**PIPING**

- Piping System Managements
- Design Principles
- Material Supplying and Certifications
- Welding Pipe Systems
- Non-welding Pipe & Tubing Systems

- Fabrication & Erection
- Inspection and Testing
- Certification of welders
- Welding Procedure with main Contractor
- Health & Safety

**PICKLING**

- Preparation Closed Loop Circulations for Pickling
- Health & Safety
- Chemical Products to Be Use for Pipe Pickling Operations
- Pickling Procedure for in Line Pickling
- Pickling Circuit Test Pressure
- Washing With Water
- Acid Washing (Hydrochloric Acid Treatment)
- Passivation
- pH Value and Visual Control of Pipe Surfaces
- Drying
- Piping System Preconditioning
- Line Conservation

- Site Conditions
- System Preparations
- Purpose of Flushing
- Activities Before Flushing
- Securing Area
- Flushing Equipments
- Flushing Fluid
- Flushing Velocity and Temperature
- Flushing Performans
- Acceptance of Cleanliness NAS/ISO
- System Cleanliness
- Oil Analyzing
- After Flushing
Complete Hydraulic Solutions offers hydraulic systems (including integrated hydraulic power unit, valve stands, accumulator stands, high quality and robust cylinders) designed, manufactured, tested and site application (piping, pickling and flushing) of which is done by Hidroproser for electric arc furnaces, secondary metallurgical facilities and Rolling Mills.
We are an internationally functioning hydraulic complete solution supplying company with worldwide services and quality.
Hydraulic systems are designed according to a working pressure that the required forces and torques are achieved. Hydraulic systems are generally designed much more approximately than 15-20% the working pressure. All components should be selected to meet the maximum system pressure.

At the same time all design parameters have to be selected specifically for each system and the customers’ requirements, rules, regulations and certifications.

**SELECTION OF PIPE SIZE**

The inner diameter and wall thickness of the pipes are determination of correct pipe size. The inner diameter selected according to an allowed pressure losses or on flow velocity. The wall thickness is selected according to the required pressure rating.

**MECHANICAL DESIGN**

- Pipe & Tube Material
- Connection System: Welding, Fittings, Flanges
- Pipe Supports

**FLOW VELOCITY**

\[
 d = \sqrt{\frac{4 \cdot Q_{\text{max}}}{\pi \cdot v}} \\
 Q = V \cdot A \\
 Re = \frac{v \cdot d}{v} \\
\]

- Laminar flow: \( Re < 2300 \)
- Turbulent flow: \( Re > 4000 \)

The critical Reynolds number should be \( Re_{kr} \) for typical hydraulic pipe flow is 2500.

**FLUID (OIL) VELOCITIES**

Recommended oil velocities to be utilized for initial pipe sizing can be

- Suction lines: \( \leq 1 \text{ m/s} \)
- Pressure lines: \( \leq 5 \text{ m/s} \)
- Return lines: \( \leq 3 \text{ m/s} \).

**PIPING AND TUBE MATERIALS**

The recommended pipe and tube materials to be used in hydraulic applications are as follows:

**TUBING**

<table>
<thead>
<tr>
<th>Steel Type</th>
<th>Tensile Strength</th>
<th>Yield Point</th>
<th>Ductile Yield</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine grain E235N acc.to EN10305-4</td>
<td>340 N/mm²</td>
<td>235 N/mm²</td>
<td>25 % min</td>
<td>Seamless, cold drawn, normal annealed, DIN EN 10305-1 and 4 Phosphated and oiled</td>
</tr>
</tbody>
</table>

**PIPING SYSTEM DESIGN**

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>250 Bar</th>
<th>315 Bar</th>
<th>400 Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Diameter (mm)</td>
<td>Wall Thickness (mm)</td>
<td>Outside Diameter (mm)</td>
<td>Wall Thickness (mm)</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>8</td>
<td>1.5</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>1.5</td>
<td>12</td>
<td>1.5</td>
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<td>2</td>
<td>16</td>
<td>2</td>
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<td>18</td>
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<td>18</td>
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<tr>
<td>20</td>
<td>2</td>
<td>20</td>
<td>2.5</td>
</tr>
<tr>
<td>22</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>2.5</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>28</td>
<td>3</td>
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<tr>
<td>30</td>
<td>3</td>
<td>30</td>
<td>4</td>
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<td>35</td>
<td>3</td>
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<tr>
<td>38</td>
<td>4</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>42</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**BUTT WELDING METHOD**

**SERIE 3000 PSI**

<table>
<thead>
<tr>
<th>Steel Type</th>
<th>Tensile Strength</th>
<th>Yield Point</th>
<th>Ductile Yield</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN1020 (St52-3 acc.to DIN2448)</td>
<td>490 N/mm² (St52.3)</td>
<td>345 N/mm² (St52.3)</td>
<td>20% min. (St52.3)</td>
<td>Seamless non-alloy steel tubes for pressure purposes</td>
</tr>
</tbody>
</table>

**SERIE 6000 PSI**

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Outside Diameter (mm)</th>
<th>Wall Thickness (mm)</th>
<th>Outside Diameter (mm)</th>
<th>Wall Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 25</td>
<td>33,7</td>
<td>4</td>
<td>33,7</td>
<td>5</td>
</tr>
<tr>
<td>DN 32</td>
<td>42,4</td>
<td>4</td>
<td>42,4</td>
<td>6,3</td>
</tr>
<tr>
<td>DN 40</td>
<td>48,3</td>
<td>4</td>
<td>48,3</td>
<td>7,1</td>
</tr>
<tr>
<td>DN 50</td>
<td>60,3</td>
<td>4,5</td>
<td>60,3</td>
<td>8</td>
</tr>
</tbody>
</table>

**SOCKET WELDING METHOD**

**SERIE 3000 PSI**

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Outside Diameter (mm)</th>
<th>Wall Thickness (mm)</th>
<th>Outside Diameter (mm)</th>
<th>Wall Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 25</td>
<td>33,7</td>
<td>4</td>
<td>33,7</td>
<td>5</td>
</tr>
<tr>
<td>DN 32</td>
<td>42,4</td>
<td>4</td>
<td>42,4</td>
<td>6,3</td>
</tr>
<tr>
<td>DN 40</td>
<td>48,3</td>
<td>4</td>
<td>48,3</td>
<td>7,1</td>
</tr>
<tr>
<td>DN 50</td>
<td>60,3</td>
<td>4,5</td>
<td>60,3</td>
<td>8</td>
</tr>
</tbody>
</table>
MATERIAL SUPPLYING

HIDPROSER supply tube and pipe, connectors; byte tipe fittings, weld fittings, square flanges, SAE flanges, made Carbon Steel or Stainless Steel as well according to the DIN or ISO Standards.

Hidroproser engineering team offers expert consultation to the customer’s project requirements with determination the best-suited solutions for piping systems. Hidroproser provides all necessary equipments and consumable materials according to standards and specifications.

DIN FITTINGS

WELD FITTINGS

SAE FLANGES / BUTT WELD END / SOCKET WELD END

SQUARE FLANGES / BUTT WELD END

VALVES

TUBES

TUBES CLAMPS

CUSTOM PRODUCTS

DN FLANGES

ADOPTERS / HOSE

FILTER ELEMENTS / OIL / COLLECTORS
Hidroproser prepared and applied procedures and technical specifications for chemical cleaning process are removed from potential risks in the field. The pickling activities are carried out expert, experienced and qualified team by HIDROPROSER.
PICKLING

PREPARATION CLOSED LOOP CIRCULATIONS FOR PICKLING

HIDROPROSER is identify and arrange of all the necessary (to by pass components such as valves and cylinders) temporary fittings and blind flanges, for the pickling circuit preparation. The pickling operation will be include interconnecting piping of Hydraulic system, Gress and Lubrication oil for carbon steel welded lines. The stainless steel lines can only apply de-greasing process.

HIDROPROSER provide an operating sequence of how propose to pickling the system.

The system schematic, showing where connections for pickling equipment will be installed. Information on how the system is to be interconnected to form a continuous loop will be shown on these drawings. Prefabricated loops will be precleaned and followed every stage of process. All valves, manifolds, cylinders, system pumps and system reservoir will be bypassed during pickling and capped to prevent entry of dirt.

Pickling concentrated will be added up until to have the solution reaching a pH value equal to 1 - 2. By the way, acid washing duration will not be less than 4 hours.

The following analysis will be randomly performed during the pickling phase; Acid Content pH control will be sufficient.

PASSIVATION

Purpose of the passivation phase is to create a protective layer on the inside walls of the piping, protecting them from oxidation. This passivating solution will be kept in circulation for 2 (four) hours keeping the temperature steady.

VISUAL CHECKING INSIDE OF PIPE SURFACE

After the finishing passivation step randomly It will be a visual check inside of the piping surface condition removing the flanged joints.

DRYING

Nitrogen will be inserted to empty the circuit as soon as possible the passivation phase is concluded, opening all drains with a low nitrogen flow and eventually, opening flanges connection in order to drain the solution as much as possible.

PIPING SYSTEM RECONDITIONNING

All temporary piping connection will be reconditioned as soon as the above here describe operations, and/or flushing phase has been completed. Particular care will be taken to avoid piping contamination during such phase.

Time frame between the chemical treatment and further flushing operation or circuit start up with final fluid, shall be as short as possible to prevent oxidation of inner piping walls. This never achievable and the whole circuit shall be kept under a preservation state.

The most suitable preservation state is achievable keeping the whole circuit under a low nitrogen pressure after drying phase and up until the system will be started up.
Hidroproser guarantees all work undertaken to comply with all relevant requirements of the customer’s specification; certification and documentation will be provided on completion.
SYSTEM PREPARATION

Only the simplest system can be flushed in one operation. In the majority of systems, they should be divided into sections or loops, the sections being flushed in turn. The separate loops should be arranged onsite using jumper leads, make-up pieces etc. to give the least number of flushing circuits possible to ensure a continuous circulation of oil with no dead-ends returning to the flushing rig reservoir.

The installation of several bleeding points on the highest points of each line should be pressure tested in order to purge air out of the installation. With this operation, pressure stabilization time will reduce significantly.

PURPOSE OF FLUSHING

After fabrication (and installation) and pressure testing of piping systems, it may be necessary to clean the piping system to remove all particles and contamination from inside the pipes and components. The aim of flushing is to remove any contamination by passing fluid through the system at velocity much higher than during normal operation, but based on calculations of Reynolds numbers.

All components ready for assembly into the system should be in a clean condition, inhibited with preservation oil and all openings sealed. All piping must be free from scale, rust, flux, etc., otherwise is will be rejected and replaced, or cleaned prior to assembly. Any contamination that may have been introduced in transit or during system assembly, and may be harmful to equipment connected to it, must be removed. Flushing is often performed immediately after pressure testing. Some of the following conditions may therefore have been set up during pressure testing but are repeated for completeness and added safety.

ACTIVITIES BEFORE FLUSHING

These may include:
- Description of the system, number, test pack, gauge, pump, flange specifications, etc.
- Pre-fabrication acceptance details
- Scope of test and support drawings
- Risk assessments and method statements
- Contamination assessments
- Relevant regulatory for the type of application and the PPE requirements, e.g. reference to stipulations in the contract, company Handbook, etc.
- Customer Health & Safety regulations
- Main contractor regulations

FLUSHING EQUIPMENT

Check that the flushing rig which consists of pumps, reservoir, filters, thermometer, particle counter, hose connections, is in a clean condition throughout. All terminations should be connected with adjacent pipe work to provide a continuous loop.

Check that the adjustable relief valves are set at a pressure above that required to pass the full pump flow through the system which is to be flushed. The filters may be of disposable element type. The filters should incorporate clogging indicators. The filter size should be selected to pass the specified pump delivery at a low-pressure drop. Select a filter size to meet the requirements of the system to be flushed. It should have a generous dirt holding capacity.

Temperature gauge and pressure gauge should be calibrated and calibration record submitted prior to start flushing. Flushing oil should be specified according to system demands.
**FLUSHING**

**FLUSHING FLUID**

The flushing fluid must be compatible with the fluid specified for the system and with system materials, especially the seals. In all cases the appropriate technical and regulatory standards will apply to the fluid selection, including supplier specifications, e.g. in the use of synthetic hydraulic oils.

The recommended flushing fluid is normally the same grade as the working fluid.

**FLUSHING VELOCITY AND TEMPERATURE**

To ensure that the system is flushed as quickly and efficiently as possible, both fluid velocity and temperature should be as high as conveniently possible. Heat oil during work to 55 °C ~ 60 °C for VG32 oil. The temperature shall be measured in the reservoir. Temperature shall not exceed 62 °C. The flushing flow is calculated and based upon achieving turbulent flow. This is achieved when Reynolds number is greater than 4000.

\[
\text{Flow} = \text{Re} \times \text{ID} \times \text{Vsc}
\]

\[
\text{Re} = \text{Reynolds number}
\]

\[
\text{ID} = \text{Inside diameter of largest pipe to be flushed}
\]

\[
\text{Vsc} = \text{Oil viscosity at flushing temperature}
\]

A reasonable temperature limit for mineral oils is 60 °C, for water-in-oil emulsions and water-glycols it is 50 °C. Higher temperatures are acceptable for silicone and some other synthetic hydraulic fluids.

**FLUSHING PERFORMANCE**

With the system prepared, fill the system by feeding the flushing fluid to the flushing rig so that the fluid is filtered before entering the system. New fluid is often dirty by hydraulic standards. Circulate the flushing fluid.

**Thermal shock**

During the flushing, the oil temperature will be oscillated but if fluid temperature exceeds 62 °C it shall not be re-used.

**Hydraulic shock**

The system may be hydraulically shocked by shutting down valves to interrupt the flow.

**Mechanical shock**

Vibrator or rubber hammer can be used on the horizontal section and corners of the line to apply hammering effect on the pipe.

---

**CLEANLINESS LEVEL CORRELATION TABLE**

<table>
<thead>
<tr>
<th>Code to ISO4406: 1999</th>
<th>Particles per Milliliter (ISO 11171 um (μ))</th>
<th>NAS 1638 (1964)</th>
<th>SAE Seviyesi (1963)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2 Microns</td>
<td>80,000</td>
<td>2,500</td>
<td>10</td>
</tr>
<tr>
<td>&gt; 5 Microns</td>
<td>20,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&gt; 15 Microns</td>
<td>10,000</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>22/20/18</td>
<td>40,000</td>
<td>10,000</td>
<td>-</td>
</tr>
<tr>
<td>22/20/17</td>
<td>10,000</td>
<td>1,300</td>
<td>-</td>
</tr>
<tr>
<td>21/19/16</td>
<td>20,000</td>
<td>5,000</td>
<td>10</td>
</tr>
<tr>
<td>20/18/15</td>
<td>10,000</td>
<td>2,500</td>
<td>9</td>
</tr>
<tr>
<td>19/17/14</td>
<td>5,000</td>
<td>1,300</td>
<td>8</td>
</tr>
<tr>
<td>18/16/13</td>
<td>2,500</td>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>17/15/12</td>
<td>1,300</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>16/14/12</td>
<td>640</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>15/13/10</td>
<td>320</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>14/12/9</td>
<td>160</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>13/11/8</td>
<td>80</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>12/10/8</td>
<td>40</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>12/10/7</td>
<td>40</td>
<td>1.3</td>
<td>-</td>
</tr>
<tr>
<td>12/10/6</td>
<td>40</td>
<td>0.64</td>
<td>-</td>
</tr>
</tbody>
</table>

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**CLEANLINESS LEVEL FOR COMPONENTS**

**Low/Medium Pressure**

Under 2000 psi (moderate conditions)

**High Pressure**

2000 to 2999 psi (low/medium with severe conditions)

**Very High Pressure**

3000 psi and over (high pressure with severe conditions)

- **Pumps**
  - Fixed Gear or Fixed Vane: 20/18/15 20/17/16 10/8/7
  - Fixed Piston: 19/17/14 18/16/13 17/15/12
  - Variable Vane: 19/17/14 18/16/13 16/14/11
  - Variable Piston: 18/16/13 17/15/12

- **Valves**
  - Check Valve: 20/18/15 20/17/14 19/17/14 18/16/13
  - Directional (selenoid): 20/18/15 20/17/14 19/17/14 18/16/13
  - Standard Flow Control: 20/18/15 20/17/14 19/17/14 18/16/13
  - Cartridge Valve: 19/17/14 18/16/13
  - Proportional Valve: 17/15/12 3 2 1
  - Servo Valve: 16/14/11 16/14/13 15/13/10

- **Actuators**
  - Cylinders, Vane Motors, Gear Motors: 20/18/15 20/17/14 19/17/14 18/16/13
  - Piston Motors, Swash Plate Motors: 19/17/14 18/16/13
  - Hydrostatic Drives: 16/15/12 16/14/11 15/13/10
  - Test Stands: 15/13/10 15/13/10 15/13/10

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FLUSHING FLUID

The flushing fluid must be compatible with the fluid specified for the system and with system materials, especially the seals. In all cases the appropriate technical and regulatory standards will apply to the fluid selection, including supplier specifications, e.g. in the use of synthetic hydraulic oils.

The recommended flushing fluid is normally the same grade as the working fluid.