.

Boiler Load Management
Operating multiple boilers at best efficiency. A system that enables boilers to talk to each other.
Boiler GUARD
Predict | Prevent | Perform

Typical Shutdown in Boiler House

- Mobery Level Controller
- Feed Water pump
- Boiler Tripping
- Safety Valve
- Blow Down Valve
- Oil Pump
- Steam Pressure
- Oil
- Heater
- High Stock Temperature
- Sensor Failure

60% Increase in Uptime Through Boiler Identification and Prediction

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- Boiler Tripping
- Safety Valve
- Blow Down Valve
- Oil Pump
- Steam Pressure
- Oil
- Heater
- High Stock Temperature
- Sensor Failure

Web Based for Motoring and Events Analysis

- Dashboard
- Reports
- Trends
- Alarms

Mobile Alerts

- GET ON Google Play
- Available on the AppStore

Typical Shutdown in Boiler House

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Complete Turnkey Projects Execution

Modernisation of Boiler Plant

Retro Fit of Burners

Root Cause Analysis

Retrofit and Modernisation

Skilled Service Engineers

Proactive Inspection

Knowledge and Training

Modernisation of Boiler Plant

Retro Fit of Burners

Root Cause Analysis
World Class Manufacturing

A Legacy of Partnership, Spanning over 70 Years

Amul Factory, 1955

Amul Factory, 2015