

## ON-LINE STEAM QUALITY AND PURITY INSTRUMENTS

### Moisture and Chemical Impurities in Steam

Process and turbine inlet steam contains impurities, such as silica, sodium, chloride, iron and solid particulates, which can cause corrosion, scaling and erosion of power plant equipment, especially steam turbines. Impurities such as sodium, chloride and silica may be present as dissolved species in liquid water, or as particulate material, such as solid NaCl. Volatile silica and chloride may exist in high-temperature or superheated steam, but dissolves rapidly in liquid water. In order to determine the amount of these impurities in steam, isokinetic sampling is required.

The isokinetic steam sampling system incorporates a probe with isokinetic nozzles to obtain representative steam samples across the pipeline diameter. Isokinetic sampling minimizes errors due to non-representative collection of particles and droplets relative to the bulk vapor phase.

### Thermochem's Multi-Nozzle Isokinetic Probe and Optional On-line Analyzers

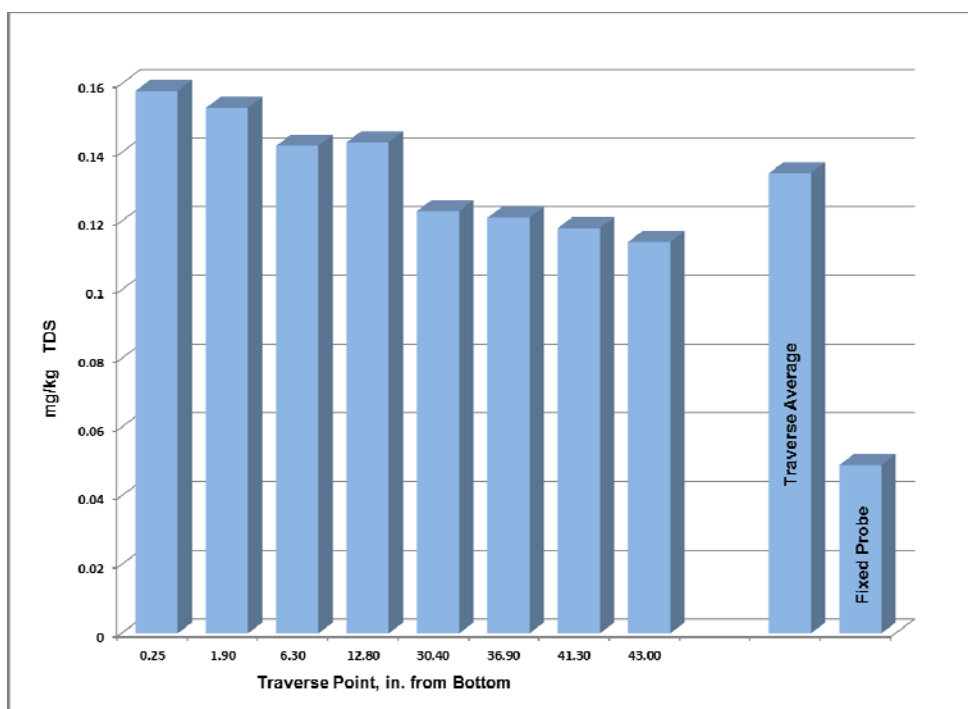
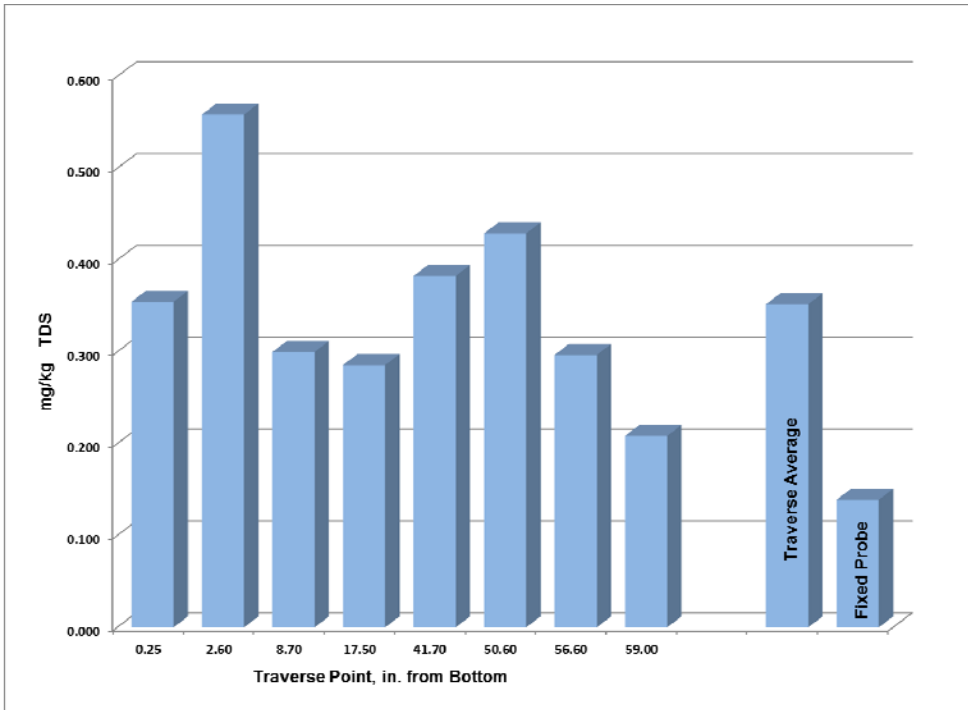
Thermochem has designed a Multi-Nozzle Isokinetic Sampling Probe (MNP2000) for steam quality and purity applications. The probe can be interfaced to the Thermochem Vacuum-Jacketed Calorimeter (SQ2000) for on-line steam quality monitoring, and/or to our sample conditioning system (SSCC) for steam purity monitoring with on-line analyzers for sodium, chloride, silica and NCG analysis.

Key design features and benefits of the Thermochem Multi-Nozzle Isokinetic Sampling Probe include:

- A profile composite of steam and entrained liquid by obtaining a true weighted average of 6 or more points across the pipeline.
- Multiple knife-edged nozzles are raised above the probe shaft and protrude into the steam flow where the sample can be extracted isokinetically with minimal flow disturbance.
- The probe shaft is off-set towards the steam flow to minimize flow disturbances by the flange assembly.
- The internal probe bore has a stepped diameter to maintain a constant, high sample velocity through the probe. This minimizes liquid hold-up and loss.
- Fully compliant with ASME PTC 19.11 for Steam Sampling and Analysis in the Power Cycle
- Superior to ASTM D1066-97 probe which suffers from stagnation boundary effects due to poor aerodynamic design, and a large internal bore causing sample hold-up and deposition of impurities.
- Superior to ASTM D1066-06 (EPRI/Jonas Single-Nozzle probe) which only collects from a single point near pipe wall and cannot obtain a representative profile of wet steam across the entire pipe diameter.



As Shown below from actual data collected at a power plant, multiple-point sampling (by a traversing probe) can produce data substantially different from the EPRI/Jonas Single-Nozzle probe which is plotted to the far right, compared to the profile average across pipeline. Multiple-point sampling produces equivalent results to the Thermochem Multi-Nozzle fixed sampling probe.



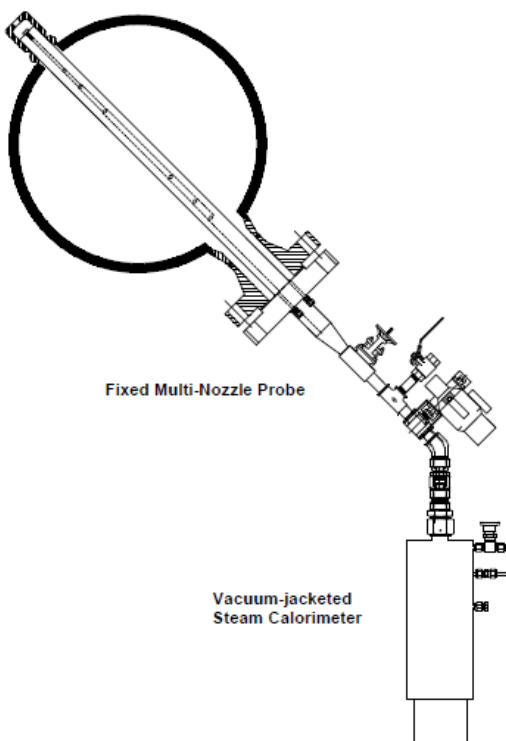
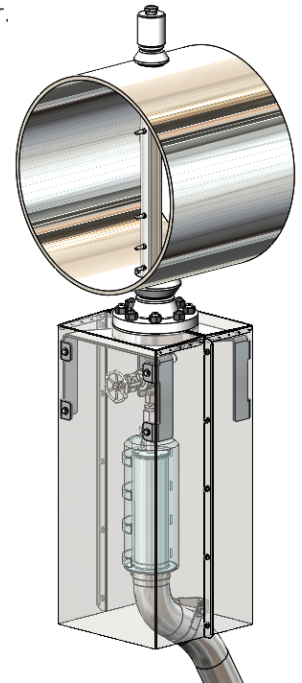
## Steam Quality

When used in the applicable range of about 98% to 99.95% steam quality, accurate entrained moisture measurements can be obtained from the Thermochem vacuum-jacketed throttling Steam Calorimeter attached to the Multi-Nozzle Isokinetic Sample Probe. The calorimeter determines the enthalpy of the steam by rapidly dropping the pressure to barometric conditions and measuring the temperature of the resulting superheated steam. The system can include automatic isokinetic flow control and is interfaced to the plant DCS or local PLC data processor.

## Applications

Our Steam Quality and Purity Testing Systems are used for:

- On-line measurements after wellfield production separators
- Monitoring after steam wash and scrubbers at plants upstream of turbines
- Early warning of steam field upset conditions such as brine carry-over and NCG spikes
- Verification of delivered steam quality and purity to power plants per contract requirements





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Empowering Energy Industries since 1985

## ABOUT THERMOCHEM

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Thermochem is a vertically integrated consultancy, service, and OEM instrument firm empowering energy industries since 1985. Our mission is to protect the assets and resources of our clients, ensuring the most efficient use of equipment and resources, through preventing corrosion and scale damage to valuable equipment and providing early detection and solutions to resource problems. We service clients in more than 30 countries, providing chemical engineering solutions and equipment for geothermal energy, oil and gas, combined cycle, cogeneration, fossil fuel and nuclear power plant projects from our offices and laboratories based in the USA and Indonesia.

We provide solutions to our clients from the ground up: exploration through operations. Our extensive range of products and services includes greenfield exploration, well testing, geochemical modeling, chemical process engineering, analytical chemistry, reservoir engineering, permit support, due diligence and specialized instrumentation such as two-phase wellbore samplers, pH-modification equipment and on-line steam quality and purity meters.

## References

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