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FROM LAB TO THE FIELD*

## Petroleum Engineering Laboratory Equipment

Routine Core Analysis

Special Core Analysis

EOR Tests

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Design and construction team of this company offers the full range of educational and research facilities of petroleum engineering with the highest quality, relying on up to date technology to providing laboratory services, research centers and universities.

- Design and construction of petroleum engineering laboratory equipment
- Advanced rock and fluid properties laboratory equipment
- Special equipment and EOR laboratory apparatuses
- Full field studies and development plans



## Core Plugging Machine (CD-R10)



The heavy built diamond tooled drill press is especially designed to drill different sizes of the cores especially 1" and 1.5" in diameter with maximum height of 3.5" upon to the request. The current equipment is comprises of 2 hp motor, a floor standing drill press, a rotary union, a water cooling circulation system (oil and other coolants are available upon to the request) and a coolant recovery pan. The union permits to connect the coring bit to the drill press and feed coolant to the coring bit .

### Technical Specification:

- Nominal diameter of coring bit: 1, 1.5"
- Maximum coring depth: 3.5"
- Compatible coolant: Water and oil (upon to the request)
- Two reservoir for fresh coolant fluid and waste coolant
- Drill speed: 160-1400 rpm
- Motor power: 2 hp





## Core Cutting Machine (CC-R20)

After drilling cylindrical core samples, it is necessary to cut preset length of core using high speed blades. The machine is a standard high performance rock saw with diamond blade and cooling system (water or oil). The saw comes with a safety splash guard, coolant recovery pan, and electrical motor with 3 hp power for soft cutting of core plug faces.

### Technical Specification:

- Maximum blade diameters: 14"
- Maximum cutting depth: 4"
- Maximum core length: 5"
- Moveable tray for easy core handling
- Lubricant and coolant fluids: Commonly water (oil is also possible)
- Circulation pump
- Waste coolant accumulator
- Motor power: 3 hp







## Core Cutting Machine (CC-R30)

After drilling cylindrical core samples, it is necessary to cut preset length of core using two parallel high speed blades. The machine is a standard high performance rock saw with diamond blade and cooling system (water or oil). The saw comes with a safety splash guard, coolant recovery pan, and electrical motor with 5 hp power for soft cutting of core plug faces.

### Technical Specification:

- Maximum blade diameters: 14"
- Maximum cutting depth: 4"
- Maximum core length: 5"
- Moveable tray for easy core handling
- Four different spacer for tuning the required space between two blades
- Lubricant and coolant fluids: Commonly water (oil is also possible)
- Circulation pump
- Waste coolant accumulator
- Motor power: 5 hp







## Soxhlet Extractor (SO-R20)

A Soxhlet extractor is originally designed for the extraction of a lipid from a solid material. Typically, a soxhlet extraction is used when the desired compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent. It allows for unmonitored and unmanaged operation while efficiently recycling a small amount of solvent to dissolve a larger amount of material. A soxhlet extractor has three main sections: A percolator (boiler and reflux) which circulates the

solvent, a thimble (usually made of thick filter paper) which retains the solid to be laved, and a siphon mechanism, which periodically empties the thimble. The cleanliness of the sample is determined from the color of the solvent that siphons periodically from the extractor which must be clear. The solvent is heated to reflux. The solvent vapor travels up a distillation arm, and floods into the chamber housing the thimble of solid. The condenser ensures that any solvent vapor cools, and drips back down into the chamber housing the solid material. The chamber containing the solid material slowly fills with warm solvent. Some of the desired compound dissolves in the warm solvent. When the Soxhlet chamber is almost full, the chamber is emptied by the siphon. The solvent is returned to the distillation flask. The thimble ensures that the rapid motion of the solvent does not transport any solid material to the still pot. This cycle may be allowed to repeat many times, over hours or days. Regarding this functionality, the soxhlet distillation extraction method is used to dissolve and extract oil and brine from rock core sample by using solvents

### Technical Specification:

- Maximum core sample diameter: 1.5"
- Maximum core sample length: 3.5"
- Maximum temperature: 450 °C
- Extractor capacity: 250 cc
- Solvent balloon: 500 cc
- Multiple unit model: 3 extractors
- Closed water cooling system



## Soxhlet Extractor (SO-R30)



A Soxhlet extractor is originally designed for the extraction of a lipid from a solid material. Typically, a soxhlet extraction is used when the desired compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent. It allows for unmonitored and unmanaged operation while efficiently recycling a small amount of solvent to dissolve a larger amount of material.

A soxhlet extractor has three main sections: A percolator (boiler and reflux) which circulates the solvent, a thimble (usually made of thick filter paper) which retains the solid to be laved, and a siphon mechanism, which periodically empties the thimble. The cleanliness of the sample is determined from the color of the solvent that siphons periodically from the extractor which must be clear. The solvent is heated to reflux. The solvent vapor travels up a distillation arm, and floods into the chamber housing the thimble of solid. The condenser ensures that any solvent vapor cools, and drips back down into the chamber housing the solid material. The chamber containing the solid material slowly fills with warm solvent. Some of the desired compound dissolves in the warm solvent. When the Soxhlet chamber is almost full, the chamber is emptied by the siphon. The solvent is returned to the distillation flask. The thimble ensures that the rapid motion of the solvent does not transport any solid material to the still pot. This cycle may be allowed to repeat many times, over hours or days. Regarding this functionality, the soxhlet distillation extraction method is used to dissolve and extract oil and brine from rock core sample by using solvents.

### Technical Specification:

- Maximum core sample diameter: 4"
- Maximum core sample length: 8"
- Maximum temperature: 450 °C
- Extractor capacity: 3 liters
- Solvent balloon: 5 liters
- Water cooling system
- Specific structure for assembling of the system





## CO<sub>2</sub>-Solvent Core Cleaning (CO<sub>2</sub>-R10)



Cleaning the polluted cores and saturated cores is one of the main concern of each special laboratories perform specific RCAL and SCAL analysis. In this regard, an equipment is designed and constructed to clean the piece of whole core or from a batch of core plug samples from crude oil, drilling mud liquids, and water from a single. The principle consists of filling the gas filled space in the core with solvent (e.g. toluene) by surrounding the core with a suitable solvent containing dissolved CO<sub>2</sub> gas and applying sufficient hydraulic pressure. The solvent mixes with oil in the core and subsequent depressurizing to atmospheric pressure removes residual oil from the core. A number of repeated cycles are required to clean the core of hydrocarbons. The main vessel is wrapped with an electrically heated belt. The solvent is pumped from an on-board supply tank to the cleaning vessel with a high pressure pump. After that, the high temperature high pressure solvent is delivered into a cooling system which not only reduce the pressure but also decrease the temperature of the hot solvent. Besides, a cyclone separator is installed to separate the CO<sub>2</sub> and the used cooled solvent when the vessel is drained.

### Technical Specification:

- Core diameters: 1, 1.5, 2.6 and 4"
- Maximum core length: 6"
- CO<sub>2</sub> pressure: 25 bar
- Maximum working pressure: 100 bar
- Maximum solvent pressure: 100 bar
- Maximum working temperature: 90 °C
- Vessel capacity: 3 liters
- Closed loop cooling system for cooling the waste stream
- Oil free water driver manual pump
- Cyclone for liquid and gas separation
- Pressure gauge×2
- Wetted materials: Stainless steel 316L







## Dean Stark Extractor (DS-R30)

The Dean-Stark apparatus is a piece of laboratory glassware used in synthetic chemistry to collect water (or occasionally other liquid) from a reactor. It is used in combination with a reflux condenser and a batch reactor for continuous removal of the water that is produced during a chemical reaction performed at reflux temperature. The dean stark extractor is also can be used to determine fluid saturation of core samples. The water fraction is vaporized by boiling solvent, condensed and then collected in a calibrated receiver. Vaporized solvent also condenses, soaks the sample, and extracts the oil. The sample is then oven dried and weighed. The oil content is determined by gravimetric difference while the water content is volumetrically measured by the receiving tube. The apparatus consists of a distillation/extraction glassware unit and a heating mantle with thermostatic controller. The glassware is composed of boiling flask with extractor, a sample support screen, volumetrically graduated water receiving tube and condenser. A flexible plastic tubing is also used to connect the condenser to the water cooling unit.

### Technical Specification:

- Maximum core sample diameter: 4"
- Maximum core sample length: 6"
- Maximum temperature: 450 °C
- Extractor capacity: 3 liters
- Solvent balloon: 5 liters
- Receiving burette: 50 cc (0.2 cc graduation with drain valve)
- Water cooling system
- Specific structure for safe assembling of the system



## Manual Core Saturator (SA-R10)



The manual saturator is used to saturate the core plug size by evacuating the air packages and inserting the pressurized fluids into the core under the pressure of maximum 300 bar. The standard apparatus includes a plug sized core cell, a vacuum pump, a hydraulic pump, a saturant vacuum tank and necessary hand operated valves and plumbing. A larger capacity cell to accommodate full size core samples is also available upon to the request.

### Technical Specification:

- Maximum core diameter: 1.5"
- Maximum core length: 12"
- Maximum working pressure: 350 bar
- Fluid accumulator: 500 cc
- Fluid saturator accumulator: 100 cc
- Vacuum pump
- Hydraulic pump
- Vacuum gauge
- Pressure gauge×2
- Basket for core loading: Stainless steel
- Vacuum erlenmeyer×2



## Gasometer (GM-R10)



The manual gasometer is designed to collect and measure the gas concomitant with the other liquids especially for live oil at ambient conditions of pressure and temperature. The gas enters the calibrated cylinder and raises the floating piston upwards which is equipped with a linear encoder lead to accurate measurement of the collected volume. The volume, temperature and pressure of the gas are continuously monitored and displayed. The gasometer is provided with inlet and outlet valves.

### Technical Specification:

- Maximum working pressure: 3 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5% full scale
- Maximum temperature measurement: 100 °C
- Temperature accuracy: 0.1 °C
- Volume: 4 liters
- Volume accuracy: 0.1 cc
- Linear encoder
- Linear encode accuracy: 5  $\mu$ m
- Wetted parts: Stainless steel 316L







## Electrical Properties Apparatus (EP-S10)

The Electrical Properties System is an instrument for ambient electrical resistivity measurements using core plug samples. The manually operated instrument includes an ambient electrical properties cell for 1.5" cores up to 4" in length, a resistivity meter and a brine resistance measurement dip cell. In addition, properties such as Formation Factor, Resistivity Index, Saturation Exponent "n", and Cementation Factor "m" can be determined.

### Technical Specification:

- Core diameter: 1.5"
- Maximum core length: 4"
- Maximum confining pressure: 5 bar
- Working temperature: Ambient
- Resistivity measurement method: 2 electrodes
- Resistivity accuracy: 0.1% full scale
- Test frequency range: 50 Hz to 100 KHz
- Automatic data acquisition and monitoring system





## Gas Permeameter (GP-R10)

The gas permeability measurement apparatus is designed in a way that it is possible to measure permeability to gas (air, nitrogen, ...) of plug sized core samples at room conditions and reservoir overburden pressure up to 20 bar using the steady state method. The instrument is designed to investigate slip factor and Klingleberg permeability versus reciprocal mean pressure relationship at different flow rates, back pressures and injection pressures by injecting gas through the test sample.

### Technical Specification:

- Core Holder (easy load)
- Core diameter: 1.5"
- Maximum core length: 3"
- Maximum injection pressure: 10 bar
- Maximum confining pressure: 16 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Permeability range: 0.5– 500 mD
- Mass flow meters
- Maximum flow rate: 500 cc/min
- Mass flow meter accuracy: 1 % full scale
- Pressure gauge×2
- Dead sample for confining pressure



## Gas Permeameter (GP-R20)



The gas permeability measurement apparatus is designed in a way that it is possible to measure permeability to gas (air, nitrogen, ...) of plug sized core samples at room conditions and reservoir overburden pressure up to 20 bar using the steady state method. The instrument is designed to investigate slip factor and Kligenberg permeability versus reciprocal mean pressure relationship at different flow rates, back pressures and injection pressures by injecting gas through the test sample. The differential pressure of both sides of the core is measured using a differential pressure transmitter and a precise gas mass flow meter is used to measure the past gas flow rate through the sample.

### Technical Specification:

- Core Holder (easy load)
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum injection pressure: 6 bar
- Maximum confining pressure: 20 bar
- Differential pressure transmitter
- Differential pressure transmitter accuracy: 0.1% full scale
- Permeability range: 0.1 – 1000 mD
- Mass flow meters
- Maximum flow rate: 1000 cc/min
- Mass flow meter accuracy: 1 % full scale
- Pressure gauge×2
- Dead billet for confining examination
- Touch panel: Equipped with special software for considering slippage factor and Kligenberg effect





## Gas Permeameter (GP-R30)



The gas permeability measurement apparatus is designed in a way that it is possible to measure permeability to gas (air, nitrogen, ...) of plug sized core samples at room conditions and reservoir overburden pressure up to 20 bar using the steady state method. The instrument is designed to investigate slip factor and Klignenberg permeability versus reciprocal mean pressure relationship at different flow rates, back pressures and injection pressures by injecting gas through the test sample. The differential pressure of both sides of the core is measured using a differential pressure transmitter and a precise gas mass flow meter is used to measure the past gas flow rate through the sample.

### Technical Specification:

- Core holder (easy load)
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum injection pressure: 6 bar
- Maximum confining pressure: 20 bar
- Differential pressure transmitter×2
- Differential pressure transmitter accuracy: 0.1 % full scale
- Permeability range: 0.001– 5000 mD
- Mass flow meters×2
- Flow rate range: 0-20 cc/min, 5-2000 cc/min
- Mass flow meter accuracy: 0.5 % full scale
- Pressure gauge×2
- Dead billet for confining examination
- Special software for considering slippage factor and Klignenberg effect





## Liquid Permeameter (LP-R10)

Permeability is the property of rocks that is an indication of the ability for fluids (gas or liquid) to flow through rocks. Generally, it is possible to measure the permeability using gas (commonly nitrogen) or liquid (commonly water). Measuring permeability due to gas is so rapid which enhances the applicability of this method. But, measurement using gas injection is somehow far from reality move operator toward using corrections. Regarding this fact, it is necessary to perform several tests by liquid injection to ensure about the corrections. In this way, a liquid permeameter is designed which is able to measure the permeability in the range of 0.5 mD to 100 mD. In addition, this apparatus is rated for confining pressure up to 400 bar able one to take into account the effect of upper layers on the permeability.

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum confining pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Permeability range: 0.5-100 mD
- Pressure indicator
- Pressure gauge
- Hydraulic pump
- No injection pump is included



## Liquid Permeameter (LP-R20)



Permeability is the property of rocks that is an indication of the ability for fluids (gas or liquid) to flow through rocks. Generally, it is possible to measure the permeability using gas (commonly nitrogen) or liquid (commonly water). Measuring permeability due to gas is so rapid which enhances the applicability of this method. But, measurement using gas injection is somehow far from reality move operator toward using corrections. Regarding this fact, it is necessary to perform several tests by liquid injection to ensure about the corrections. In this way, a liquid permeameter is designed which is able to measure the permeability in the range of 0.1 mD to 5000 mD. In addition, this apparatus is rated for confining pressure up to 400 bar able one to take into account the effect of upper layers on the permeability.

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum confining pressure: 400 bar
- Pressure transmitter×2
- Pressure transmitter accuracy: 0.1 % full scale
- Permeability range: 0.1- 5000 mD
- Pressure indicator×2
- Pressure gauge
- Hydraulic pump
- No injection pump is included
- Special software







## **Saturator and Gravimetric Porosimeter (GPO-R10)**

Several methods have been developed to measure the porosity and pore volume of a sample. One method is called the fluid resaturation method. In this method a clean and dried sample is weighted, saturated with a liquid of known density in desiccator, and then reweighed. The weight change divided by the density of the fluid results in the pore volume.

### **Technical Specification:**

- Desiccator volume: 10 liters
- Desiccator equipped with valve
- Vacuum pump
- Digital Balance
- Weighting accuracy: 0.01 g
- Vacuum erlenmeyer
- Silica gel



## Helium Porosimeter (PO-R10)



The porosity of a rock is one of the basic parameters measure how much of rock volume is open space (also called pore volume). Porosity is usually expressed as a percentage of the material's total volume. The designed equipment is rated for injection pressure of up to 10 bar (higher pressure is available upon to the request) works based on the Boyle's and Charles' law expansion of helium gas. An optional full diameter matrix cup can be added for determination of grain volume of whole diameter core samples. Each sample matrix cup is interchangeable and is provided with stainless steel billets for calibration.

### Technical Specification:

- Core holder
- Core diameter: 1.5"
- Maximum core length: 3"
- Maximum injection pressure: 10 bar
- Pressure transmitter
- Pressure accuracy: 0.25% full scale
- Porosity range: 1-40%
- Pressure regulator
- Pressure indicator
- Standard billets for calibration×1 set



## Helium Porosimeter (PO-R20)



The porosity of a rock is one of the basic parameters measure how much of rock volume is open space (also called pore volume). Porosity is usually expressed as a percentage of the material's total volume. The designed equipment is rated for injection pressure of up to 10 bar (higher pressure is available upon to the request) works based on the Boyle's and Charles' law expansion of helium gas. This equipment utilizes a data acquisition software allows for data logging and calculation of pore volume, grain density, porosity and bulk volume and also calibration data. An optional full diameter matrix cup can be added for determination of grain volume of whole diameter core samples. Each sample matrix cup is interchangeable and is provided with stainless steel calibration check plugs.

### Technical Specification

- Core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum injection pressure: 10 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.1% full scale
- Porosity range: 0.5-40 %
- Standard billets for calibration×1 set
- Standard check plugs with known porosity×1 set
- Touch panel
- Special software for calibration, automatic initial and final pressure recording, calculation of porosity, pore volume, grain density and bulk volume





## Helium Porosimeter (PO-R30)



Bench top-automatic helium gas expansion porosimeter especially designed for 1.5” cores in diameter with length of up to 3.5” is designed and constructed to measure the porosity in the range up to 50 %. It can also be designed and constructed for whole core matrix cup upon to the request of the client. Utilizes a highly accurate 0-10 bar transducer. Exclusive use of computer controlled valves allows automated control of the measurement process.

The software ensures that the system is fully calibrated and the equilibrium is established prior to the logging of all pressure measurements. Output files are generated that allow easy transfer of results to databases and spreadsheets for report generation.

### Technical Specification:

- Core holder
- Core diameter: 1.5”
- Core length: 3.5”
- Maximum injection pressure: 10 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.1% full scale
- Porosity range: 0.2-50 %
- Standard billets for calibration×1 set
- Standard check plugs with known porosity×1 set
- Automatic valves for automatic controlling of the system
- Special software for calibration, automatic initial and final pressure recording, calculation of porosity, pore volume, grain density and bulk volume



## Helium Porosimeter at Confining Pressure (POC-R10)



Routine porosity measurement equipment measure the porosity of the cores without considering the confining pressure on the samples. But in general, although the confining pressure is not able to significantly affect the porosity value, considering the reservoir volume a slight change in the porosity may leads to a huge deviation on the estimated value of original oil in place. Regarding this fact, porosity measurement at net confining stress is necessary to estimate more realistic amount of fluid in place for any hydrocarbon reservoir. This especial apparatus allows finding the effects of compaction on the rock properties. The equipment can be used for grain density measurement at net confining stress.

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3"
- Maximum confining pressure: 300 bar
- Maximum injection pressure: 10 bar
- Pressure regulator
- Pressure transmitter
- Pressure transmitter accuracy: 0.5% full scale
- Porosity range: 1-30%
- Pressure gauge
- Pressure indicator
- Hydraulic pump
- Standard billets for calibration×1 set



## Helium Porosimeter at Confining Pressure (POC-R20)



Routine porosity measurement equipment measures the porosity of the cores without considering the confining pressure on the samples. But in general, although the confining pressure is not able to significantly affect the porosity value, considering the reservoir volume a slight change in the porosity may lead to a huge deviation on the estimated value of original oil in place. Regarding this fact, porosity measurement at net confining stress is necessary to estimate more realistic amount of fluid in place for any hydrocarbon reservoir. This special apparatus allows finding the effects of compaction on the rock properties. The equipment can be used for grain density measurement at net confining stress

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3"
- Maximum confining pressure: 400 bar
- Maximum injection pressure: 150 bar
- Pressure regulator
- Pressure transmitter
- Pressure transmitter accuracy: 0.1% full scale
- Porosity range: 0.5-40%
- Pressure gauge
- Hydraulic pump
- Standard billets for calibration×1 set
- Standard check plugs with known porosity×1 set
- Special software for calibration, automatic initial and final pressure recording, calculation of porosity, pore volume, grain density, bulk volume and automatic pressure recording





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (SS316L) (CS250-E20)



The high pressure piston cylinder type transfer vessels are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle. The cylinders are made of stainless steel 316 L which can also be manufactured by titanium based on the client order.

### Technical Specifications:

- Maximum working pressure: 400 bar
- Maximum working temperature: 100 °C
- Volume: 250 cc
- Rolling stainless steel ball for agitation and mixing
- Connections and fittings: Stainless Steel 316L
- Wetted part material: Stainless steel 316L



## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (SS316L) (CS250-E30)



The high pressure piston cylinder type transfer vessels are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle. The cylinders are made of stainless steel 316 L which can also be manufactured by titanium based on the client order.

### Technical Specifications:

- Maximum working pressure: 600 bar
- Maximum working temperature: 100 °C
- Volume: 250 cc
- Rolling stainless steel ball for agitation and mixing
- Connections and fittings: Stainless Steel 316L
- Wetted part material: Stainless steel 316L





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (SS316L) (CS500-E20)



The high pressure piston cylinder type transfer vessels are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle. The cylinders are made of stainless steel 316 L which can also be manufactured by titanium based on the client order.

### Technical Specifications:

- Maximum working pressure: 400 bar
- Maximum working temperature: 100°C
- Volume: 500 cc
- Rolling stainless steel ball for agitation and mixing
- Connections and fittings: Stainless Steel 316L
- Wetted part material: Stainless steel 316L





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (SS316L) (CS500-E30)



The high pressure piston cylinder type transfer vessels are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle. The cylinders are made of stainless steel 316 L which can also be manufactured by titanium based on the client order.

### Technical Specifications:

- Maximum working pressure: 600 bar
- Maximum working temperature: 100°C
- Volume: 500 cc
- Rolling stainless steel ball for agitation and mixing
- Connections and fittings: Stainless Steel 316L
- Wetted part material: Stainless steel 316L



## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (SS316L) (CS750-E20)



The high pressure piston cylinder type transfer vessels are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle. The cylinders are made of stainless steel 316 L which can also be manufactured by titanium based on the client order.

### Technical Specifications:

- Maximum working pressure: 400 bar
- Maximum working temperature: 100 °C
- Volume: 750 cc
- Rolling stainless steel ball for agitation and mixing
- Connections and fittings: Stainless steel 316L
- Wetted part material: Stainless steel 316L





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (SS316L) (CS750-E30)



The high pressure piston cylinder type transfer vessels are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle. The cylinders are made of stainless steel 316L which can also be manufactured by titanium based on the client order.

### Technical Specifications:

- Maximum working pressure: 600 bar
- Maximum working temperature: 100°C
- Volume: 750 cc
- Rolling stainless steel ball for agitation and mixing
- Connections and fittings: Stainless Steel 316L
- Wetted part material: Stainless steel 316L





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (Titanium) (CT250-E20)



The high pressure piston cylinder type transfer vessels made of titanium are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle.

### Technical Specifications:

- Maximum working pressure: 400 bar
- Maximum working temperature: 100°C
- Volume: 250 cc
- Rolling titanium ball for agitation and mixing
- Connections and fittings: Stainless steel 316L
- Corrosion resistance
- Wetted part material: Titanium



## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (Titanium) (CT250-E30)



The high pressure piston cylinder type transfer vessels made of titanium are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle.

### Technical Specifications:

- Maximum working pressure: 600 bar
- Maximum working temperature: 100°C
- Volume: 250 cc
- Rolling titanium ball for agitation and mixing
- Connections and fittings: Stainless steel 316L
- Corrosion resistance
- Wetted part material: Titanium





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (Titanium) (CT500-E20)



The high pressure piston cylinder type transfer vessels made of titanium are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle.

### Technical Specifications:

- Maximum working pressure: 400 bar
- Maximum working temperature: 100°C
- Volume: 500 cc
- Rolling titanium ball for agitation and mixing
- Connections and fittings: Stainless steel 316L
- Corrosion resistance
- Wetted part material: Titanium





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (Titanium) (CT500-E30)



The high pressure piston cylinder type transfer vessels made of titanium are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle.

### Technical Specifications:

- Maximum working pressure: 600 bar
- Maximum working temperature: 100°C
- Volume: 500 cc
- Rolling titanium ball for agitation and mixing
- Connections and fittings: Stainless steel 316L
- Corrosion resistance
- Wetted part material: Titanium



## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (Titanium) (CT750-E20)



The high pressure piston cylinder type transfer vessels made of titanium are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle.

### Technical Specifications:

- Maximum working pressure: 400 bar
- Maximum working temperature: 100 °C
- Volume: 750 cc
- Rolling titanium ball for agitation and mixing
- Connections and fittings: Stainless steel 316L
- Corrosion resistance
- Wetted part material: Titanium





## Piston Cylinder Type Shipping Bottle for Oil and Gas Sampling (Titanium) (CT750-E30)



The high pressure piston cylinder type transfer vessels made of titanium are commonly used in the oil and gas industries to transfer the liquid/gas samples into the laboratory for analysis. Regarding this, Fars EOR Tech. Co manufactured a double end piston type cylinder for safe transportation of the reservoir fluid to the laboratory. The transfer vessel utilized an internal low-friction floating piston to separate the driving fluid from the driven fluid. The inside surface of the piston is highly polished for sake of lowering the friction between the cylinder and the internal piston. The internal piston utilizes two different rubber parts to not only ensure the sealing of two sides but also to center the piston inside the piston avoiding any damage of piston wall. All bottles are equipped with multi-port gauge valves for each end plug to control the injection pressure and injection fluid easily. On the sample side, there is also incorporated an evacuation port nipple and plug which is crucial if the valves faced with malfunction.

All of the valves and installed connections and fitting are protected using a newly designed protection cap which not only introduce a protective capability but also it an act like a support for handling the shipping bottle.

### Technical Specifications:

- Maximum working pressure: 600 bar
- Maximum working temperature: 100 °C
- Volume: 750 cc
- Rolling titanium ball for agitation and mixing
- Connections and fittings: Stainless steel 316L
- Corrosion resistance
- Wetted part material: Titanium





## **Sand Pack Core Flooding (SPCF-E10)**



The sand pack core flooding is a vessel filled with sand and dedicated to evaluate and optimize oil recovery for different injection protocols and fluids e. g. miscible and immiscible injection, surfactant injection, polymer injection and etc.

### **Technical Specification:**

- Visual Sand pack cell
- Cell parts: Transparent plexi glass
- Cell diameter: 1.5"
- Cell length: 40 cm
- Working pressure: ambient
- Working temperature: ambient



## Sand Pack Core Flooding (SPCF-E20)



The sand pack core flooding is a vessel filled with sand and dedicated to evaluate and optimize oil recovery for different injection protocols and fluids e. g. miscible and immiscible injection, surfactant injection, polymer injection and etc.

### Technical Specification:

- Sand pack cell
- Cell parts: Stainless steel 316L
- Cell diameter: 1.5"
- Cell length: 40 cm
- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 1^{\circ}\text{C}$
- Fluid accumulator $\times 2$ : 500 cc
- Pressure gauge $\times 2$
- Touch panel: Equipped with software for automatic data acquisition and monitoring system (automatic pressure and temperature recording)





## Sand Pack Core Flooding (SPCF-E30)



The sand pack core flooding is a vessel filled with sand and dedicated to evaluate and optimize oil recovery for different injection protocols and fluids e. g. miscible and immiscible injection, surfactant injection, polymer injection and etc.

### Technical Specification:

- Sand pack cell
- Cell parts: Stainless steel 316L
- Cell diameter: 1.5"
- Cell length: 40 cm
- Maximum working pressure: 600 bar
- Pressure transmitter×2
- Pressure transmitter accuracy: 0.25 % full scale
- Back pressure regulator: 400 bar
- Maximum working temperature: 100 °C
- Temperature resolution: ±1°C
- Fluid accumulator×3: 500 cc
- Miniature fluid accumulator: 100 cc for rinsing the system
- Pressure gauge×3
- Data acquisition system
- Touch panel: Equipped with software for automatic data acquisition and monitoring system (automatic pressure and temperature recording)



## Benchtop Core Flooding (BCF-E10)



The BCF-E10 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids such as surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure of 400 bar for liquid/liquid displacements under unsteady state conditions at confining pressures up to 400 bar. This apparatus is consisted of one transfer vessel and core holder capable the system to perform different injection scenarios. In addition, the transfer vessel can be used for chemical or microbial flooding.

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum working pressure: 400 bar
- Maximum confining pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Working temperature: Ambient
- Accumulator: 500 cc
- Pressure gauge×2
- Hand pump





## General Core Flooding (CF-E10)



The CF-E10 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids, e.g. miscible and immiscible gas injection, surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure and temperature of 400 bar and 100°C under unsteady state conditions at confining pressures up to 400 bar. This apparatus is consisted of four different transfer vessels and one core holder capable the system to perform different injection scenarios. One of the transfer vessels is a miniature type which can be used for rinsing the lines by fulfill it with toluene or other solvents.

### Technical Specifications:

- Hassler core holder
- Core diameter: 1.5”
- Maximum core length: 3.5”
- Maximum working pressure: 400 bar
- Maximum confining pressure: 400 bar
- Pressure transmitter×2
- Pressure transmitter accuracy: 0.5 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution: ±1 °C
- Accumulator×2: 500 cc
- Pressure gauge×2
- Hydraulic pump×1



## General Core Flooding (CF-E20)



The CF-E20 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids e. g. miscible and immiscible gas injection, surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure and temperature of 400 bar and 100 °C for displacements under unsteady state conditions at confining pressures up to 400 bar. This apparatus is consisted of four different transfer vessels and one core holder capable the system to perform different injection scenarios. One of the transfer vessels is a miniature type which can be used for rinsing the lines by fulfill it with toluene or other solvents. In addition, this miniature transfer vessel can be used for chemical or microbial flooding which the injected slug is small.

### Technical Specifications:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum working pressure: 400 bar
- Maximum confining pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.1% full scale
- Differential pressure transmitters×2
- Differential pressure transmitter accuracy: 0.1% full scale
- Back pressure regulator: 400 bar
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 1^{\circ}\text{C}$
- Fluid accumulators×3: 500 cc
- Miniature fluid accumulator×1: 100 cc for rinsing the system
- Pressure gauge×2
- Hydraulic pump
- Data acquisition system
- Touch panel





## General Core Flooding (CF-E30)



The CF-E30 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids, e.g. miscible and immiscible gas injection, surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure and temperature of 600 bar and 100°C for displacements under unsteady state conditions at confining pressures up to 600 bar. This apparatus is consisted of four different transfer vessels and one core holder capable the system to perform different injection scenarios. One of the transfer vessels is a miniature type which can be used for rinsing the lines by fulfill it with toluene or other solvents. In addition, this miniature transfer vessel can be used for chemical or microbial flooding which the injected slug is small.

### Technical Specifications:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum working pressure: 600 bar
- Maximum confining pressure: 600 bar
- Pressure transmitter×2
- Pressure transmitter accuracy: 0.1 % full scale
- Differential pressure transmitters×2
- Differential pressure transmitter accuracy: 0.1 % full scale
- Gas back pressure regulator: 600 bar
- Maximum working temperature: 100°C with resolution of  $\pm 1$  °C
- Temperature resolution:  $\pm 1$ °C
- Fluid accumulator×3: 750 cc
- Miniature fluid accumulator×1: 100 cc for rinsing the system
- Gasometer: Equipped with a linear encoder
- Hydraulic pump
- Data acquisition system
- Software for automatic pressure and temperature recording



## Microbial Core Flooding (SFB-E30)



The core flooding system is designed and constructed in a very flexible and modular fashion, therefore it can be employed in most of the upstream studies with appropriate modifications with a special respect to MEOR core flooding experiments. Different types of experiments could be conducted using this apparatus such as conventional fluid injection, soaking experiment for determining the wettability alteration capability of microbes and bacteria, adsorption test, tertiary oil recovery and other experiments related to the injection of microorganisms into the core plugs.

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum working pressure: 400 bar
- Maximum confining pressure: 400 bar
- Pressure transmitter×2
- Pressure transmitter accuracy: 0.1% full scale
- Maximum working temperature: 100 °C
- Temperature resolution: ±1°C
- Fluid accumulators×2: 500 cc
- Miniature fluid accumulator×1: 100 cc for rinsing the system
- Wetted parts: Stainless steel 316L
- Hydraulic pump×1
- Data acquisition system×1
- Touch panel×1: Equipped with a software for automatic pressure and temperature recording





## Core Acidizing (CA-S20)



The core acidizing system is designed in a way that it is possible to inject an acid solution into a rock sample at reservoir conditions to modify the natural permeability of rock by dissolving some minerals present in the rock. Since the wetted material is hastelloy, it is possible to not only investigate the efficiency of different HCl-HF formulations to attack plugging minerals, but also to study the effects of flow rate and temperature on core samples permeability.

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum working pressure: 400 bar
- Maximum confining pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.1% full scale
- Differential pressure transmitter×2
- Differential pressure transmitter accuracy: 0.1% full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 1$  °C
- Fluid accumulator×2: 500 cc (Hastelloy C-276)
- Fluid accumulator: 100 cc (Stainless steel 316L) for rinsing the system
- Wetted parts: Hastelloy C-276 and stainless steel 316L
- Touch panel: Equipped with software for automatic data acquisition and monitoring system (automatic pressure and, temperature recording and core pressure drop)
- Hydraulic pump



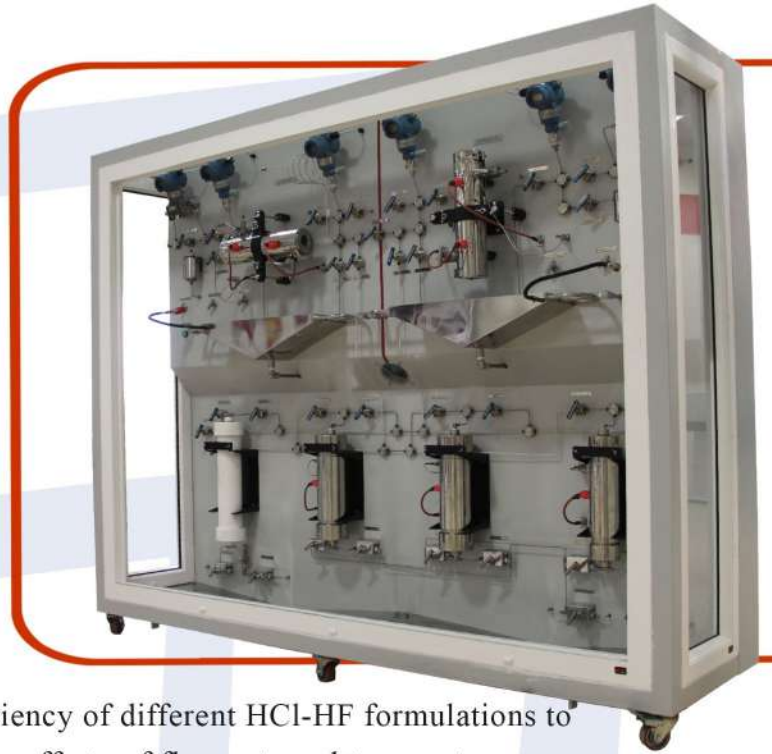
## Core Acidizing (CA-S30)

The core acidizing system is designed in a way that it is possible to inject an acid solution into a rock sample at reservoir conditions to modify the natural permeability of rock by dissolving some minerals present in the rock.

Since the wetted material is hastelloy, it is possible to not only investigate the efficiency of different HCl-HF formulations to attack plugging minerals but also to study the effects of flow rate and temperature on core samples permeability.

### Technical Specification:

- Hassler core holder×2
- Core diameter: 1.5”
- Maximum core length: 6”
- Maximum working pressure: 600 bar
- Maximum confining pressure: 600 bar
- Pressure transmitter×4
- Pressure transmitter accuracy: 0.1 % full scale
- Differential pressure transmitter×2
- Differential pressure transmitter accuracy: 0.1 % full scale
- Gas back pressure regulator×2: 600 bar (Hastelloy C-276)
- Maximum working temperature: 100 °C
- Fluid accumulator×2: 750 cc (Hastelloy C-276)
- Fluid accumulator: 750 cc (Stainless steel 316L)
- Low pressure accumulator for easy charging of the high pressure acid accumulator ×1: 1000 cc (PTFE)
- Asymmetric design to perform two parallel acid injections into different cores
- Equipped with manual rocking system for core holder rotation at 90, 180, 270 and 360 degrees
- Vertical, horizontal and reverse injection of fluid
- Wetted parts: Hastelloy C-276 and stainless steel 316L
- Computer system: Equipped with software for automatic data acquisition and monitoring system
- High pressure single pump×1 (600 bar)







## Asphaltene Detection and Analyzing System (PSA-S10)

Asphaltenes and waxes are of the most dreadful and expensive challenges of petroleum industry for both oil recovery and processing. Precipitation of such complex mixtures is a major factor that causes severe difficulties in oil recovery and processing such as plugging, flow interruption, wettability alteration and formation damage.

This apparatus is specially designed to precisely study different aspects of asphaltene precipitation at field conditions. The flexibility associated with this equipment makes it more appropriate for conducting comprehensive research in different areas of asphaltene problems, specially precipitation detection, asphaltene size analyzing, etc.

### Technical Specifications:

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure accuracy: 0.1 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 0.2$  °C
- Cell volume: 250 cc
- High pressure cell equipped with high pressure sight glass
- Back light
- Microscope
- Digital camera
- High pressure hand pump
- Wetted parts: Stainless steel 316L
- Particle size analyzer software





## Wettability Alteration Chamber (WAC-S20)



Wettability alteration chamber is designed for the purpose of core wettability restoration prior to SCAL studies. Wettability changes are obtained by subjecting the core to reservoir conditions of temperature and pressure for weeks. At this stage, a wettability transition may occur in the oil-invaded pores depending on the stability of the thin water films, located between the pore walls and the oil.

### Technical Specification:

- Maximum core diameter: 1.5"
- Maximum working pressure: 400 bar
- Maximum working temperature: 100 °C
- Cell volume: 100, 300, 500 cc
- High pressure cell×3
- Pressure gauge×4
- Hydraulic pressurizing system
- Wetted parts: Stainless steel 316L



## Wettability Alteration Chamber (WAC-S30)



Wettability alteration chamber is designed for the purpose of core wettability restoration prior to SCAL studies. Wettability changes are obtained by subjecting the core to reservoir conditions of temperature and pressure for weeks. At this stage, a wettability transition may occur in the oil-invaded pores depending on the stability of the thin water film, located between the pore walls and the oil.

### Technical Specification:

- Maximum core diameter: 1.5" for plug
- Maximum core diameter: 4" for whole core
- Maximum working pressure: 600 bar
- Maximum working temperature: 120 °C
- Heating System: Oven
- Cell volume for core plug: 100, 300, 750 cc
- Cell volume for whole core (4"): 3000 cc
- High pressure cell×4
- Pressure gauge×5
- Hydraulic pressurizing system
- Wetted parts: Stainless steel 316L





## Recombination Cell (RC-S10)

This HP-HT Recombination Cell is designed to make a homogenous mixture of oil and gas using a mixing system. What you need is oil and gas sample with pre-defined volumes. Using a pressurizing system, you can reach your ideal pressure. Temperature is also provided with heating elements or jackets. Very powerful mixing system is another option of this apparatus.

### Technical Specification:

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5% full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 1$  °C
- Cell volume: 500 cc
- Hydraulic pressurizing system
- Stainless steel ball mixing mechanism
- Wetted parts: Stainless steel 316L







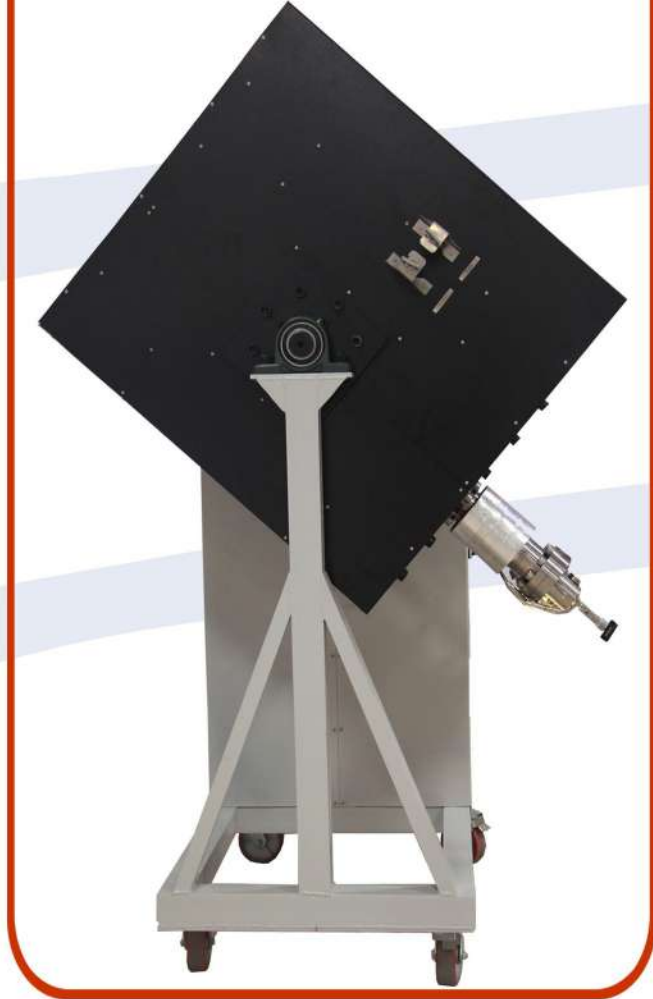
## Recombination Cell (RC-S20)

This HP-HT Recombination Cell is designed to make a homogenous mixture of oil and gas using a mixing system. What you need is oil and gas sample with pre-defined volumes. Using a pressurizing system, you can reach your ideal pressure. Temperature is also provided with heating elements or jackets. Very powerful magnetic mixing is another option of this apparatus.

### Technical Specification:

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25% full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 0.5$  °C
- Cell volume: 1000 cc
- Hydraulic pressurizing system
- Magnetic mixing mechanism
- Wetted parts: Stainless steel 316L
- Touch panel: Equipped with Data acquisition software





## Recombination Cell (RC-S30)

This HP-HT Recombination Cell is designed to make a homogenous mixture of oil and gas using a mixing and cell rocking (optional) system. What you need is oil and gas sample with pre-defined volumes. Using a pressurizing system, you can reach your ideal pressure. Temperature is also provided with heating elements or jackets. Very powerful magnetic mixing is another option of this apparatus.

### Technical Specification:

- Maximum working pressure: 600 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.1% full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 0.1$  °C
- Cell volume: 2000 cc
- Hydraulic pressurizing system
- Equipped with two visual sight glasses
- Magnetic and rocking mixing mechanism
- Including 500 cc, 600 bar stainless steel shipping bottle  $\times 1$  pcs
- Wetted parts: Stainless steel 316L
- Touch panel: Equipped with data acquisition software and PC connection port



## Manual PVT (MPV-S10)



The PVT system is designed to study phase behavior of hydrocarbon fluids at reservoir conditions of pressure and temperature. It can be used to perform PVT tests on black oil, volatile oil, etc. Homogeneous sample heating is provided by a controlled temperature jacket.

### Technical Specification

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 0.5$  °C
- Heating system: Thermal jacket
- HP-HT cell
- Cell volume: 100 cc
- Mixing system





## PVT (PV-S10)

The PVT system is designed to study phase behavior of hydrocarbon fluids at reservoir conditions of pressure and temperature. It can be used to perform PVT tests on black oil, volatile oil, etc. The system uses an embedded high pressure pump to control the pressure and pressure and volume of the reservoir fluid in the cell. A magnetic coupled stirrer mounted inside the sample chamber provides efficient fluid mixing and ensures fast equilibrium of sample phases. Homogeneous sample heating is provided by a controlled temperature jacket.



### Technical Specification:

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 0.5$  °C
- Heating system: Thermal jacket
- HP Visual cell equipped with 2 sight glasses
- Cell volume: 100 cc
- Volume accuracy: 0.01 cc
- Magnetic mixing system
- Mixing motor power: 400 W
- Induction magnetic stirrer speed: 1000 rpm
- Constant pressure and flow rate mode
- Flow rate range: 0.01-20 cc/min
- Image capturing system to observe and record phase behavior changes
- Visual detection capability of bubble point
- CCD camera: 4 megapixel
- Macro lens: Computar (C mount, magnification of 10 $\times$ )
- Touch panel: Equipped with a software for controlling the system



## PVT (PV-S20)

The PVT system is designed to study phase behavior of hydrocarbon fluids at reservoir conditions of pressure and temperature. It can be used to perform PVT tests on black oil, volatile oil, etc. The system uses an embedded high pressure pump to control the pressure and volume of the reservoir fluid in the cell. The unit can be configured for either oil or gas condensates studies by inverting the position of the cell using the rocking system. A video camera system helps the operator to determine the gas/liquid interface.

A magnetic coupled stirrer mounted inside the sample chamber provides efficient fluid mixing and ensures fast equilibrium of sample phases. Homogeneous sample heating is provided by a controlled temperature jacket.



### Technical Specification:

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 0.2$  °C
- Heating system: Thermal jacket
- HP Visual cell equipped with 2 sight glasses
- Cell volume: 300 cc
- Volume accuracy: 0.01 cc
- Rocking system
- Magnetic mixing system
- Mixing motor power: 400 W
- Induction magnetic stirrer speed: 1500 rpm
- Constant pressure and flow rate mode
- Flow rate range: 0.01-30 cc/min
- Image capturing system to observe and record phase behavior changes
- Visual detection capability of bubble point and dew point
- CCD camera: 4 megapixel
- Macro lens: Computer (C mount, magnification of 10 $\times$ )
- Touch panel: Equipped with a software for controlling the system
- Computer system: Equipped with a software for controlling the system





## PVT (PV-S30)

The PVT system is designed to study phase behavior of hydrocarbon fluids at reservoir conditions of pressure and temperature. It can be used to perform PVT tests on black oil, volatile oil, etc. The system uses an embedded high pressure pump to control the pressure and volume of the reservoir fluid in the cell. The unit can be configured for either oil or gas condensates studies by inverting the position of the cell using the rocking system. A video camera system capable the operator to determine the gas/liquid interface. A magnetic coupled stirrer mounted inside the sample chamber provides efficient fluid mixing and ensures fast equilibrium of sample phases. Homogeneous sample heating is provided by a controlled temperature jacket.



### Technical Specification:

- Maximum working pressure: 600 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.1% full scale
- Maximum working temperature: 100 °C
- Temperature resolution:  $\pm 0.1$  °C
- Heating system: Thermal jacket
- HP Visual cell equipped with 2 sight glasses
- Cell volume: 400 cc
- Volume accuracy: 0.001 cc
- Rocking system
- Magnetic mixing system
- Mixing motor power: 400 W
- Induction magnetic stirrer speed: 2000 rpm
- Constant pressure and flow rate mode
- Flow rate range: 0.01-30 cc/min
- Image capturing system to observe and record phase behavior changes
- Visual detection capability of bubble point and dew point
- CCD camera: 4 megapixel
- Back light
- Macro lens: Computer (C mount, magnification of 10 $\times$ )
- Gasometer $\times$ 1: Equipped with a linear encoder
- Touch panel: Equipped with a software for controlling the system
- Computer system: Equipped with a software for controlling the system





## Capillary Tube Viscometer (CTV-S10)



This viscometer is designed for the viscosity measurement of fluids at reservoir. The fluid viscosity is important in any EOR development plan, reservoir fluid characterization, oil production optimization, thermal EOR process, asphaltene onset measurement, and supercritical fluid studies at elevated pressure and temperature. This high pressure/high temperature incorporates a digital pressure gauge and temperature.

### Technical Specification:

- Liquid viscosity range: 1-500 cP
- Calculating the viscosity using Hagen–Poiseuille equation
- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Maximum working temperature: 100°C
- Temperature resolution:  $\pm 0.1$  °C
- Heating system: Oven





## Gas-Oil Ratio Measurement (GO-S10)

This well-known property of any oil reservoir determines the amount of gas separated from a unit volume of reservoir liquid (oil) which is measured at standard condition. GOR plays an important role to assess the hydrocarbon volume in place and prepare the best production scenario. Regarding this importance, the GOR apparatus is designed in way that it is possible to flash pressurized liquids and measure the liberated gas at equilibrium conditions and dead liquid using calibrated collecting devices. The system is equipped with a manual 4 lit gasometer to measure the liberated gas with accuracy of 1cc while the pressure and temperature of the system are indicated.

### Technical Specification

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure accuracy: 0.5 % full scale
- Live oil accumulator
- Gasometer×1: Equipped with a linear encoder
- Vials for separation of liquid and gas





## Liquid-Liquid Unsteady State Relative Permeameter (URP-ES20)



Unsteady state relative permeability measurement is a basic and inexpensive linear displacement test for immiscible and incompressible fluids. Regarding this, URP-ES20 is designed in a way that it is able to perform different injection protocol to measure the relative permeability by different analysis method including Johnson-Bossler-Naumann (JBN), modified JBN, Toth et al. and the Jones-Roszelle methods. Unsteady-state method is particularly suited for measuring endpoint values of the non-wetting phase. The URP-ES20 system provides a versatile facility to carry out unsteady state relative permeability studies for liquid/liquid at reservoir temperature.

### Technical Specification:

- Hassler core holder
- Core diameter: 1.5”
- Maximum core length: 3.5”
- Maximum working pressure: 400 bar
- Maximum confining pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Differential pressure transmitters×2
- Differential pressure transmitter accuracy: 0.25 % full scale
- Fluid accumulators×2: 500 cc
- Miniature fluid accumulator: 100 cc for rinsing the system
- Hydraulic pump
- An off-line software for calculating the relative permeability using JBN, modified JBN, JR and Toth et al. methods
- Touch panel: Equipped with a software for automatic pressure and temperature





## Liquid-Liquid Unsteady State Relative Permeameter (URP-ES30)



Unsteady state relative permeability measurement is a basic and inexpensive linear displacement test for immiscible and incompressible fluids. Regarding this, URP-ES30 is designed in a way that it is able to perform different injection protocol to measure the relative permeability by different analysis method including Johnson-Bossler-Naumann (JBN), modified JBN, Toth et al. and the Jones-Roszelle methods. Unsteady-state method is particularly suited for measuring endpoint values of the non-wetting phase. The URP-ES30 system provides a versatile facility to carry out unsteady state relative permeability studies for liquid/liquid at reservoir pressure and temperature.

### Technical Specification:

- Hassler Core holder
- Core diameter: 1.5"
- Maximum core length: 3.5"
- Maximum working pressure: 400 bar
- Maximum confining pressure: 600 bar
- Pressure transmitter×2
- Pressure transmitter accuracy: 0.1 % full scale
- Differential pressure transmitters×2
- Differential pressure transmitter accuracy: 0.1 % full scale
- Gas back pressure regulator: 400 bar
- Maximum working temperature: 100 °C
- Fluid accumulators×3: 500 cc
- Miniature fluid accumulator: 100 cc for rinsing the system
- Gasometer×1: Equipped with a linear encoder
- Hydraulic pump
- Wetted parts: Stainless steel 316L
- Data acquisition system
- Software for recording the temperature and pressure  
Off-line software for calculating the relative permeability using JBN, modified JBN, JR and Toth et al





## Pendant Drop Contact Angle and IFT Measurement (CA-ES10)

IFT as the indication of energy at the interface of two immiscible fluids; is a vital parameter for any EOR process. The EOR agents such as surfactants, alkaline and polymers tend to reduce the IFT between oil and water to decrease capillary forces and recovering more residual oil.

Drop shape analysis (pendant drop method) is a convenient way to measure surface tension. Pendant drop tensiometry, enhanced by video-image analysis, has been considered as a very accurate method for measuring the IFT of fluid/fluid interface for a wide range of IFT values. In this method, video images of pendant drops are digitized to determine the interface loci, then measuring the IFT through the solution of the Young-Laplace equation. Wettability of the reservoir rock and interfacial tensions between the reservoir fluids play the most important role on the oil recovery efficiency. The outcomes of several research works in EOR Research Center are utilized to design these two apparatuses for accurate wettability and IFT measurement.

### Technical Specifications:

- IFT range: 3-72 mN/m
- Contact angle range:  $5^{\circ}$ - $179^{\circ}$
- Working pressure: Ambient
- Working temperature: Ambient
- Automatic dosing pump
- Glass visual cell
- CCD camera: 4 Mega Pixel
- Macro lens: computer (C mount, magnification of  $10\times$ )
- Three degree of freedom camera positioner
- Back light
- Online special software for analyzing the shape of the drop for measuring the IFT and contact angle of the liquid-liquid systems





## Pendant Drop Contact Angle and IFT Measurement (CA-ES20)



IFT as the indication of energy at the interface of two immiscible fluids; is a vital parameter for any EOR process. The EOR agents such as surfactants, alkaline and polymers tend to reduce the IFT between oil and water to decrease capillary forces and recovering more residual oil.

Drop shape analysis (pendant drop method) is a convenient way to measure surface tension. Pendant drop tensiometry, enhanced by video-image analysis, has been considered as a very accurate method for measuring the IFT of fluid/fluid interface for a wide range of IFT values. In this method, video images of pendant drops are digitized to determine the interface loci, then measuring the IFT through the solution of the Young-Laplace equation.

Wettability of the reservoir rock and interfacial tensions between the reservoir fluids play the most important role on the oil recovery efficiency. The outcomes of several research works in EOR Research Center are utilized to design these two apparatuses for accurate wettability and IFT measurement.

### Technical Specifications:

- IFT range: 3-72 mN/m<sup>-1</sup>
- Contact angle range: 5°-179°
- Working pressure: Ambient
- Maximum working temperature: 50 °C (not suitable for volatile solvents)
- Moving Parts (Visual Cell and Needle)
- Automatic dosing pump
- Metal-Glass visual cell
- CCD camera: 4 Mega Pixel
- Macro lens: Computar (C mount, magnification of 10×)
- Three degree of freedom camera positioner
- Back light
- Online special software for analyzing the shape of the drop for measuring the IFT and contact angle of the liquid-liquid systems





## HP-HT Pendant Drop IFT Measurement (VIT-ES20)



The Pendant Drop Interfacial Tension system measures interfacial tension between liquid-gas and liquid-liquid interfaces using pendent drop method as well as the contact angle between liquid and solid interfaces at reservoir pressure and temperature to 400 bar and 100°C. The cell is designed in a way that it is possible to utilize different sizes of needles to achieve a wide measurement range. This apparatus utilizes two different manual pump for independent discharge of bulk fluid and drop fluid into the visual cell equipped with sapphire sight glasses metallically sealed. The system also equipped with online image processing software captures and analysis the images as a function of time. The visual cell has an external heaters placed inside the body of the cell to achieve a homogenous heating. The cell is designed so that the injected phase can enter from the bottom or the top of the visual cell.

### Technical Specifications:

IFT range: 3-72 mN.m<sup>-1</sup>

- Maximum working pressure: 400 bar
- Pressure transmitter
- Pressure accuracy: 0.5 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution: ±0.5 °C
- High pressure cell equipped with 2 HP sight glasses
- High pressure manual pump×2
- CCD camera: 4 megapixel
- Macro lens: Computer (C mount, magnification of 10×)
- Four degree of freedom camera positioner
- Back light
- Online drop shape analysis software



## HP-HT Pendant Drop IFT Measurement Apparatus (VIT-ES30)



The Pendant Drop Interfacial Tension system measures interfacial tension between liquid-gas and liquid-liquid interfaces using pendant drop method as well as the contact angle between liquid and solid interfaces at reservoir pressure and temperature to 700 bar and 150 °C. The cell is designed in a way that it is possible to utilize different sizes of needles to achieve a wide measurement range. This apparatus utilizes two different manual pump for independent discharge of bulk fluid and drop fluid into the visual cell equipped with sapphire sight glasses metalically sealed. The system also equipped with online image processing software captures and analysis the images as a function of time. The visual cell has an external heaters placed inside the body of the cell to achieve a homogenous heating. The cell is designed so that the injected phase can enter from the bottom or the top of the visual cell.

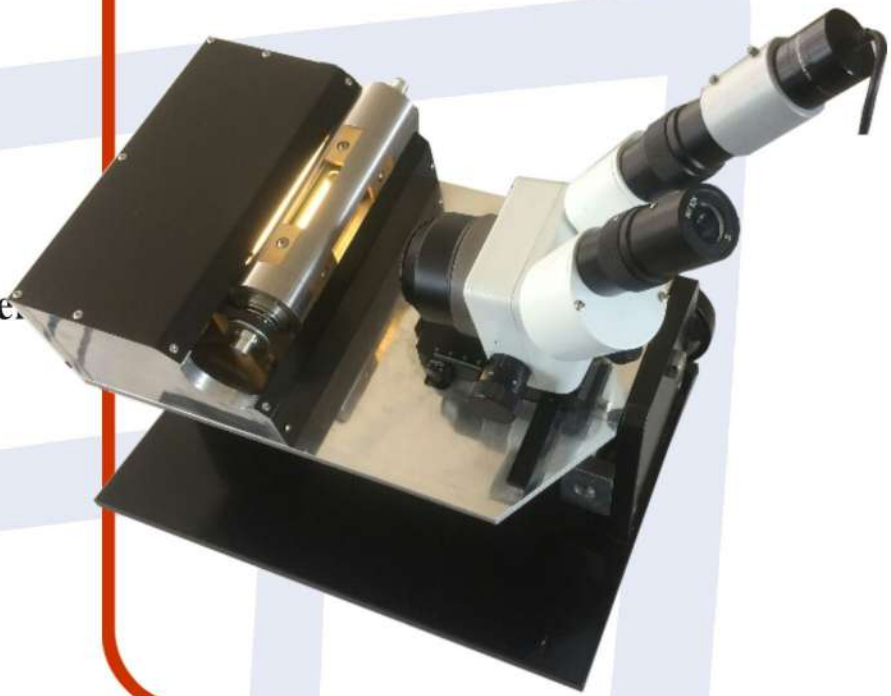
### Technical Specifications:

- IFT range: 1-72 mN.m<sup>-1</sup>
- Maximum working pressure: 600 bar
- Pressure transmitter
- Pressure accuracy: 0.25 % full scale
- Maximum working temperature: 100 °C
- Temperature resolution: ±0.1 °C
- High pressure cell equipped with 2 HP sight glasses
- High pressure manual pump×2
- CCD camera: 4 megapixel
- Macro lens: Computar (C mount, magnification of 10×)
- Four degree of freedom camera positioner
- Back light
- Online drop shape analysis software





## Spinning Drop IFT Measurement (SD-ES10)



IFT as the indication of energy at the interface of two immiscible fluids, is a vital parameter for any EOR process. The EOR agents such as surfactants, alkaline and polymers tend to reduce the IFT between oil and water to decrease capillary forces and recovering more residual oil.

The designed Spinning Drop apparatus (SD-ES10) is able to measure ultralow interfacial tension down to  $10^{-5}$ -5 mN/m. Ultra low interfacial tensions which is utilized by special types of chemicals results in high oil recovery through IFT reduction and wettability alteration. These results help operator to develop and optimize emulsions and microemulsions.

### Technical Specification:

- IFT range:  $10^{-5}$ -5 mN/m
- Working pressure: Ambient
- Working temperature: Ambient
- Maximum cell speed: 12000 rpm
- Capillary diameter: 0.105" (2.6 mm)
- Microscope
- Digital camera
- Magnification: 20×
- Back light (for better contrast and sharpness)
- Camera positioner





## HP Dual Pump (400 bar) (P2-400)



Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. These pumps are introduced into two different categories of single pump and dual pump. The dual pump is designed especially for continuous injection of fluids and solutions for pressure up to 400 bar based on the request with maximum volume of 50 cc. The advantage of the dual pump is the capability of using each barrel as an individual pump which change one dual pump to two individual single pump.

### Technical Specification:

- Maximum injection pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Cylinder volume: 50 cc
- Minimum flow rate: 0.01 cc/min
- Maximum flow rate: 50 cc/min
- Flow rate resolution:  $2 \times 10^{-4}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Dual Pump (700 bar) (P2-700)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. These pumps are introduced into two different categories of single pump and dual pump. The dual pump is designed especially for continuous injection of fluids and solutions for pressure up to 700 bar based on the request with maximum volume of 35 cc. The advantage of the dual pump is the capability of using each barrel as an individual pump which change one dual pump to two individual single pump.

### Technical Specification:

- Maximum injection pressure: 700 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Constant pressure mode
- Constant flow rate mode
- Cylinder volume: 35 cc
- Minimum flow rate: 0.01 cc/min
- Maximum flow rate: 32 cc/min
- Flow rate resolution:  $2 \times 10^{-4}$
- Wetted parts: Stainless steel 316L
- Touch panel







## HP Single Pump (15 bar) (P1-15F)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 500 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 15 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 500 cc
- Minimum flow rate: 0.01 cc/min
- Maximum flow rate: 50 cc/min
- Flow rate resolution:  $2 \times 10^{-4}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (15 bar) (P1-15P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 250 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 15 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 250 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 25 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (40 bar) (P1-40F)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 500 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 40 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 500 cc
- Minimum flow rate: 0.01 cc/min
- Maximum flow rate: 50 cc/min
- Flow rate resolution:  $2 \times 10^{-4}$
- Wetted parts: Stainless steel 316L
- Touch panel







## HP Single Pump (40 bar) (P1-40P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 250 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 40 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 250 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 25 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (70 bar) (P1-70F)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 500 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 70 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 500 cc
- Minimum flow rate: 0.01 cc/min
- Maximum flow rate: 50 cc/min
- Flow rate resolution:  $2 \times 10^{-4}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (70 bar) (P1-70P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 250 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 70 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 250 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 25 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel







**HP Single Pump (250 bar)  
(P1-250F)**

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 500 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### **Technical Specification:**

- Maximum injection pressure: 250 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 500 cc
- Minimum flow rate: 0.01 cc/min
- Maximum flow rate: 50 cc/min
- Flow rate resolution:  $2 \times 10^{-4}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (250 bar) (P1-250P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 250 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 250 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.5 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 250 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 25 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (400 bar) (P1-400F)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 500 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 500 cc
- Minimum flow rate: 0.01 cc/min
- Maximum flow rate: 50 cc/min
- Flow rate resolution:  $2 \times 10^{-4}$
- Wetted parts: Stainless steel 316L
- Touch panel







## HP Single Pump (400 bar) (P1-400P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 250 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 250 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 25 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (700 bar) (P1-700P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 100 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 700 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 100 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 10 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel





## HP Single Pump (1000 bar) (P1-1000P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 100 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 1000 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 100 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 10 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel







## HP Single Pump (1400 bar) (P1-1400P)

Pumps consist of a general base unit which includes, Servo Motor, Gear Box and HMI based controlling unit. These pumps are designed for applications requiring accurate pulse less flow and pressure control for delivery of fluids, solvents, solutions. This pump consists of a single injection unit with maximum barrel volume of 100 cc. Besides, it is possible to inject the fluids at constant flow and constant pressure mode.

### Technical Specification:

- Maximum injection pressure: 1400 bar
- Pressure transmitter
- Pressure transmitter accuracy: 0.25 % full scale
- Constant pressure mode
- Constant flow rate mode
- Pulseless injection
- Cylinder volume: 100 cc
- Minimum flow rate: 0.001 cc/min
- Maximum flow rate: 10 cc/min
- Flow rate resolution:  $2 \times 10^{-5}$
- Wetted parts: Stainless steel 316L
- Touch panel



## Mud Balance (MB-D10)



Mud balance measure the density and specific gravity of drilling fluid and cement slurries. This apparatus is designed based on API recommended practice. It is designed portable to be carried to rig in order to on-site measurement.

### Technical Specification:

- Designed based on API Recommended Practice 13I
- Specific gravity measurement range: 0.79-2.72
- Stainless steel cup
- Working temperature: ambient
- Working pressure: ambient



## **Marsh Funnel (MF-D10)**



This apparatus simply measures the viscosity of drilling fluid and cement slurries. Funnel viscosity is reported as the time (in seconds) which is required for one quart of sample to pass the funnel. Marsh funnel is made up of rugged plastic resists to deformation caused by temperature change. Also, the measuring cup is graduated in cubic centimeters.

### **Technical Specifications:**

- Designed based on API Recommended Practice 13I
- Resistance plastic
- Graduated cup
- Working temperature: ambient
- Working pressure: ambient





## Retort Kit (RK-D10)



This apparatus simply measures the oil, water and solid volume of drilling fluid. The sample is heated up to 550° C. Then, the vapors pass through a condenser. The condensates are collected to measure the oil and water volume of drilling fluid.

### Technical Specifications:

- Designed based on API Recommended Practice 13I
- Stainless steel carry case
- Stainless steel cup
- Working temperature: up to 550° C
- Working pressure: ambient



## LPLT Filter Press (FP-D10)



This apparatus measures drilling fluid and cement filtration at ambient condition based on API procedure. It is also applicable to check the wall-building (filter cake) properties of drilling mud and cement slurries using a filter paper.

### Technical Specification:

- Designed based on API Recommended Practice 13I
- Working temperature: ambient
- Working pressure: 100 psig
- Stainless steel cells
- Filtration diameter: 9 cm



## HPHT Filter Press (FP-D20)



This apparatus measures drilling fluid and cement filtration at HPHT condition. Also, it is designed to be capable to conduct permeability plugging test at reservoir condition. Hence, this apparatus could provide accurate simulation and measurement of down-hole static filtration.

### Technical Specification:

- Designed based on API Recommended Practice 13I
- Working temperature: up to 200°C
- Working pressure: up to 6000 psi
- Pressure transmitter accuracy: 0.01 range
- Stainless steel cells
- Application of native core sample is feasible





## Sand Content Set (SCS)



The CF-E10 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids, e.g. miscible and immiscible gas injection, surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure and temperature of 400 bar and 100°C under unsteady state conditions at confining pressures up to 400 bar. This apparatus is consisted of four different transfer vessels and one core holder capable the system to perform different injection scenarios. One of the transfer vessels is a miniature type which can be used for rinsing the lines by fulfill it with toluene or other solvents.

### Technical Specifications:

- Calculates volume percentage of particles larger than 74 microns
- Bottle wash : 500ml
- Including rod stirring, plastic, 4in



## Methylene Blue Test Set (MBS-R10)



The CF-E10 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids, e.g. miscible and immiscible gas injection, surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure and temperature of 400 bar and 100°C under unsteady state conditions at confining pressures up to 400 bar. This apparatus is consisted of four different transfer vessels and one core holder capable the system to perform different injection scenarios. One of the transfer vessels is a miniature type which can be used for rinsing the lines by fulfill it with toluene or other solvents.

### Technical Specifications:

- 25g methylene blue reagent, stable powder form for up to 500 tests
- 50 x 0.1ml special amber glass burette
- Burette clamp and stand
- Two amber 500ml solution storage bottles
- Three glass 600ml beakers
- Two glass dropping rods
- 1L volumetric flask
- 100 Sheet pack of 24cm diameter filter paper



## pH Meter (pH)



The CF-E10 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids, e.g. miscible and immiscible gas injection, surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure and temperature of 400 bar and 100°C under unsteady state conditions at confining pressures up to 400 bar. This apparatus is consisted of four different transfer vessels and one core holder capable the system to perform different injection scenarios. One of the transfer vessels is a miniature type which can be used for rinsing the lines by fulfill it with toluene or other solvents.

### Technical Specifications:

- Voltage: 220 v – 50 Hz
- PH limit: 0-14
- Temperature: up to 100 °C
- Accuracy:  $\pm 0.01$
- Size: 230 \* 180 \* 60 mm





## Differential Sticking Tester (DST-D10)



This apparatus measures the stuck tendency coefficient of a drilling fluid. The probability of the occurrence of stuck pipe situation by a drilling fluid, and also, the performance of an additive to stuck solution could be measured by this setup.

### Technical Specification:

- Designed based on API Recommended Practice 13I
- Working pressure: 477 psig
- Working temperature: ambient
- Pressure transmitter accuracy: 0.01 range
- Stainless steel cell
- Accurate dial torque meter



## Calcimeter Apparatus (CM-D10)



This apparatus measures the calcium carbonate (calcite) and magnesium carbonate (dolomite) content of drilling cuttings. The test is based on the reaction between calcite and dolomite with hydrochloric acid and consequent carbon dioxide emission. Formation of carbon dioxide increases the cell pressure which is measured by accurate pressure gauge.

### Technical Specification:

- Designed based on ASTM D 4373-02
- Working temperature: ambient
- Working pressure: up to 30 psig
- Poly-carbonate cell body and PTFE caps



## Auto Calcimeter Apparatus (CM-D20)



This apparatus measures the calcite and dolomite content of drilling cuttings automatically. Pressure data is transmitted to the software, and analysis is performed by the online software. Hastelloy cell resistant to hydrochloric cell is designed as reaction cell.

### Technical Specification:

- Designed based on ASTM D 4373-02
- Working temperature: ambient
- Working pressure: up to 30 psig
- Online software
- Hastelloy reaction cell





## Rheometer (VSR-D10)



VG meter measures the direct-indicating viscosity and the gel strength of drilling fluid. It is a rotational cylinder and bob rheometer. This instrument has 6 variable speeds. When the outer cylinder is full of drilling fluid, the inner cylinder rotates at a specific velocity. So, the torque which is exerted to the inner cylinder is measured accurately. Viscosity is calculated based on the torque measurement.

### Technical Specifications:

- Designed based on API Recommended Practice 13I
- variable speeds 6
- Software for data analysis
- Working temperature: ambient
- Working pressure: ambient



## Drilling Simulator Structure (DSS-H1)



The CF-E10 is dedicated to evaluate and optimize oil recovery for different injection protocols and fluids, e.g. miscible and immiscible gas injection, surfactant injection, polymer injection and etc. This apparatus is rated for maximum pressure and temperature of 400 bar and 100°C under unsteady state conditions at confining pressures up to 400 bar. This apparatus is consisted of four different transfer vessels and one core holder capable the system to perform different injection scenarios. One of the transfer vessels is a miniature type which can be used for rinsing the lines by fulfill it with toluene or other solvents.

### Technical Specifications:

- Height: 4m
- Stainless steel resistant to corrosion and temperature changes
- A completely natural drilling equipment simulation
- Motor type: Gear box motor



## Mud Circulation Structure (MCS-R10)



This device is used as a simulator of the mud circulation system

### Technical Specifications:

- Height: 2.5m
- Mud circulation simulator
- Stainless steel resistant to corrosion and temperature changes
- A completely natural drilling equipment simulation
- Motor type: Gear box motor
- Shale Shaker
- Mud Pit





## Copper Corrosion Measuring Device (CCM-P10)



The instrument is designed and made for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test". It is suitable to determine corrosiveness of aviation gasoline, jet fuels, vehicle gasoline, natural gasoline, hydrocarbon with Reid vapor pressure , solvent oil, diesel oil, distillate oil, lubricating oil and other petroleum products, to copper.

### Technical Specifications:

- It consists of a stainless steel bath
- Electronic temperature control system
- Working range: The ambient temperature up to 100 ° C
- Stainless steel bombs
- Includes copper base and copper sheet



## Cloud Point Measuring Device (CPM-P10)



This device is designed to provide highly accurate cloud a temperatures of petroleum products during cooling.

### Technical Specifications:

- Digital Temperature Sensor
- Equipped with a temperature controller of -50 to 50 degrees Celsius
- Static color for device body
- It has the ability to add a pour point measurement system



## Pour Point Measuring Device (PPM-P10)



Pour Points express the lowest temperature which the sample keeps its liquidity while cooled under the certain standards.

Pour Point devices are used generally in labs which analyses oil products (naphta – biodisel) while testing samples whether they are appropriate to the standards or not.

### Technical Specifications:

- Digital Temperature Sensor
- Equipped with a temperature controller of -50 to 50 degrees Celsius
- Static color for device body
- It has the ability to add a pour point measurement system





## Reid Vapor Pressure Measuring Device (RVP-P10)



The REID Vapor Pressure Measuring Device is an automated Reid Vapor pressure instrument in full compliance with standards. These methods are for the determination of vapor pressure of gasoline, volatile crude oil, and other volatile petroleum products. The Reid method is particularly suitable for determination of vapor pressure of crude oil for transportation, storage and general handling purposes.

### Technical Specifications:

- The machine includes water bath
- Cylinders made of stainless steel
- Electronic temperature control
- Static color of the body



## **Distillation Apparatus for Petroleum fluids (DA-P10)**



This instrument is designed and made as per standards Test Method for Distillation Characteristics of Petroleum Products and ASTM Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure. It is suitable to determine the distillation characteristics of gasoline, aviation gasoline, jet fuels, and solvent having special boiling point, naphtha, diesel oil, distillate fuels and similar petroleum products.

### **Technical Specifications:**

- Receiving cylinder: 100 ml
- Distillation Flask: 125 ml
- Thermometer: from -2 to 300 °C
- Temperature controller: 0 °C to 60 °C
- Temperature accuracy:  $\pm 0.5^{\circ}\text{C}$
- Temperature display mode: Digitally
- The refrigeration bath is made of stainless steel



## Smoke Point Measuring Device (SPM-P10)



This apparatus has capability of determination of the smoke point of kerosene and aviation turbine fuel

### Technical Specifications:

- It has capability of determination of the smoke point of kerosene and aviation turbine fuel
- 0-50mm black glass scale with white markings
- Brass plated door with curved glass window
- A candle socket
- A mirror can be attached to the chimney to aid smoke detection
- Mounted on a cast iron base with aluminum support rod





## Softening Point of Asphalts and Tar Pitches Measuring Device (SPD-P10)



The instrument is designed and made as per the national standard Test Method for Softening Point of Asphalt. It is suitable to determine the softening point of asphalt, tar, liquid asphalt and other types of asphalt. It is the best choice of asphalt manufacturers, highway and bridge construction companies, college and universities, and research and development departments.

It adopts microcomputer control technology, linear heating, and automatic stirring working mode. It is convenient, efficient, and reliable. It is the desired instrument for the laboratory to determine the softening point of asphalt.

### Technical Specifications:

- Magnetic heater with temperature regulator -
- Beaker 800cc
- Brass ring
- Magnetic stirrer
- Pellets with the weight of 3.5 gr
- Glass Thermometer : 0-400°C



## **Penetration of Bituminous and Lubricating Grease Materials Measuring Device (PBM-P10)**



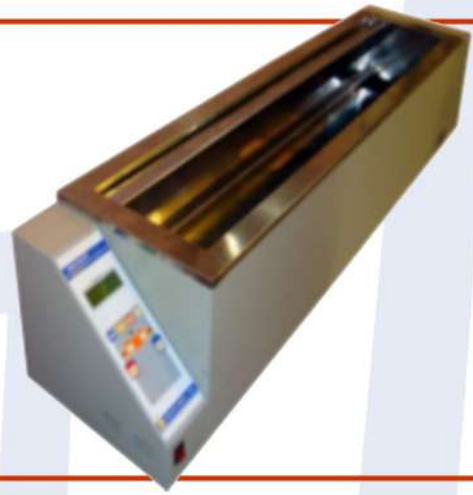
This instrument is used to determine the penetration of pavement petroleum asphalt, modified asphalt, liquid petroleum asphalt and emulsified asphalt. It is also suitable to test solid particle, powder, colloid and raw-food materials such as cheese, glycine, butter, cream and leavening. It can be widely used in food industry, highway engineering and other industrial fields.

### **Technical Specifications:**

- Stainless Steel
- Needle length: 45mm
- Aluminum Cup 3
- Indicator Resolution: 0.01 mm
- Dimension changeable According to Order



## Ductility of Bituminous Materials Measuring Device (DM-P10)



The Ductility Testing Machine is used to determine the ductility of bituminous materials in a briquette mould by measuring the breaking elongation at a constant speed. The Internal tank is made of stainless steel. The bath is fitted with an immersion heater in order to obtain (in normal conditions), the test temperature.

### Technical Specifications:

- Thermometer with the accuracy of 1°C
- Ruler with a precision of 0.01 cm
- Electric heater
- Working temperature: Ambient
- Internal water bath
- Stainless Steel





## Flash Point Measuring Device (FPM-P10)



This device is used to determine the flash point value of petroleum products. It is widely used in railway, aviation, electric power, oil industry and scientific research departments, etc.

### Technical Specifications:

- Range of temperature : up to 400 °C
- Thermocouple sensors
- Electric heater
- Sensitivity of 1°C



## Aniline-Point Measuring Device (APM-P10)



This device is designed and manufactured under GB Determination of Aniline Point in Petroleum Products for testing aniline point of dark petroleum products.

### Technical Specifications:

- Testing Range : 0 - 150°C
- Weight about 20 kg
- Temperature accuracy of 0.1 °C
- Stainless Steel



## Ostwald's Viscometer (OV-P10)



Ostwald viscometer, also known as U-tube viscometer or capillary viscometer is a device used to measure the viscosity of the liquid with a known density.

### Technical Specifications:

- Includes stopwatch
- Includes pycnometer
- Pipet and Poor
- Includes distilled water





## Saybolt Viscometer (SV-P10)



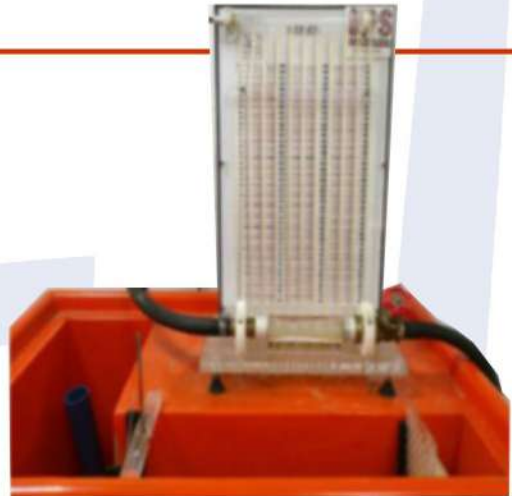
The saybolt viscometer controls the heat of the fluid and the viscosity is the time it takes the fluid to fill a container. These viscometers are most commonly used for fieldwork to measure the viscosity of oils, syrups, varnish, paints and Bitumen emulsions.

### Technical Specifications:

- Made of stainless steel
- Equipped with a bath with a capacity of about 10 liters
- Thermometer setting temperature
- Temperature: from ambient temperature to 240 degrees of Celsius



## Venturi Meter (VM-FM10)



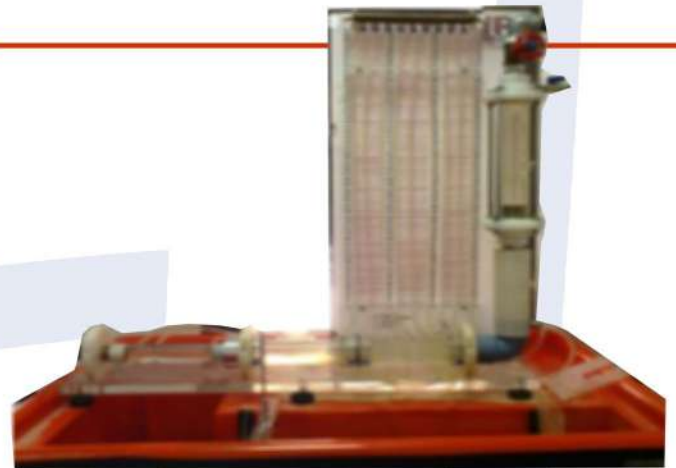
Venturi meters are flow measurement instruments which use a converging section of pipe to give an increase in the flow velocity and a corresponding pressure drop from which the flow-rate can be deduced. They have been in common use for many years, especially in the water supply industry.

### Technical Specifications:

- Direct measurement of the static head
- Ability to analyze quantities at different rates
- Can be installed on hydraulic tables
- Easy to install
- The pressure distribution is quite visible
- Flow control valve
- Multiple manometers to measure the change in fluid pressure across the cross section
- The internal diameter of the inlet and outlet is 26 mm
- Throat diameter 16 mm
- Graded and waterproof plot
- Pipes and fittings made qualified PVC
- piezometers for measuring Venturi pressure



## Orifice Meter (OM-FM10)



An Orifice Meter is basically a type of flow meter used to measure the rate of flow of Liquid or Gas, especially Steam, using the Differential Pressure Measurement principle. It is mainly used for robust applications as it is known for its durability and is very economical.

As the name implies, it consists of an Orifice Plate which is the basic element of the instrument. When this Orifice Plate is placed in a line, a differential pressure is developed across the Orifice Plate. This pressure drop is linear and is in direct proportion to the flow-rate of the liquid or gas.

### Technical Specifications:

- 16 mm orifice
- Rate control valve
- Multi tube manometer
- A horsepower centrifuge pump
- Bullet Rotameter
- Pipes and fittings made of qualified PVC







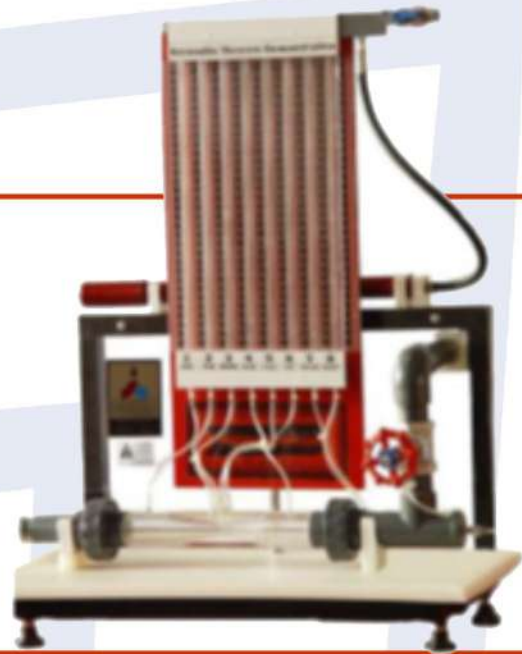
## Flow meters (FM-FM10)

### Technical Specifications:

- Direct measurement of the static head
- Ability to analyze quantities at different rates
- Can be installed on hydraulic tables
- Easy to install
- Centrifuge pump
- Pipes and fittings made qualified PVC
- :Different types of flow meters
- Venturi meter
- Orifice meter
- Flow nozzle
- Rota meter
- Turbine meter
- Vortex flow meter
- Magnetic flow meter
- Positive displacement meter
- Pitot tube



## Bernoulli Test Device (BD-FM10)



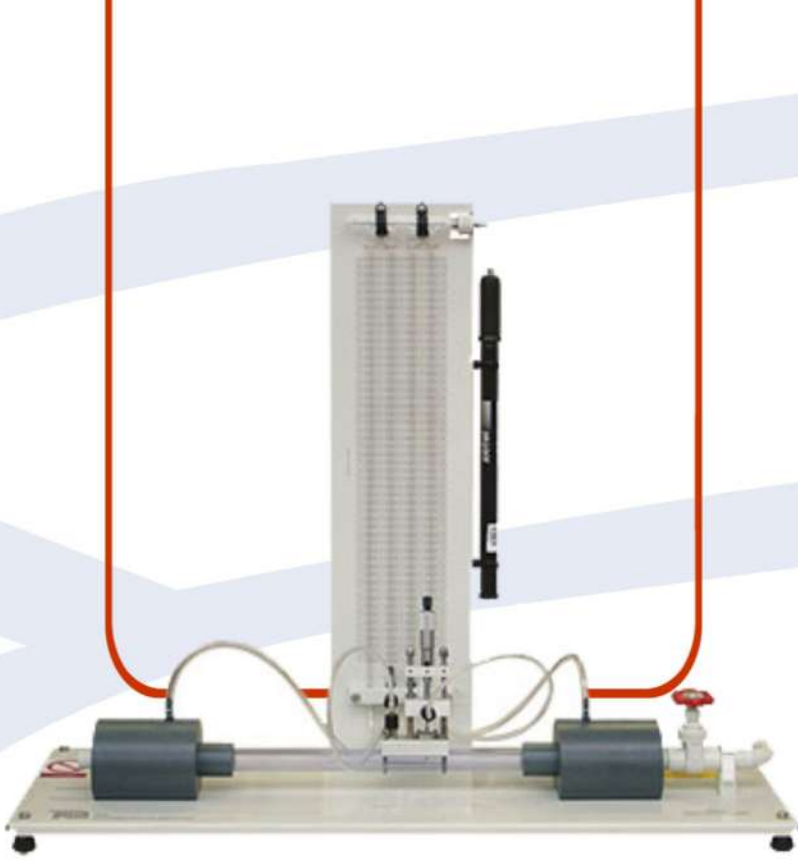
The equipment is designed and fabricated to demonstrate the Bernoulli's theorem. It consists of a test section made of acrylic. It has convergent and divergent sections. Pressure tappings are provided at different locations in convergent and divergent section. Present set-up is self contained water re-circulating unit, provided with a sump tank, centrifugal pump etc. An arrangement is done to conduct the experiment on different flow rates. Flow rate of water is measured with the help of measuring tank and stopwatch.

### Technical Specifications:

- Venturi nozzle input and output area: 338/88 mm<sup>2</sup>
- Multi tube manometers
- Pipes and fittings made of qualified PVC



## Friction Measuring Device in Pipes (FMP-FM10)



### Technical Specifications:

- 2 piezometers to display the differential pressure in a laminar flow
- pressure sensors for turbulent flow 2
- Brass tube with external diameter 6mm and internal diameter 4mm
- Electrostatic paint







## Osborne-Reynolds Device (OR-FM10)

### Technical Specifications:

- The main reservoir of Plexiglas
- Pipes and fittings made of qualified PVC
- Tank with colored needles
- Large tank to prevent - The valve to control the flow and create the necessary conditions system turbulence
- Needle valve for accurate control of fluid flow to determine Reynolds number in slow, transient and confusing states
- Color injection system for viewing different streams
- Glass tube visible to display flow in different modes
- Electrostatic paint



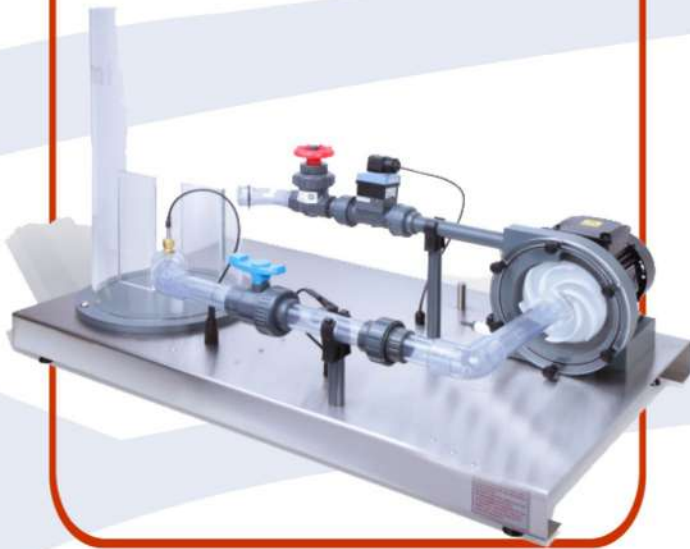


## Series and Parallel Pump Apparatus (SPP-FM10)

### Technical Specifications:

- Study of pump performance in both serial and parallel modes and fluid pressure variations
- Power measurement system in digital form
- Measuring current and voltage digitally
- Voltmeters and amps to indicate the power of the pumps at any moment
- Pressure Sensors 4
- Pipes and fittings made of qualified PVC





## Centrifugal Pump Machine (CP-FM10)

### Technical Specifications:

- Pipes and fittings made of qualified PVC
- Pumps of specified capacity
- It has an electromotor with proper power display for rpm report
- Equipped with high accuracy precision sensors
- Contains filters after the tank and before the pump
- It has two electronic pressure sensors before and after the pump and the corresponding display in bar





## Parabolic Trough Solar Collector (PTSC-S10)



This system concentrates solar energy on a tube that passes from the focal line of parabolic trough mirrors and increases the temperature of heat transfer fluid. For this, the system tracks the sun and controls the amount of the flow rate.

### Technical Specification:

- Structure length: 4.5 m
- Structure aperture: 4 m
- Structure material: Structural steel
- Structure coating: Galvanized
- Maximum wind force: 100 km/hr
- Receiver tube material: Stainless steel
- Receiver tube coating: Selective
- Mirror reflectivity: 94%
- Mirror thickness: 4 mm
- Rotating system accuracy: 0.4°
- Encoder accuracy: 0.1°
- Collector rotating limit: 250°
- Rotating control: Calculating
- Maximum operation pressure: 15 bar
- Pressure transmitter accuracy: 0.5% of full scale
- Maximum temperature of oil: 200 °C
- Temperature transmitter accuracy: 0.5 °C
- Touch panel with controlling software



## Parabolic Trough Solar Collector (PTSC-S20)



This system concentrates solar energy on a tube that passes from the focal line of parabolic trough mirrors and increases the temperature of heat transfer fluid. For this, the system tracks the sun and controls the amount of the flow rate.

### Technical Specification:

- Structure length: 12.5 m
- Structure aperture: 6 m
- Structure material: Structural steel
- Structure coating: Galvanized
- Maximum wind force: 100 km/hr
- Receiver tube material: Stainless steel
- Receiver tube coating: Selective
- Mirror reflectivity: 94%
- Mirror thickness: 4 mm
- Rotating system accuracy: 0.3°
- Encoder accuracy: 0.1°
- Collector rotating limit: 250°
- Rotating control: Calculating
- Maximum operation pressure: 15 bar
- Pressure transmitter accuracy: 0.5% of full scale
- Maximum temperature of oil: 275 °C
- Temperature transmitter accuracy: 0.5 °C
- Touch panel with controlling software

