Gas Separated Measurement System

- **Single Well Measurement**
- **Well Group Measurement**
- **Measure Station Measurement**
- **Separated Team Measurement**
- **United Station Measurement**

CMS Series

Version 2 Amendment in 2016

Drafted by: Tosilon Tech-Flow Division
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General Description

CMS Series Oil-Gas Separated Measurement System is multi-phase flow Measurement system researched & developed in our company. CMS employs advanced Gas-Liquid Cylindrical Cyclone Separated Technology to separate Gas & Liquid, and uses Coriolis Mass Flow Meter to measure the accuracy of gas & liquid. Because of the high accuracy, wide measure ratio, without maintain and strong flow characteristics of Coriolis Mass Flow Meter, meanwhile is also not affected by liquid physical characteristics(such as density & viscosity), and the CMS is very specially applied to oil field complicated flow condition, varied flow, varied water content, etc. complicated mining industry.

CMS Series Oil-Gas Separated Measurement System can measure and display mixed liquid total mass, instant flow and density, meanwhile which can also calculate water content ratio, oil production at the suitable industry condition, and the accuracy error totally meets international <oil field oil-gas integrated output design regulation(GB50350 -2005)> regulated single well oil-gas measured accuracy requirement, also complete the current domestic oil well produced liquid multi-phase flow mixed phase transport measured technology.

Every elements of CMS Series Oil-Gas Separated Measurement System meet the below relevant regulations and standards during the process of design & production:

GB50350-2005
Oil-field Oil-Gas integrated transport design regulation

GB 3836
Explosion Ambient usage Ex-proof electric equipment

SY/T6682-2007
Using coriolis mass flow meter to measure liquid hydrocarbons flow

SY 0402-2000
Petroleum gas station technological pipeline project construction & acceptance regulation

SY/T0090-2006
Oil-gas field & pipeline instruments controlled system design regulation

SY/T0515-2007
Separator regulation

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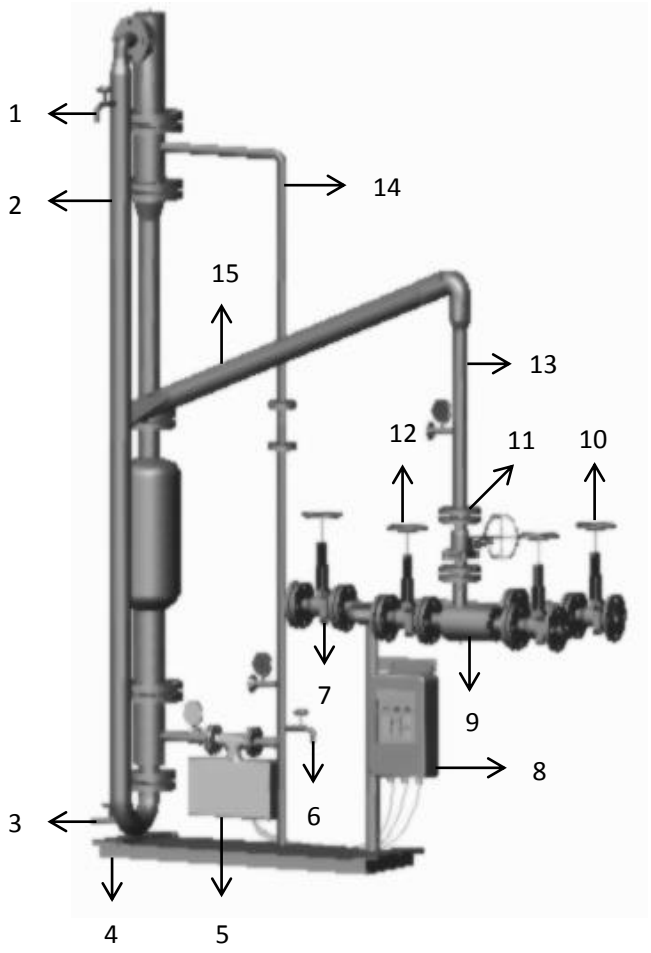
System Characteristics

· High accuracy, real-time on-line measurement
· Easy operation, Convenient Movement
· Easy Installation, Convenient Maintenance
· Installation Space-Saving
· High Reliability
· Comprehensive Application, Wide Measure-Ratio
· The matched mass flow meters are produced by our own company, which are well-known and reliable

Structure & Principle

Structure Schematic Diagram

Sr.	Description
1	Gas Phase Exhaust Valve
2	Separated Pipe
3	Liquid Phase Exhaust Valve
4	Base
5	Mass Flow Sensor
6	Sampling Valve
7	Mixed Control Valve
8	Mass Flow Transmitter
9	Filter
10	One-way Control Valve
11	Feed Control Valve
12	By-pass Valve
13	Feed Pipe
14	Gas Phase Circulating Flow Pipe
15	Jet Pipe



Structure Components

CMS Oil-Gas Separated Measurement System is Made of the below 5 Main Parts:

1. Gas-Liquid Separated System
2. Gas-Liquid Separated Control System
3. Crude- Oil Measured Instrument
4. Gas Measured Instrument
5. Valves & Pipeline Elements

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Working Principle

Gas-Liquid two-phase separated working principle

CMS working principle as per the above schematic diagram, entrance is connected by down dip angle pipeline and vertical pipeline, multi-phase flow goes into main separator through feed liquid pipe. Because of rotational flow function, Centrifugal Force, Gravity and Buoyancy Force become a turnover pyramid type vortex surface in separator. Large density liquid phase flow into separator bottom along the wall of vertical pipeline, while small density gas phase goes up to the top of separator along the center of vortex, finally gas phase and liquid phase separately discharged from separator top and bottom. Meanwhile adjusts liquid level and pressure through automatic control system to achieve two phases completely separated, and the separated liquid phase and gas phase separately measured by liquid and gas single phase flow meter. The precision design of separator is the key to ensure whole performance of system. Accuracy separator design will make sure well separate of liquid and gas phase under the complicated industry condition, to ensure measure accuracy of instrument. According to customers' supplied industry condition, measured accuracy requirements, our company can re-amend CMS Series size, and to design, manufacture and relevant instrument control system. CMS covers a wide application, including current major oil-well and process integrated transfer.

CMS Control Principle

CMS employs automatic control principle, according to industry condition flow type simulation on-site, meanwhile considering completely of the relationship among liquid level, pressure, gas-liquid flow and valve location, to composite perfect complex adjustment system. Through building correct gas-liquid separated model and using perfect control system, to achieve good gas-liquid balance of separator and get the reasonable separated effects, then to ensure the accuracy of measurement.

Measurement Principle

After separated, flow liquid separated into gas-phase and liquid-phase, and gas-phase can be measured by gas flow meter, liquid-phase can be measured by mass flow meter. Meanwhile because of mass flow meter special principle, which can calculate the flowed pure water and pure oil mass by outputting on-site pure water and pure oil density, to achieve the single-measurement function of oil-well produced oil.

Moreover this device can also analyze & deal with the measured parameter by computer, then automatically to generate liquid, gas, water(oil) instant parameter curved line, daily production report etc., also can achieve the remote monitor of measured parameter as per customers' requirements.

Type Option Description & Main Technology Parameter

Type Option

For Example: CMS25-02DW1A

CMS25 – **02 D W 1 A**

1 2 3 4 5 6

Sr.	Oil-Gas Separated Measurement System Model Spec. (CMS25) CMS25-02DW1A
1	Liquid-phase Flow Meter Model Code(C7)
2	Tracing Heat Type(Electric)
3	Gas-phase Flow Meter(None)
4	Equipment Interface Flange Spec. Code(DN50)
5	Special Defined Symbol(outdoor fixed type)
6	Oil-Gas Separated Measurement System Model Spec. (CMS25) CMS25-02DW1A

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Type Option Relevant Sheet

Oil-Gas Separated Measurement System Spec. Model	Liquid-phase Mass Flow Meter Model		Tracing Heat Type	Gas-phase Flow Meter	Equipment Interface Flange Spec.			Special Defined Symbol
	Code	Products Model			Code	Caliber	G/B No.	
CMS25	01	C3	W (None) D (Electric) S (Water) Tracing heat type as per customers' requirements, preferred option is electric tracing heat.	W (None) Y (Yes) Gas Measurement as per customers' requirements	1	DN50	GB/T9119-2000 PN40	A: (outdoor fixed type) B: (indoor fixed type) C: (vehicular type) D: (system type) T: (special order)
	09	G15						
	02	C7						
	10	G25						
CMS50	03	C20			1	DN50		
	10	G25						
	04	C36						
	11	G50						
CMS80	05	C75			2	DN80		
	06	C150						
	11	G50						
CMS100	07	C360			3	DN100		
	08	C600			4	DN150		

Model Spec. & Relevant Parameter

Model Spec.	Nominal Diameter	Liquid-phase Flow Range (t/h)	Pressure-proof Testing Pressure (MPa)	Rated Pressure (MPa)	Sensor Interface Flange Spec. GB/T9115.1-2000	Outside Dimension (m) (L*W*H)
CMS25-01	DN25	1.8-15	6	4	DN15 PN40	1.6×0.6×2.6
CMS25-02	DN25	4.2-30	6	4	DN25 PN40	1.6×0.6×2.6
CMS50-03	DN40	12-240	6	4	DN25 PN40	2.0×0.8×3.4
CMS50-04	DN50	21.6-320	6	4	DN50 PN40	2.0×0.8×3.4
CMS80-05	DN50	45-900	6	4	DN50 PN40	
CMS80-06	DN80	90-1800	6	4	DN80 PN40	
CMS100-07	DN100	216-4320	6	4	DN100 PN40	6.0×2.0×5.5
CMS100-08	DN150	360-7200	6	4	DN150 PN40	6.0×2.0×5.5
CMS25-09	DN25	1.8-20	6	4	DN15 PN40	1.6×0.6×2.6
CMS25-10	DN25	4.2-50	6	4	DN25 PN40	1.6×0.6×2.6
CMS50-10	DN25	12-240	6	4	DN25 PN40	2.0×0.8×3.4
CMS50-11	DN50	30-600	6	4	DN50 PN40	2.0×0.8×3.4
CMS80-11	DN50	45-900	6	4	DN50 PN40	

Note: the above parameter as per the below standard

Ambient temperature 20 Deg. C, atmosphere pressure 101.325KPa

Kinetic viscosity less than 400mPa.S, density less than 0.9160g/cm3 middle crude oil

System internal pressure loss 0.1MPa

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CMS Oil-Gas Measurement System Technology Parameter

Liquid-phase measurement error ≤±3%

Water content relative error ≤±3%

Gas-phase measurement error ≤±10%

Rated pressure: 4.0 MPa

Pressure-proof testing pressure: 6.0 MPa

Range of Application

Medium Kinetic Viscosity: 0~1000mPa.S

Rates of Water Content: 1~100%

Medium Temperature: 5~80 Deg. C

Ambient Temperature: -20~55 Deg. C

Ambient Humidity: 10~85%

Gas-Oil Ratio: <300 (m3/t)

Explosion-proof Requirements

CMS Oil-Gas Separated Measurement System as per GB3836 Stipulated Relevant Requirements, Which Explosion-proof Mark as Below:

Ex ib IIC T3~T6 system matched C series sensor+B1 transmitter

Exd ib IIB T3~T6 system matched G series sensor+IPT150 transmitter

Exe II T5~T6 system matched electric tracing heat belt

Protection Class

CMS series oil-gas separated measurement system outside shell protection class is IP67

Structure Material

Gas-oil separated control parts material: 0Cr18Ni9

Bases parts material: 0Cr18Ni9

Pipeline structure parts material: 20 steel, for transferring liquid to use seamless steel pipe.

Liquid-Phase Mass Flow Meter Interface Electric Parameter

Power Supply: 220VAC±15%,50Hz; or 24VDC±10%

Leading wire interface: Divided installation junction box interface is G3/4, integrated installation as per transmitter requirement.

(For detailed information pls. Refer to mass flow meter operation description)

Electric Tracing Heat Power

CMS25 series: electric tracing heat need power is 1.375kw

CMS50 series: electric tracing heat need power is 1.75kw

CMS100 series: electric tracing heat need power is 5.5kw

Equipment Weight: Unit: kg

Type	CMS25A	CMS25C	CMS50A	CMS50C	CMS100
Weight	320	520	650	730	2100

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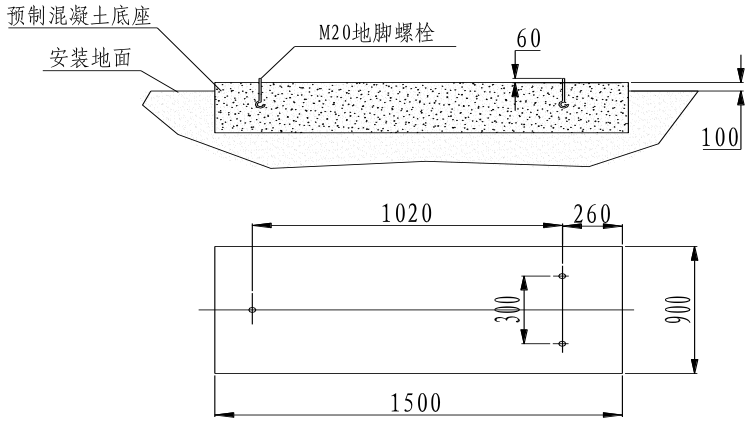
Installation Foundation Requirement

CMS25 Series

This series can be installed both outdoor and indoor, when installed indoor, the room required net height at least up to 3m. And installed base should be concrete construction, you can pre-place three fixed bolts as per the below dimension to fix the equipment base, meanwhile need to lead the relevant pipeline to installation location place. Such as the below diagram:



The above dimensions are all counted as per unit(mm). Concrete height as per floor condition, generally no less than 500mm.

After installed, fixed equipment by grounded bolts, then to connect correctly the measured pipeline into equipment interface: entrance general control valve and exit general control valve. Meanwhile to put mass flow sensor correctly into instrument interface and connect with the relevant mass flow transmitter. Also checking repeatedly to ensure correct wire connected. **After installation, to check each flange connection thread and ensure all are tightly locked.**

CMS50 Series

This series can be installed both outdoor and indoor as per usage condition. The ground base should be cement concrete structure and depth no less than 500mm; depth of pre-embedded anchor bolts no less than 200mm, exposed height of anchor bolts no less than 60mm

CMS100 Series

This series can be installed both outdoor and indoor as per usage condition. The ground base should be reinforced concrete structure ,depth of pre-embedded anchor bolts no less than 400mm, depth of reinforced concrete no less than 800mm. Exposed height of anchor bolts no less than 80mm.

Operation Guide

About the measurement of oil-well production, because of the complicated oil-well production condition, different oil-well produces oil, gas and water is also very different, meanwhile crude oil contents sand and wax, etc. **(procedure gathering & transporting measurement also has the same above condition)**, so you have to be serious to operate as per the below requirement.

All Valves Should Be Closed State While Equipment Installation Initially. Checking Each Flange Connection Interface And Ensuring without leakage point.

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First Step: Main Pipeline Check

After connected pipeline, ensuring mixed control valve, feed liquid control valve to be closed, then to open bypassing valve and let the oil-well liquid enter into system bypassing valve to wash pipeline, after half hour, firstly to open feed liquid control valve, then to open mixed control valve and close bypassing valve to let oil-well liquid enter into measuring system, meanwhile to listen carefully whether there is flow sound when oil-gas continuously flow through valve and pressure gauge has pressure data, if there is flowing sound of oil-gas continuously flow through valve, main pipeline is in working order. On the other hand, main pipeline is stoppage, and need to be adjusted until main pipeline is in working order.

Second Step: Equipment Check

At the same time you can hear the flowing sound when oil-gas mixture flowing through feed liquid control valve and feed liquid pipe entering into separated pipeline, meanwhile before and after pressure gauge displays pressure raised, from this to confirm feed liquid pipeline parts are in working order.

Third Step: Entering Into Working

After to open mixed control valve: pressure gauge displaying pressure fallen, and then keeping stability after the fallen value up to some certain value, and feed liquid pipeline pressure gauge displaying value is bigger, whereas sensor outlet pressure gauge displaying value is relative smaller. System entrance and exit mutual pressure difference value is so different according to oil-well industry condition. Approaching pipeline you can hear liquid flowing sound. Meanwhile mass flow transmitter will display the relevant flow rate, from this to confirm the whole equipment is in working order.

Following is the schematic diagram of liquid flowing in the equipment as normal working:

Single Well Pipeline → Filter → Feed Liquid Control Valve → Feed Liquid Pipe → Jet Flow Pipe → Separated Pipe →

→ | → Gas Control System → Gas Circulating Flow Pipe →
→ Liquid Control System → Mass Flow Meter → | → Mixed Control Valve →

→ Single Direction Control Valve → Outlet General Control Valve → Entering Into Mixed Pipeline

Forth Step: Mass Flow Meter Zero Point Calibration

After half-hour of the system normal operation, firstly to open bypassing valve and let oil-well feed liquid go through bypassing valve, then to close mixed control valve and feed liquid valve one by one, ensuring mass flow meter sensor inner is fully filled with medium and static of the system, then to make zero point calibration as per mass flow meter description manual. After zero point calibration to open the relevant valve and begin to measure.
Note: Pls. read carefully mass flow meter usage description manual before operation.

The equipment may require the relevant supporting facilities as per the different usage environment.

If the lowest ambient temperature for the equipment under 10 Deg. C every year, moreover, the temperature oil flowing into equipment is also lower, you need to prepare the relevant tracing heat temperature protected facilities, to avoid the crude oil be frozen in the measured chamber and difficultly restart.

If the equipment stopped, to open exhaust-valve before stopped and to exhaust air completely in the equipment chamber, to avoid the pipeline blocked in the future usage.

For normal condition, in summer if the lowest ambient temperature is more than 25 Deg. C every day, you should close tracing heat power.(according to medium condition)

To normally employ the below two ways tracing heat as per customers' in-site environment:

If working environment temperature no less than 10Deg. C of the equipment every year, moreover, kinetic viscosity of middle crude oil and light crude oil less than 400mPa.S, to match the relevant specification water-jacket heat exchanger to heat the crude oil, then the equipment will be in normal working order.

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If the lowest working environment temperature under 5 Deg. C, moreover, kinetic viscosity between 400~10000mPa.S of thick oil, to employ electric tracing heat to heat the thick oil and ensure the oil temperature in the equipment no less than 20 Deg. C.

For the crude oil who has the wax content more than 30% and condensation point more than 35 Deg. C, to employ electric tracing heat, and temperature controller to control the temperature, ensuring temperature in the equipment chamber no less than 50 Deg. C.

To choose the specific tracing heat according to the different environment condition.

Vehicular Type Operation Description

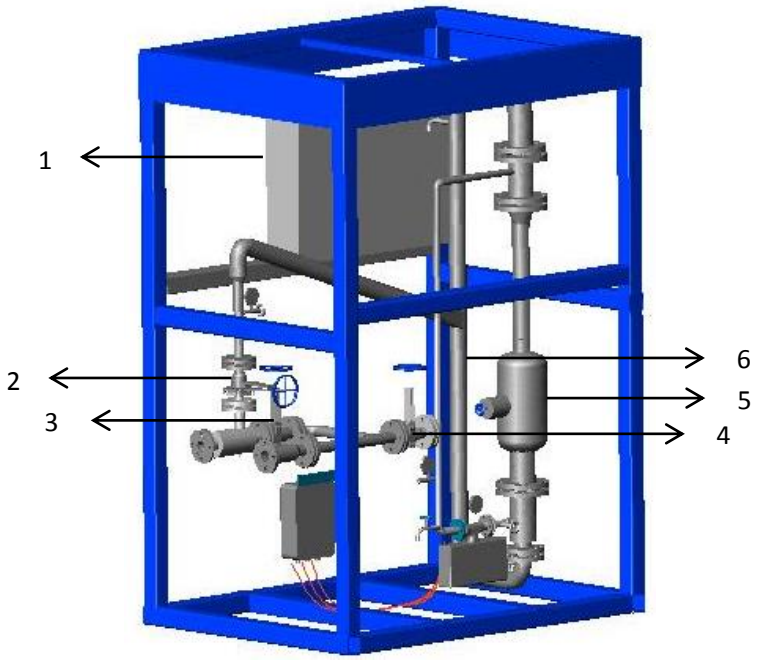
The movable measurement system is mainly designed for the measurement of the remote wells. It can be placed in the light van easily and used for multi-group wells or wells field. The relevant structure technology requirements and all the parameters are the same with the stationary oil-gas separated measurement system.

Notes for Transport

First	Keep all the valves close.
Second	For the measurement system is a kind of precision system, the vehicle should run at low speed, lower than 15km/h and avoid bump. The equipment should be tied firmly in the transport vehicle. The equipment should be gently moved, if necessary, the hoist can be used.

Structure diagram is as follows

Sr.	Description
1	Electric Cabinet
2	Fluid Entry Control Valve
3	Bypass Control Valve
4	Mixture Control Valve
5	Control Part
6	Separator Tube Part



Measurement Steps

First Step	choose the well to be measured, and choose the connector according to the situation
Second Step	connect the movable measurement system to the measured single-well with flexible pipes. Pay attention to the directions of the exits and entrances power-on: the power supply of the movable measurement system is AC220V
Third Step	The cable provided is three-core cable and the third core is the ground wire. The power supply is connected by professional electrician.

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Fourth Step	choose the single-well measurement time.
Fifth Step	keep the mixture control valve and fluid entry control valve close. Open bypass valve and beam-pumping unit to let the fluid from the well enter the system bypass. And the impurity such as wax block will pass through the bypass pipe and wash the pipe. After half an hour, open the fluid entry valve and mixture control valve and then close the bypass control valve to replace the process to make the fluid from the well enter the measurement system and measure. When the measurement time reaches the preset single-well measurement time, the total flow will be automatically converted to the current daily output and will not be accumulated with instantaneous flow.
Sixth Step	after the measurement, open the emptying valve at the bottom of the system, and then close all the valves and fasten it at the transport vehicle. Then it can be transported.

Attentions

The measurement instrument and electrical hear tracing of this system must be fixed to the ground firmly.

Extension springs of the control part are quick-wear parts, please change on time if damaged

For the vehicular movable type oil-gas separated measurement system, its cables should be connected firmly in use, and the surface insulator should not be scratched when moving. After measurement, the internal of the equipment should be emptied and cleared.

The equipment should be maintained regularly, including electrical part and mechanical part. Keep the surface of the equipment clean, without greasy dirt. Regularly check if the valves are shut.

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