XP Polishers
Mobile Ultra-Fine Solids Management

2015 – Revision D

www.ElginSeparationSolutions.com
Founded in 1990, we have evolved to become the industry leader in reliable, durable and fully integrated solids management systems for the HDD Industry.
The Birth of Fines
The key to an effective solids control system start with the control of fines.

The heart of the problem rests in the increase in the surface area as solids degrade.

Down-hole Degradation
The rotating nature of the bit and tubular equipment creates an environment in which cuttings are “crushed” into smaller particles.

Physical Dispersion
Physical charges inherent to particles will enhance the dispersion of particles in the fluid. A key element of solids reactivity (a critical issue when dealing with clays).

Surface Degradation
Artificial force impacted on solids in the form of centrifugal (i.e. pumps) and axial (i.e. shakers) energy.

Annulus Transport
As solids-laden drilling fluid moves through the drill string annulus, the violent contact of solids with other solids, the bore-hole wall and the drill string further degrades cuttings.
Traditional HDD System Limitations

Traditional Systems Can Not Manage Particles Smaller than Fine Silt

<table>
<thead>
<tr>
<th>HDD Solids Classification</th>
<th>API Classification</th>
<th>Micron Range</th>
<th>Inches*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Drilled Solids</td>
<td>Intermediate and Coarse</td>
<td>&gt;440</td>
<td>&gt;0.018”</td>
</tr>
<tr>
<td>Sand</td>
<td>Medium</td>
<td>74 to 440</td>
<td>0.0031” to 0.018”</td>
</tr>
<tr>
<td>Silt</td>
<td>Ultra-Fine and Fine</td>
<td>2 to 74</td>
<td>0.000083” to 0.0031”</td>
</tr>
<tr>
<td>Clay</td>
<td>Colloidal</td>
<td>0.5 to 2</td>
<td>0.000021” to 0.000083”</td>
</tr>
<tr>
<td>Colloids</td>
<td>Colloidal</td>
<td>&lt;0.5</td>
<td>&lt;0.000021”</td>
</tr>
</tbody>
</table>

Particle Size - Microns

Barite

Colloidal
Ultra Fine
Fine
Medium
Intermediate
Coarse
## Traditional HDD System Limitations

Typically Defined by the Maximum Capability of the Hydrocyclones

<table>
<thead>
<tr>
<th>Primary Solid Control Devices</th>
<th>Equipment</th>
<th>Solids Classification</th>
<th>Micron Range</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalping Shaker</td>
<td>Large Drilled Solids</td>
<td>&gt;440</td>
<td>&gt;0.018”</td>
<td></td>
</tr>
<tr>
<td>Fine Screen Shaker</td>
<td>Sand</td>
<td>&gt;74</td>
<td>&gt;0.0031”</td>
<td></td>
</tr>
<tr>
<td>Desander</td>
<td>Sand</td>
<td>&gt;74</td>
<td>&gt;0.0031”</td>
<td></td>
</tr>
<tr>
<td>Desilter</td>
<td>Silt</td>
<td>&gt;30</td>
<td>&gt;0.001”</td>
<td></td>
</tr>
<tr>
<td>Centrifuge</td>
<td>Clay</td>
<td>&gt;2</td>
<td>&gt;0.000083”</td>
<td></td>
</tr>
<tr>
<td>Chemically-Enhanced Centrifuge</td>
<td>Colloids</td>
<td>&gt;0</td>
<td>&gt;0”</td>
<td></td>
</tr>
</tbody>
</table>

Traditional HDD systems are unable to remove solids <30 microns from the drilling fluid; ultra-fine solids are allowed to collect & grow in the mud system.
Drilling Fluid Solids Life Cycle

The Make-Up of Drilled Solids Evolve With the Drilling Program

All drilling programs will slowly degrade solids into fines the longer the drilling fluid is recycled.
Drilling Fluid Solids Life Cycle
The Make-Up of Drilled Solids Evolve With the Drilling Program

All drilling programs will slowly degrade solids into fines the longer the drilling fluid is recycled.
Drilling Fluid Solids Life Cycle
The Make-Up of Drilled Solids Evolve With the Drilling Program

- **Colloidal**
- **Ultra Fine**
- **Fine**
- **Medium**
- **Intermediate**
- **Coarse**

**Extended Drilling**
For long bores or when the drilling fluids are recycled continuously, ultra fine and colloidal solids will build. They cannot be removed without the use of a centrifuge.

**Horizontal**
As drilling settles into the horizontal section, the nature of the solids become more fine. As such, hydrocyclones are needed.

**Top Hole**
When drilling first starts the cuttings are course and can easily be managed by traditional shaker technology.

All drilling programs will slowly degrade solids into fines the longer the drilling fluid is recycled.
# Ultrafine Solids Treatment

Effective Impact on Drilling Fluid Life is Substantial

<table>
<thead>
<tr>
<th>Maximum Solid Control Device</th>
<th>Equipment Image</th>
<th>Target Design Consideration</th>
<th>Cut Point Consideration</th>
<th>Relative Effect on Drilling Fluid Life*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fine Screen Shaker System</strong></td>
<td><img src="image" alt="Fine Screen Shaker System" /></td>
<td>125% of the Rig Circulation Rate</td>
<td>Target a &gt;100 Micron Cut</td>
<td>3X</td>
</tr>
<tr>
<td><strong>Hydrocyclone System</strong></td>
<td><img src="image" alt="Hydrocyclone System" /></td>
<td>125% of the Rig Circulation Rate</td>
<td>Target a 30 Micron Cut</td>
<td>4X</td>
</tr>
<tr>
<td><strong>Centrifuge System</strong></td>
<td><img src="image" alt="Centrifuge System" /></td>
<td>20% of the Rig Circulation Rate</td>
<td>Target a 5 Micron Cut</td>
<td>8X</td>
</tr>
</tbody>
</table>

*When compared to coarse screen shaker systems.
## High Speed Decanter Centrifuges


<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum G Force</th>
<th>Maximum Speed</th>
<th>Capacity</th>
<th>Bowl Diameter</th>
<th>Bowl Length</th>
<th>Gearbox Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESS-1448 HD2</td>
<td>2,100</td>
<td>3,250 rpm</td>
<td>200 gpm (12 Lps)</td>
<td>14” (356 mm)</td>
<td>48” (1,219 mm)</td>
<td>52:1 or 125:1</td>
</tr>
<tr>
<td>ESS-1655 HD</td>
<td>2,300</td>
<td>3,400 rpm</td>
<td>265 gpm (17 Lps)</td>
<td>16” (406 mm)</td>
<td>55” (1,397 mm)</td>
<td>56:1</td>
</tr>
<tr>
<td>ESS-1967 HD2</td>
<td>2,500</td>
<td>3,100 rpm</td>
<td>500 gpm (31 Lps)</td>
<td>19” (470 mm)</td>
<td>67” (1,702 mm)</td>
<td>80:1</td>
</tr>
</tbody>
</table>

Elgin’s barite recovery and solids control centrifuges can be fitted with a host of VFD, FHVD, MVD control options in both explosion proof and non-explosion proof configurations.
Centrifuge Controls Portfolio
Available options are dependent on the centrifuge and application.

<table>
<thead>
<tr>
<th>NEMA 7X Cast Aluminum Enclosure (MVD)</th>
<th>NEMA 4X SS VFD Cabinet Enclosure with HMI</th>
<th>NEMA 4X SS VFD with HMI Air Conditioning and Purged Air</th>
<th>NEMA 7X Cast VFD Enclosure</th>
<th>Hydraulically Driven (FHVD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Stop/Start with Fluid Clutch Soft Start</td>
<td>Fully Variable Frequency Controlled</td>
<td>Fully Variable Frequency Controlled</td>
<td>Main Drive Variable Frequency Controlled</td>
<td>Fully Variable Speed Controlled</td>
</tr>
<tr>
<td>Push-Button Controls</td>
<td>HMI Touch-Screen</td>
<td>HMI Touch-Screen</td>
<td>Push-Button Controls</td>
<td>Push-Button Controls</td>
</tr>
<tr>
<td>Dual-Sheave Poly-chain</td>
<td>Polychain Sheave</td>
<td>Polychain Sheave</td>
<td>Standard Sheave</td>
<td>N/A</td>
</tr>
</tbody>
</table>
HDD Centrifuge Integration
Centrifuge Technology Targets Near Colloidal and Ultra Fine Solids

Tango 600 XPT or XPS Integrated ESS-1448 HD2 Centrifuge System
Build seamlessly into the primary mud system, the XPT and XPS Polishing Systems provide maximize drilling fluid life. Fully integrated centrifuge, dilution tank, PC pump, screw conveyor and centrate pump.

Independent ESS-1967 HD2 XP Polisher Mobile Centrifuge Packages
Built into a 36K triple-axel when using a single ESS-1967HD2 centrifuge or a 56’ dual-axel rock-over trailer, when using two ESS-1967HD2 centrifuges, these systems are designed to handle large volumes of drilling fluids without slowing down drilling operations.

Independent ESS-1448 HD2 XP Polisher Mobile Centrifuge Package
Utilizing a 30K triple-axel trailer, the ESS-1448 XP Polisher integrates with existing solids control assets (i.e. Tango 400, Tango 600, Tango 800, etc.). On board power and chemical injection (Select Floc LP3) systems are available for 100% removal of suspended solids.

Each XP Polisher system can be integrated with a number of customer-specified customizations.
Packaged mud reclamation systems are designed to integrate a number of processes into one platform and may include generator packages and trailers.

Tango 600 XPT System
Mobile Systems are Designed to Provide a Series of Integrated Processes:

- **Tertiary Treatment**
  - Performed via decanter centrifuge to achieve a tertiary cut down to 5 microns.

- **Fluid Transport, Flow & Mixing**
  - Provides feed to hydrocyclone system, mixing systems, and tank agitation.

- **Fluid Mixing & Containment**
  - Provides drilling fluid management & mixing through the use of tanks & agitators.

- **Secondary Separation**
  - Performed via hydrocyclones to achieve a secondary cut down to 30 microns.

- **Primary Separation**
  - Performed via a shaker system to achieve a primary cut down to 100 microns.
Tango 600 XPS System

Mobile Systems are Designed to Provide a Series of Integrated Processes:

- **Secondary Separation**
  - Performed via hydro-cyclones to achieve a secondary cut down to 30 microns.

- **Primary Separation**
  - Performed via a shaker system to achieve a primary cut down to 100 microns.

- **Fluid Transport, Flow & Mixing**
  - Provides feed to hydro-cyclone system, mixing systems, and tank agitation.

- **Tertiary Treatment**
  - Performed via decanter centrifuge to achieve a tertiary cut down to 5 microns.

- **Fluid Mixing & Containment**
  - Provides drilling fluid management & mixing through the use of tanks & agitators.

Packaged mud reclamation systems are designed to integrate a number of processes into one platform and may include generator packages and trailers.
ESS-1448 XP Polisher System

Mobile Systems are Designed to Provide a Series of Integrated Processes:

- **Fluid Mixing & Hydration**
  Optional hydration manifold allows for thorough mixing of polymers.

- **On-Board Feed & Centrate Pump**
  On-board PC pump to feed the centrifuge. Includes self-priming centrate pump.

- **Solids Management**
  Solids are discharged directly to an on-board screw conveyor for waste handling.

- **Secondary Separation**
  Performed via hydro-cyclones to achieve a secondary cut down to 30 microns.

- **Primary Separation**
  Performed via a primary treatment unit (i.e. Elgin’s Tango 600HD2).

Packaged mud reclamation systems are designed to integrate a number of processes into one platform and may include generator packages and trailers.
ESS-1967HD2 XP Polishing System

Mobile Systems are Designed to Provide a Series of Integrated Processes:

- **Maximum Control**
  Integrated proprietary HMI touch-screen VFD control system.

- **Fluid Management**
  Integrated centrate tank and self-priming centrate pump.

- **Centrifuge Feed System**
  Performed via an on-board VFD adjustable progressive cavity feed pump.

- **High Volume Treatment**
  Uses our most advanced ESS-1967 HD2 centrifuge with variable speed drives.

- **On-Board Generator Power**
  Powered by a 100KW prime on-board generator package with remote controls.

Packaged mud reclamation systems are designed to integrate a number of processes into one platform and may include generator packages and trailers.
ESS-1967HD2 XP Polishing System
Mobile Systems are Designed to Provide a Series of Integrated Processes:

- **On-Board Generator Power**
  Powered by a 300KW prime on-board generator package with remote controls.

- **Maximum Control**
  Integrated proprietary HMI touch-screen VFD control system.

- **High Volume Treatment**
  Uses dual ESS-1967 HD2 centrifuges with variable drives.

- **Fluid Management**
  Integrated centrate tanks and self-priming centrate pump.

- **Centrifuge Feed System**
  Performed via dual on-board self-priming solids-handling feed pumps.

Packaged mud reclamation systems are designed to integrate a number of processes into one platform and may include generator packages and trailers.
Closing the Loop
Chemically Enhanced Mechanical Solid/Liquid Separation

Elgin’s product portfolio of proprietary polymers and capital equipment provides a “one-stop” shop for any solids control management challenge.
Elgin Value
Definitive Value Proposition in Utilizing Elgin Centrifuges

Unsurpassed Experience
Elgin has shipped more than 550 newly manufactured decanter centrifuges, 200 remanufactured centrifuges, 850 newly manufactured VCD’s and over 100 remanufactured VCDs to over 40 different countries.

Unsurpassed Durability
With more than 25 years of experience building centrifuges for the oil and gas industry, Elgin has developed a reputation for the most durable systems in the market. The average asset life exceeds 10 years with proper preventative maintenance.

Full-Scale Engineering Support
Elgin’s dedicated Engineering team evaluates system hydraulics, frictional losses, predictive reliability, and failure mode evaluation analysis (“FMEA”) for each centrifuge designed. Months of product validation testing is performed prior to the release of any Elgin centrifuge.

Elgin manufactures its own spare parts and consumables ensuring 100% integrated accountability for the entire centrifuge.