



Technical White Paper: Intelligent Single-Well and Well-Group Multiphase Metering Solutions for Oilfields

1. Executive Summary

As oil and gas fields enter their mid-to-late development stages, well production characteristics have become increasingly complex, featuring high gas-liquid ratios, high water cuts, and fluctuating operating conditions. Traditional metering methods (such as glass tube level gauges or tipping bucket meters) can no longer meet the demands of "refined single-well management" and "digital transformation." Inaccurate metering not only leads to distorted production data — affecting geological analysis and allocation decisions — but also incurs high operational costs and safety risks due to frequent manual interventions.

Dongying Jingtao Energy Technology Co., Ltd. (hereinafter referred to as "**Jingtao Energy**"), leveraging its deep expertise in petroleum electronic instrumentation, presents the next-generation "**Intelligent Single-Well and Well-Group Multiphase Metering Solution**." This solution encompasses two core product series: the **Skid-Mounted Single-Well Multi-Parameter Metering Device** and the **Well-Group Multi-Function Metering Device**.

Our solution innovatively integrates a composite separation technology combining "**Geyser Impact + Multi-Stage Cyclonic Flow + Needle Bubble Bursting**," effectively resolving the challenges of gas-liquid separation in high gas-content crude oil. It enables real-time, precise metering of liquid volume, gas volume, water cut, temperature, pressure, and associated gas CO₂ content. The system boasts a high metering accuracy of $\pm 5\%$, supports **non-stop well operations**, **wireless remote transmission**, and **fully unattended**



operation. Notably, our skid-mounted equipment features an optimized separator inner diameter design that classifies it as non-special equipment (exempt from pressure vessel regulations), eliminating cumbersome registration and inspection procedures, thereby significantly reducing compliance costs and time for clients.

This white paper details the technical principles, core advantages, product architecture, and field performance of this solution, demonstrating how Jingtao Energy empowers oilfield enterprises to achieve real-time production data, refined management, and intelligent operations.

2. Industry Challenges

Oilfield operators currently face severe challenges in single-well and well-group metering:

- **Low Accuracy & Data Distortion:** Traditional separation technologies are incomplete, leading to severe gas-liquid entrainment. This causes significant errors in liquid and gas measurements, failing to reflect true well productivity and hindering optimal production allocation.
- **Poor Adaptability to High Gas Conditions:** In high gas-liquid ratio wells, traditional equipment often suffers from gas carry-over into the liquid phase or liquid carry-over into the gas phase, causing flow meter drift or even damage.
- **High OPEX & Low Efficiency:** Traditional metering relies on manual well switching, reading, and recording, resulting in high labor intensity and human error. Frequent calibration and maintenance consume significant production time.
- **Safety & Environmental Risks:** Manual operations involving high-pressure pipeline switching pose leakage risks. Traditional equipment often lacks comprehensive explosion-proofing and leak detection, failing to meet increasingly stringent HSE (Health, Safety, and Environment) standards.
- **Burdensome Special Equipment Regulations:** Conventional pressure vessels require registration, filing, and regular annual



inspections. The lengthy approval processes and high compliance costs delay project deployment.

- Low Digitalization: Data silos are prevalent, with a lack of real-time upload and analysis capabilities, making it difficult to support the oilfield's "Four Modernizations" (Standardization, Informatization, Automation, and Intelligence).

3. Core Technical Principles

Jingtao Energy's metering systems are built on the core technical route of "Multi-Stage Gradient High-Efficiency Separation + High-Precision Instrumentation Metering + Intelligent Control & Analysis."

3.1 Composite High-Efficiency Gas-Liquid Separation Technology

Addressing the complex nature of well effluents, we uniquely combine multiple separation mechanisms to ensure thorough gas-liquid separation:

- Geyser Impact Pre-Separation: Well fluid exits through a geyser head, spraying in an umbrella shape against baffles and nozzles. This sudden kinetic energy change allows a large volume of free gas to escape instantly.
- Needle Bubble Bursting: For media rich in micro-bubbles, specially designed bursting needles physically puncture and collapse bubbles, significantly reducing the gas content in the liquid phase.
- Multi-Stage Cyclonic Centrifugal Separation: The liquid enters cyclonic plates, generating high-speed rotation. Centrifugal force throws residual micro-bubbles to the center for release. A multi-stage series design extends the fluid path and stabilization time, achieving deep separation.
- Flow Stabilization & Sedimentation: The separated liquid phase enters a stabilization zone to further eliminate turbulence, ensuring a stable single-phase medium enters the flow meter.



3.2 Multi-Parameter High-Precision Metering Technology

- **Liquid Phase Metering:** Utilizes high-precision Coriolis mass flow meters to directly measure liquid mass flow, density, and temperature. Built-in algorithms calculate oil volume, water volume, and water cut in real-time.
- **Gas Phase Metering:** Employs dedicated gas flow meters with temperature and pressure compensation to accurately measure gas production under both working and standard conditions.
- **Online CO₂ Detection (Optional):** Integrates an infrared CO₂ analysis module to monitor CO₂ content in associated gas (0-100%) in real-time, providing data support for carbon capture and corrosion prevention decisions.

3.3 Intelligent Control & Data Transmission

- **Fully Automatic Operation:** The system is pre-programmed with metering cycles, sequences, and well selection, automatically completing the entire process of selection, separation, metering, (blowdown), and reset, achieving true unattended operation.
- **Wireless Remote Transmission:** Built-in 4G/5G/NB-IoT modules transmit metering data and equipment status in real-time to the cloud or the oilfield SCADA system, supporting remote monitoring and fault diagnosis.
- **Visual Interaction:** Equipped with an explosion-proof touch screen to intuitively display real-time data, historical curves, alarm information, and reports on-site.

4. Product Portfolio & Architecture

4.1 Skid-Mounted Single-Well Multi-Parameter Metering Device

Positioning: Ideal for temporary single-well metering, new well testing, remote scattered wells, and scenarios requiring mobile



metering.

Core Features:

- **Ultimate Portability:** Skid-mounted compact design (950×1100×1700mm) allows transport via pickup trucks, small vans, or trailers for flexible relocation.
- **Independent Power Supply:** Equipped with a large-capacity battery pack and an intelligent charge/discharge management system. It can operate continuously for over 7 days without external power (or 8 hours with electric tracing heating enabled), solving the challenge of powerlessness in remote fields.
- **Non-Special Equipment:** The separator inner diameter is designed to be <150mm. According to regulation TSG 21-2016, it is not classified as a fixed pressure vessel, exempting it from registration, filing, and annual inspection procedures.
- **Non-Stop Well Metering:** When paired with a four-way valve modification at the wellhead, metering can be initiated while the well is producing normally, eliminating production loss due to shutdowns.
- **Full Explosion-Proof Design:** Electrical systems, pipeline materials, and welding processes comply with petroleum industry explosion-proof standards, verified by pressure and flaw detection tests.

Technical Specifications:

Item	Specifications
Metering Accuracy	Liquid $\leq \pm 5\%$, Gas $\leq \pm 5\%$, CO ₂ Content $\leq \pm 5\%$
Liquid Range	Rated 10~120 t/d, Max 10~200 t/d
Gas Range	0 ~ 720 m ³ /d (Working Condition)
CO ₂ Detection	0 ~ 100% (Optional)
Working Pressure	2.5 MPa



Item	Specifications
Ambient Temp	-35℃ ~ 80℃ (Media Temp < 150℃)
Protection Rating	IP55
Communication	RS485 / Wireless Remote Transmission

4.2 Well-Group Multi-Function Metering Device

Positioning: Designed for centralized well pads and valve groups to perform automatic polling metering for multiple wells.

Core Features:

- **Multi-Well Polling:** Supports automatic polling for 1~12 wells (customizable). The number of wells, timing, and sequence are fully configurable.
- **High-Efficiency Well Selection:** Utilizes large-bore electric three-way valves for rapid action. The pipeline remains unobstructed during switching to prevent pressure buildup. The design eliminates dynamic sealing structures, fundamentally avoiding internal leakage caused by seal wear.
- **Strong Adaptability Separation:** Combines Geyser Impact, Cyclonic Separation, and Flow Stabilization technologies to adapt to complex conditions such as high gas-liquid ratios and high viscosity (<5000 MPa·s).
- **High Automation:** Fully automatic operation with self-diagnosis and self-blowdown functions, achieving true unattended status.
- **Data Integration:** Graphical visual terminal with one-click data export, seamlessly docking with oilfield "Four Modernizations" platforms.



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Number of Wells	1 ~ 12 Wells (Customizable)
Metering Accuracy	Liquid $\leq \pm 5\%$, Gas $\leq \pm 5\%$
Liquid Range	Rated 10~120 m ³ /d (Customizable)
Gas Range	0 ~ 720 m ³ /d (Working Condition, Customizable)
Design Pressure	2.5 MPa
Applicable Viscosity	< 5000 MPa · s
Dimensions	6000 × 2200 × 2000 mm (12-well config)
Power Supply	AC 220V

5. Key Advantages & Value Proposition

Dimension	Traditional Metering	Jingtao Energy Smart Solution	Customer Value
Separation Effect	Single gravity or simple cyclonic; severe entrainment	Composite Separation (Geyser+Cyclonic+Needle); thorough separation	Accuracy improved to $\pm 5\%$; reliable data
Compliance Cost	Special equipment; requires annual inspection/filing	Non-Special Equipment (Skid-mounted); exempt from inspection/filing	Saves time & fees; rapid deployment



Operation Mode	Requires well shutdown, manual switching, on-site reading	Non-stop metering, auto-polling, remote transmission	Reduces production loss; lowers labor costs
Power Dependency	Requires grid power or generators	Built-in Battery; off-grid independent operation (Skid)	Solves power-less well issues; flexible deployment
Safety	High manual intervention; leakage risks	Fully enclosed explosion-proof; unattended	Intrinsic safety; meets highest HSE standards
Digitalization	Lagging data; paper records	Real-time cloud sync; auto-generated reports	Empowers digital transformation; supports decision-making
Special Features	Measures only liquid or gas	Multi-parameter integration (CO ₂ , water cut, etc.)	Multi-function ; comprehensive well dynamics

6. R&D Capabilities & Certifications

Jingtao Energy possesses strong independent R&D and manufacturing capabilities:



- Corporate Qualifications:
 - ◆ National High-Tech Enterprise
 - ◆ Shandong Provincial "Specialized and New" Enterprise
 - ◆ Shandong Provincial First-Set (Tai) Technical Equipment Enterprise
 - ◆ National Technology-Based SME
 - ◆ CNAS Accredited Laboratory Partner
- Intellectual Property:
 - ◆ 21 valid patents (including 5 invention patents and 2 international PCT patents)
 - ◆ 8 software copyrights
 - ◆ Winner of the China Patent Technology Achievement Gold Award
 - ◆ Participant in drafting 1 National Standard; lead drafter of over 20 enterprise standards
- Industry-Academia-Research Cooperation: Deep collaborations with renowned institutions like China University of Petroleum and Shandong University of Chemical Technology ensure continuous innovation.
- Manufacturing & Testing:
 - ◆ Advanced CNC machining, welding, and assembly production lines.
 - ◆ Equipped with full sets of pressure testing, flaw detection, and flow calibration devices to ensure (excellence) in every ex-factory unit.

7. Application Scenarios & Case Studies

7.1 Typical Application Scenarios

- Remote Scattered Wells: Single wells without grid power or with difficult access; utilizes the skid-mounted device's built-in power and portability for rapid deployment.
- New Well Testing & Evaluation: Exploration phases requiring frequent relocation and rapid acquisition of accurate productivity data.
- High Gas-Liquid Ratio Wells: "Problem wells" where traditional



metering fails; restores accurate metering using composite separation technology.

- Sensitive Area Well Sites: Locations near residential areas or with high environmental requirements; leverages unattended operation and low leakage risk.
- Old Oilfield Digital Retrofit: Replacing old glass tubes or tipping buckets and integrating into the oilfield production command system.

7.2 Field Performance Results

In practical applications at a major oilfield, Jingtao Energy's metering devices demonstrated exceptional performance:

Well ID	Station Data (t/d)	Jingtao Measured Data (t/d)	Error (%)	Conclusion
14P**4	50.2	51.5	+2.58%	Excellent Accuracy
15P**5	42.4	43.9	+3.53%	Reliable Data
16X**7	51.4	49.58	-3.54%	Controllable Deviation
K71**20	36.0	37.2	+3.33%	Better than Industry Standard
K71**17	35.0	36.1	+3.14%	Strong Stability
K71**16	26.0	25.3	-2.69%	Good Repeatability



Customer Feedback:

"This equipment not only solved our problem of inaccurate metering in high-gas wells but also saved us significant approval time due to its 'non-special equipment' status. The built-in battery design allowed us to easily achieve automated metering even in areas without grid coverage." — Technical Director, Oilfield Operations District

8. After-Sales Service System

Jingtao Energy commits to providing high-quality service throughout the product lifecycle:

- Professional Training: Comprehensive training on installation, operation, maintenance, and data analysis to ensure client teams are fully proficient.
- Regular Inspections: Proactive regular inspection services to check equipment status, calibrate metering accuracy, and prevent potential failures.
- Software Upgrades: Lifetime free upgrades for control software and cloud platforms to continuously optimize user experience.
- Spare Parts Support: Maintains a sufficient spare parts inventory to ensure rapid replacement of critical components.

9. Conclusion

Dongying Jingtao Energy Technology Co., Ltd. has redefined the standards for single-well and well-group metering through innovative composite separation technology, intelligent control systems, and a profound understanding of oilfield site requirements. Our solution not only provides high-precision metering data but also delivers significant cost reduction and efficiency gains through unique advantages such as "non-special equipment classification," "off-grid operation," and "non-stop well metering."

As the oil and gas industry moves towards intelligence and green



development, Jingtao Energy is ready to be your most trusted partner. We aim to drive refined oilfield management with precise metering data, jointly creating an efficient, safe, and sustainable energy future.

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