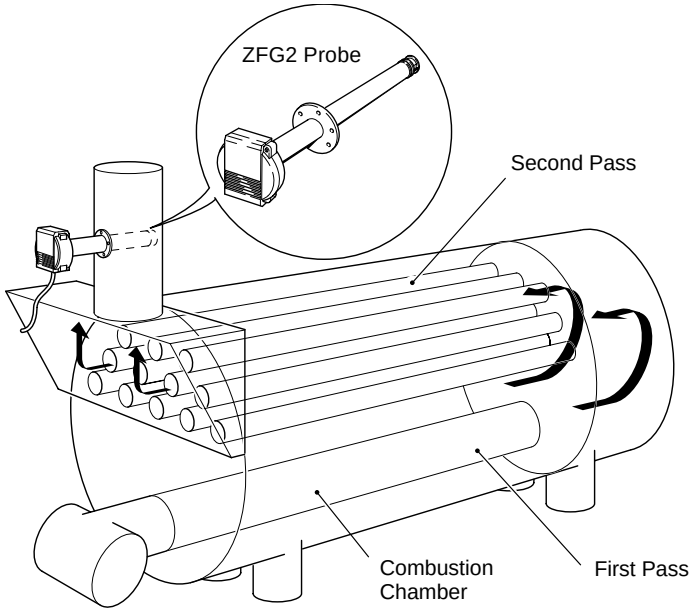
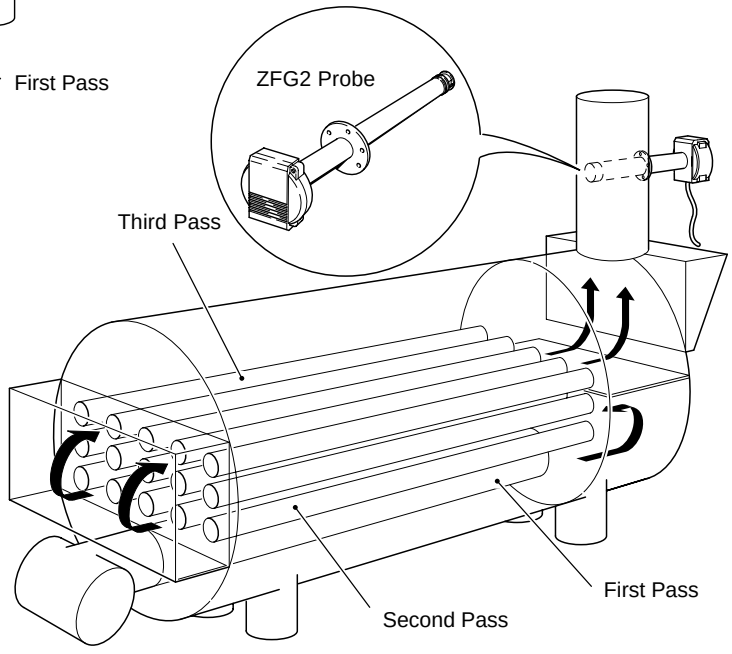
Oxygen Monitoring of Stack Gases in General Industry



2-Pass Boiler



3-Pass Boiler

The illustration above shows typical examples of 2-pass and 3-pass Package Boilers. To avoid erroneous readings due to tramp air, the Zirconia probe should be mounted such that the sensor end of the probe is within the central third of the flue duct and as close as possible to the smoke box.

Why use O_2 Monitoring in Stack Gases?

The customer needs:

- To ensure efficient combustion of fuel.
- To minimize heat loss.
- To minimize emissions and enable accurate emissions monitoring.

Why use ABB Instrumentation?

- ABB offer greater security at a lower cost by having:
  - proven reliability – over 100 years of process instrumentation experience and over 27 years applicational experience in Zirconia oxygen analysis,
  - full installation, commissioning and routine servicing facilities available, plus a worldwide network of companies and agents to ensure backup in most areas.
- Transmitters and probes designed, manufactured and supported by the same company.
- Comprehensive range of field-proven products available.

What ABB products are suitable?

- **ZFG2/ZMT or ZFG2/ZDT Zirconia Probe Systems:**
  - the ZFG2 probe is truly in-situ, requiring no sampling,
  - probes lengths available, 1.0m, 1.5m and 2.0m – to suit all applications,
  - low maintenance requirements and unique design features, ensure low cost-of-ownership – even under the most arduous conditions,
  - fully site-serviceable, requiring no special tools over the life of the probe,
  - long intervals between calibration (the ZMT auto-calibration option reduces the need for routine attention),
  - innovative sensor technology gives long sensor life (from 4 to 10) years on normal applications and reduced long-term drift,
  - speed of response is maintained over long time periods on the dirtiest applications,
  - our probe design ensures system accuracy is maintained over the full working process temperature range without recalibration.

Installation

- The IP rating of the probe ensures trouble-free operation on both indoor and outdoor installations.
- The ZMT/ZDT transmitter can be mounted adjacent to, or up to 100 metres from the probe.
- Auto-calibration option reduces need for routine attention.
- The ZFG2 probe can be mounted in any orientation.

Process Description

Basic Measurement/Analysis Theory

All Zirconia oxygen analyzers, whether extractive or in-situ type, utilize a ceramic (Zirconia) solid electrolyte sensor which is specific to oxygen.

When the solid electrolyte temperature is 600°C or higher and a difference in partial pressure of oxygen exists across the sensor, a flow of oxygen ions takes place from the higher to the lower partial pressure.

Air is used to give a reference oxygen partial pressure on one side of the sensor against which the sample is compared on the other side.

Accurate sensor temperature control and compensation for process temperature generated thermoelectric effects ensure accurate measurement under all normal process conditions.

On-line manual (semi-automatic) or automatic calibration is either single point or two-point by means of test gas injection.

Combustion Control

For complete combustion of fuel an excess of air is required, the level of which is dependent on fuel type, burner design and boiler design.

Air consists mainly of oxygen (20.95%) and nitrogen (78.08%). As Nitrogen contributes nothing to the combustion process, it is essential that the excess air is kept to a level which gives maximum efficiency.

This optimum level may vary considerably according to the firing rate of the boiler (boiler load) and is measured by the residual oxygen content in the flue gases.

Emission Monitoring

For calculation of the total emissions (SO_2, NO_x, CO_2, etc.) over a given time period, the total gas volumes must be known. Gas volumes are normally calculated from the O_2 value measured on a dry basis (extractive system).

If the water vapour content of the stack gases is known, a dry value for O_2 can be calculated from the wet (in situ) value.

Alternatively, the probe must be used in an extractive ‘dry’ measurement system to give a true 'dry' O_2 measurement.

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