The M-I SWACO 3-Phase Separator is designed to efficiently separate well effluent into three phases: oil, water, and gas. This advanced instrumented vessel is suitable for land frac flowback and well test operations and helps operators understand the performance characteristics of a well efficiently and safely.

The separator consists of the vessel, an oil and water flow measuring system that utilizes turbine meters, and electronic gas flow measurement systems with several sampling points. To provide accurate measurements, the vessel is fitted with pneumatic regulators that maintain a constant pressure and a constant liquid level inside the vessel using control valves on the oil, water, and gas outlets.

The separator is fitted with a removable and serviceable effluent diverter tube, a mist extractor, a vortex breaker and a weir plate. These components reduce the risk of liquids in the gas line (carry over) and gas in the liquid line (carry under), which affect the flow rate measurements. The separator can also accommodate small quantities of sand or solids, disposed of via the trash line.

The 3-Phase Separator can accommodate small quantities of sand or solids, disposed of via the trash line. The separator is built in compliance with ASME VIII, Division 1 and NACE MR-0175 for H2S environments. Its skid can also be designed to SEPCO OPS05 and API RP2A standards.

Accurate, safe separation and measurement of oil, gas and water from well effluent

APPLICATONS
The 3-Phase Separator is used for production well testing and frac flowback operations.

PROBLEMS
Not knowing the exact composition and volumes of well effluent can hinder sound economic decisions.

SOLUTIONS
During well testing, the M-I SWACO 3-Phase Separator effectively separates well effluent into three phases: oil, water, and gas, allowing for accurate distribution decisions.

ECONOMICS
The durable and easy-to-maintain 3-Phase Separator provides accurate dissection and measurement of effluent characteristics to facilitate cost-effective choices. Bypass capabilities allow full production to continue during any repairs that may be necessary.

ENVIRONMENTAL
Should the vessel become over-pressurized, multiple safety valves direct flow to a safe and contained area, thus reducing risk to personnel and the environment.

APPLICATIONS
The 3-Phase Separator is used for production well testing and frac flowback operations.

PROBLEMS
Not knowing the exact composition and volumes of well effluent can hinder sound economic decisions.

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ENVIRONMENTAL
Should the vessel become over-pressurized, multiple safety valves direct flow to a safe and contained area, thus reducing risk to personnel and the environment.
3-Phase Separator

Success story

Texas: 3-Phase Separator shines in HPHT sour gas application

The situation

An upstream operator in the Haynesville Shale required a reliable reliable service equipment package for high-pressure, high-temperature (HPHT) sour gas testing. The equipment package needed to withstand the rigors of a gas well in an HPHT environment.

The solution

After analyzing the customer’s requirements, M-I SWACO recommended a service delivery plan comprising a 15K psi working pressure equipment package that included its field-proven 3-Phase Separator. The 40”-H2S-40”-H2S 3-Phase Separator was engineered as a part of a package. Critical to this operation was the capability of the separator to deliver longer retention times for better separation and the incorporation of multiple pressure relief valves to protect personnel and the environment against vessel over-pressurization. In addition, the recommended 3-Phase Separator package included Electronic Flow Measurement for improved accuracy and real-time data acquisition to meet the client’s specific needs.

The results

The use of the M-I SWACO 3-Phase Separator as part of the high-pressure, high-temperature, H2S environment package allowed M-I SWACO to successfully deliver and execute a solution that met the client’s technical objectives. The design of this high performance 3-Phase Separator increased the separator’s retention time, allowing for longer separation and improved efficiency. The separator was equipped with a service delivery plan comprising a 15K psi working pressure equipment package that included an HPHT separator, a 3-Phase Separator, and a service delivery plan comprising a 15K psi working pressure equipment package that included an HPHT separator.

For more information about M-I SWACO’s 3-Phase Separator technology, contact your nearest M-I SWACO representative.
The M-I SWACO 3-Phase Separator is a technically advanced instrumented vessel designed to efficiently separate well effluent into three phases—oil, water, and gas. The vessel was developed for land frac flowback and well test operations and helps operators understand the performance characteristics of a well efficiently and safely.

The separator consists of the vessel, an oil and water flow measuring system that utilizes turbine meters, and electronic gas flow measurement systems with several sampling points. To provide accurate measurements, the vessel is fitted with pneumatic regulators that maintain a constant pressure and a constant liquid level inside the vessel using control valves on the oil, water, and gas outlets.

The separator is fitted with a removable and serviceable effluent diverter tube, a mist extractor, a vortex breaker and a weir plate. These components reduce the risk of liquids in the gas line (carry over) and gas in the liquid line (carry under), which affect the flow rate measurements. The separator can also accommodate small quantities of sand or solids, disposed of via the trash line.

The 3-Phase Separator is built in compliance with ASME VIII, Division 1 and NACE MR-0175 for H2S environments. Its skid can also be designed to SEPCO OPSO55 and API RP2A standards.

APPLICATIONS
The 3-Phase Separator is used for production well testing and frac flowback operations.

PROBLEMS
Not knowing the exact composition and volumes of well effluent can hinder sound economic decisions.

SOLUTIONS
During well testing, the M-I SWACO 3-Phase Separator effectively separates well effluent into three phase—oil, water, and gas, allowing for correct distribution decisions.

ECONOMICS
The durable and easy-to-maintain 3-Phase Separator provides accurate dissection and measurement of effluent characteristics to facilitate cost-effective choices. Bypass capabilities allow full production to continue during any repairs that may become necessary.

ENVIRONMENTAL
Should the vessel become over-pressurized, multiple safety valves direct flow to a safe and contained area, thus reducing risk to personnel and the environment.

ACCURATE, SAFE SEPARATION AND MEASUREMENT OF OIL, GAS AND WATER FROM WELL EFFLUENT

3-Phase Separator
The M-I SWACO 3-Phase Separator is a technically advanced instrumented vessel designed to efficiently separate well effluent into three phases.
During the production test, the produced well effluent, including all gas and liquids, flows into the inlet of the separator. The diverter tube redirects the flow providing interchange that allows liquids to settle more readily within the separator. FREE gas in the separator passes through a mist extractor that removes any entrained liquids remaining in the gas. Gas continues to percolate out of liquids while sitting in the separator. The gas then flows out of the top of the vessel and through the gas outlet, where it is measured and purged into the atmosphere if the volume is insufficient, or flared. A metal protector plate blocks any spitting liquid from re-entering and rising through the gas outlet.

Liquids continue to settle with the oil separating from the water and rising out of the solution. A weir plate allows the oil to enter into the oil chamber while keeping the water in its chamber. The level control values both the oil and water outlets allow the separator to control and measure the quantity of fluids removed, to be processed accordingly. Both the water and oil gas flows through meters to be measured and processed accordingly.

An integral component of the M-I SWACO Production Testing Services, the 3-Phase Separator is available for rental or for sale to third-party customers.

To stay aware of the benefits of using our 3-Phase Separator technology, contact your nearest M-I SWACO representative.

**Features**
- Available in multiple configurations, sizes, and pressure ratings to meet individual customer needs
- Skid made for easy transport
- Multiple safety valves to re-direct flow in the event of over-pressurization
- Designed to meet all applicable specifications for rental services, including API Fig. 61
- Replaceable inlet diverter fails to increase vessel life
- External float chambers allow operators to easily check float operation during use
- Bypass capabilities allow for maintenance, repairs and replacements without having to shut in the well
- Conforming capabilities of all fluid phases provides options on how to distribute output

**Advantages**
- Effectively separates free gas, oil, and water from well effluent
- Unobstructed production for maintenance and repairs
- Designed with 2” in corrosion allowance for extended vessel life
- Safe for use in API environments
- Long operational life
- Easily transportable
- Promotes cost effective choices
- Environmentally acceptable
- Provides single-phase surface sampling and flow metering over a wide range of flow rates
- Low maintenance design

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### 3-Phase Separator

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>M-I SWACO Type 3 Separator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Sizes</td>
<td>20&quot; x 180&quot; D., 24&quot; x 180&quot; D., 30&quot; x 180&quot; D., 36&quot; x 180&quot; D.</td>
</tr>
<tr>
<td>Minimum Design Temperature</td>
<td>420°F (215°C)</td>
</tr>
<tr>
<td>Maximum Design Temperature</td>
<td>420°F (215°C)</td>
</tr>
<tr>
<td>Pressure Safety Valve (PSV)</td>
<td>500 psig on 42&quot; vessel, 600 psig on 30&quot; vessel</td>
</tr>
<tr>
<td>Material of Construction</td>
<td>SA-516-70, A36, A572 GR-50, A500 GR-B, SA516-70, A36, A572 GR-50, A500 GR-B</td>
</tr>
<tr>
<td>Applications</td>
<td>ASME Section VIII, Division 1, NACE MR0175, API 12J, ANSI/API 650, Class 150, Class 150, 150# flanged, certified of Conformance</td>
</tr>
</tbody>
</table>

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**Mechanical Specifications**

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>42&quot; x 180&quot; 3-Phase Separator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>SA516-70, A36, A572 GR-50, A500 GR-B, NACE MR0175, API 12J, ANSI/API 650, Class 150, Class 150, 150# flanged, certified of Conformance</td>
</tr>
<tr>
<td>Maximum Design Pressure</td>
<td>1,400 psi</td>
</tr>
<tr>
<td>Minimum Design Pressure</td>
<td>0 psig</td>
</tr>
<tr>
<td>Attention</td>
<td>All designs are 1502 psi untested unions</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-20º F (-29º C) on 30&quot;, -10º F (-23º C) on 42&quot;</td>
</tr>
<tr>
<td>Temperature</td>
<td>7,000 bbl/day.</td>
</tr>
<tr>
<td>Flow</td>
<td>2 – 3&quot;</td>
</tr>
<tr>
<td>Inlet</td>
<td>2&quot; male</td>
</tr>
<tr>
<td>Oil Outlet</td>
<td>3&quot; male</td>
</tr>
<tr>
<td>Water Outlet</td>
<td>2&quot; male</td>
</tr>
<tr>
<td>Oil and Water Outlet</td>
<td>3&quot; male, 4&quot;</td>
</tr>
<tr>
<td>Lap Joint Flanges</td>
<td>2 sets of 2&quot; (external floats)</td>
</tr>
</tbody>
</table>

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**Success story**

**Texas-3 Phase Separator shines in HPHT sour gas application**

The situation
An operator in the Haynesville Shale required a reliable hostile service equipment package for high-pressure, high-temperature (HPHT) sour gas production. The presence of a gas well in an HPHT environment.

The solution
After analyzing the customer’s requirements, M-I SWACO recommended a service delivery plan comprising a 1,400 psi working pressure equipment package that included its field-proven 3-Phase Separator. The 42-in. 1400 psi NACE 3-Phase Separator was recommended as part of a package. Critical to this operation was the capacity of the separator to deliver longer retention times for better separation and the incorporation of multiple pressure relief valves to protect personnel and the environment against vessel over-pressurization and exposure to H₂S gas. In addition, the recommended 3-Phase Separator would include Electronic Flow Measurement for improved accuracy and real-time data acquisition to meet the client’s specific needs.

The results
Use of the M-I SWACO 3-Phase Separator as part of the high-pressure, high-temperature, high-hydrocarbon environment package allowed M-I SWACO to successfully deliver and execute a solution that met the client’s technical objectives. The design of this high performance 3-Phase Separator increased operational efficiency and provided the necessary reliability and performance with no saw production time (HPTD) related to this separator. The result was a service equipment package that allowed the customers to process the well, producing greater than 30 MMcf/day of gas, with water rates exceeding 7,000 bbl/day.
During the production test, the produced well effluent, including gas and liquids, flows into the inlet of the separator. The diverter tube redirects the flow providing interference that allows liquids to settle more readily within the separator. Free gas in the separator then passes through a mist eliminator that removes any entrained liquids remaining in the gas. Gas continues to percolate out of liquids while settling in the separator. The gas then flows out of the top of the vessel and through the gas outlet, where it is measured and purge into the flare for the volume to be monitored, or flare. A metal protector block blocks any splashing liquid from retracting and rising through the gas outlet.

Liquids continue to settle, with the oil separating from the water and rising out of solution. A lower plate allows the oil to rise into the oil chamber while keeping the water in its chamber. The level control values on both the oil and water outlets allow the operator to control and measure the quantity of fluids removed, to be processed accordingly. Both the water and oil gases through meters to be measured and processed accordingly.

An integral component of the M-I SWACO Product Testing Services, the 3-Phase Separator is available for rental or for sale to third-party customers.

To learn more about the benefits of using our 3-Phase Separator technology, contact your nearest M-I SWACO representative.

### 3-Phase Separator

#### General Specifications

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>1440 psig Testing 3-Phase Separator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Sizes</td>
<td>2” x 30”, 3” x 42”</td>
</tr>
<tr>
<td>Minimum Operating Pressure (MOP)</td>
<td>600 psi on 2” vessel, 800 psi on 3” vessel</td>
</tr>
<tr>
<td>Maximum Design Temperature</td>
<td>200°F (93°C) on 30”, 125°F (52°C) on 42”</td>
</tr>
<tr>
<td>Minimum Design Temperature</td>
<td>20°F (-6°C) on 30”, 0°F (-17°C) on 42”</td>
</tr>
<tr>
<td>Material of Construction</td>
<td>SA-516-70, A572 GR-50, A500 GR-B, A570 Class 2H (S)</td>
</tr>
<tr>
<td>Applicable Standards</td>
<td>ASME Section VIII, Division 1 (API 12J)</td>
</tr>
<tr>
<td>Adequate Compatibility</td>
<td>Intermediate and high-temperature (HPHT) fluids</td>
</tr>
</tbody>
</table>

### Mechanical Specifications

<table>
<thead>
<tr>
<th>Internal Connections</th>
<th>42” Female 30” Male 2” Female 2” Male 2” Female 2” Male 2” Female 2” Male 2” Female 2” Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Connections</td>
<td>42” Female 30” Male 2” Female 2” Male 2” Female 2” Male 2” Female 2” Male</td>
</tr>
<tr>
<td>Radial Bypasses</td>
<td>42” Female 30” Male 2” Female 2” Male 2” Female 2” Male 2” Female 2” Male</td>
</tr>
<tr>
<td>Material of Construction</td>
<td>SA-516-70, A572 GR-50, A500 GR-B, A570 Class 2H (S)</td>
</tr>
<tr>
<td>Adequate Compatibility</td>
<td>Intermediate and high-temperature (HPHT) fluids</td>
</tr>
</tbody>
</table>

### Advantages

- **High Capacity:** 7,000 bbl/day.
- **High Efficiency:** The performance of the 3-Phase Separator increased separation efficiency of well effluents by 80% with no non-productive time (NPT) related to the equipment.
- **Long Operational Life:** The separator is designed for high-pressure, high-volume operations while offering long operational life.
- **Easy Transportability:** The separator is designed for easy transportability with minimal maintenance and repairs.
- **Environmental Acceptability:** The separator is environmentally acceptable and has no non-productive time (NPT) related to the equipment.
- **Reliable Performance:** The separator is designed for reliable and consistent performance.

### Features

- **Available in multiple configurations:** The separator is available in multiple configurations to meet the specific needs of the client.
- **Skid mounted for easy transport:** The separator is skid mounted for easy transport and can be customized to meet the client’s specific needs.
- **Multiple safety valves to exist in the event of over-pressurization:** The separator is equipped with multiple safety valves to exist in the event of over-pressurization.
- **Designed to meet all applicable standards:** The separator is designed to meet all applicable standards to ensure safety and compliance.
- **Low maintenance design:** The separator is designed for low maintenance and repairs, allowing for reduced downtime.
- **Effectively separates gas, oil, and water from well effluent:** The separator is designed to effectively separate gas, oil, and water from well effluent.
- **Unobstructed production for extended vessel life:** The separator is designed to allow for unobstructed production for extended vessel life.
- **Operators to easily control and measure water from well effluent:** The separator is designed to allow operators to easily control and measure water from well effluent.
- **Valves on both the oil and water outlets:** The separator is equipped with valves on both the oil and water outlets to control and measure water from well effluent.
- **Low maintenance design:** The separator is designed for low maintenance and repairs, allowing for reduced downtime.
- **Measurement for improved accuracy and real-time data collection:** The separator is equipped with measurement for improved accuracy and real-time data collection to meet the client’s specific needs.

### Successful Story

**Texas:** 3-Phase Separator shines in HPHT sour gas application

The situation

A major operator in the Haynesville Shale required a reliable hostile service equipment package for their high pressure, high-temperature environment. The separator needed to be able to withstand the pressure and temperature conditions of a gas well in an HPHT environment.

The solution

After analyzing the customer’s requirements, M-I SWACO recommended a service delivery plan comprising a 15K psi working pressure equipment package that included its field-proven 3-Phase Separator. The 42" x 40K psi NACE 3-Phase Separator was engineered as part of a package. Critical to this operation was the ability of the separator to deliver longer operation times for better separation and the incorporation of multiple pressure relief valves to protect personnel and the environment against vessel over-pressure conditions.

In addition, the recommended 3-Phase Separator included Electronic Flow Measurement for improved accuracy and real-time data collection to meet the client’s specific needs.

The results

Use of the M-I SWACO 3-Phase Separator as part of the high pressure, high-temperature, hostile service environment package allowed M-I SWACO to successfully deliver and execute a solution that met the client's technical objectives. The design of the high performance 3-Phase Separator increased production by 20% and resulted in a 400% increase in the capacity of the separator to deliver production. The separator also included its field-proven 3-Phase Separator technology, which is designed to meet all applicable standards and provide long operational life.
The M-I SWACO 3-Phase Separator is a technically advanced instrumented vessel designed to efficiently separate well effluent into three phases. The vessel was developed for land frac flowback and well test operations and helps operators understand the performance characteristics of a well efficiently and safely. The separator consists of the vessel, an oil and water flow measuring system that utilizes turbine meters, and electronic gas flow measurement systems with several sampling points. To provide accurate measurements, the vessel is fitted with pneumatic regulators that maintain a constant pressure and a constant liquid level inside the vessel using control valves on the oil, water and gas outlets. The separator is also accommodated small quantities of sand or solids, disposed of via the drain line.

The 3-Phase Separator is built in compliance with ASME VIII, Division 1 and NACE MR-0175 for H2S environments. Its skid can also be designed to SEPCO OPSO55 and API RP2A standards.

APPLICATIONS
The 3-Phase Separator is used for production well testing and frac flowback operations.

PROBLEM
Not knowing the exact composition and volume of well effluent can hinder sound economic decisions.

SOLUTION
During well testing, the M-I SWACO 3-Phase Separator effectively separates well effluent into three phases: oil, water, and gas, allowing for correct distribution decisions.

ENVIRONMENTAL
Should the vessel become overpressurized, multiple safety valves direct flow to a safe and contained area, thus reducing risk to personnel and the environment.

3-Phase Separator
The M-I SWACO 3-Phase Separator is a technically advanced instrumented vessel designed to efficiently separate well effluent into three phases.