3. Description

The HEINKEL HF-Inverting Filter Centrifuge is used for separating crystalline, granular, fibrous and amorphous solids from suspensions.

The machine is of simple and sturdy construction and requires little maintenance.

The main assemblies of the machine are:

- Drum with drum insert
- Shaft with hydraulic axial cylinder
- Solids housing and filtrate housing
- Machine housing
- Base frame with lateral support for load cell
- Main drive
4. Shipping & Handling

The machine is supplied completely assembled.

Eyebolts are provided for lifting the centrifuge. The machine must not be lifted at any other points. (See ill. 2).

In order to avoid damage to the sensitive load cell of the feed control during transportation and handling it is specially protected. Set up for operation should be in accordance with paragraph 5.3 and shown on illustration 3.

Whenever the machine is to be moved again, the load cell must be protected per paragraph 5.3.

For exact dimensions see general arrangement drawing.

<table>
<thead>
<tr>
<th></th>
<th>HF 300 (mm) / (inch)</th>
<th>HF 600 (mm) / (inch)</th>
<th>HF 800 (mm) / (inch)</th>
<th>HF 1000 (mm) / (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1600 / 63</td>
<td>3050 / 120</td>
<td>4060 / 159\frac{3}{8}</td>
<td>4620 / 181\frac{3}{8}</td>
</tr>
<tr>
<td>C</td>
<td>925 / 36\frac{7}{16}</td>
<td>1460 / 57\frac{1}{2}</td>
<td>1860 / 73\frac{3}{16}</td>
<td>2160 / 85</td>
</tr>
<tr>
<td>max. width</td>
<td>750 / 29\frac{1}{2}</td>
<td>1315 / 51\frac{3}{4}</td>
<td>1570 / 61\frac{15}{16}</td>
<td>1770 / 69\frac{3}{16}</td>
</tr>
</tbody>
</table>
5. Erection

No special construction work is required for installing the centrifuge.

The parts of the building on which the inverting filter centrifuge is mounted are only subject to static load. Therefore, the weight of the machine (including drum charge) is the only factor that has to be considered for the layout of the supporting constructions. A special vibration-absorbent foundation is not required. The machine can be installed on any level floor of a building provided that the permissible floor loading is not exceeded.

5.1 Erection without base frame
The machine has four feet (vibration dampers) which should be anchored to the ground.

5.2 Erection with base frame
The machine is mounted on a base frame. Between this base frame and the machine there are rubber buffers. The base frame should be anchored to the ground.

5.3 Transport protection of load cell
In order to avoid damage to the delicate load cell of the feed control during transportation and handling, it is specially protected (see Ill. 3).

Prepare the load cell for operation, i.e. for weight control as follows:
- Loosen nut (No. 148) and knurled nut (No. 147).
- With nut (No. 139) lift the machine until the spacer blocks between machine and base frame can be removed.
- Remove spacer blocks.
- Loosen nut (No. 139) in order to lower the machine so that it loads the rubber buffer (No. 159) and through it the load cell.
- Secure rubber buffer (No. 159) with bolt (No. 149).
- Do not yet tighten the bolts (Nos. 139, 147 and 148).
- Check if the weighing behaviour of the machine is not impeded through the pivot point. There must be a gap of $> 3 \text{ mm (} \frac{1}{8}" \text{)}$ between the rubber buffers (No. 112) and the base frame.

The cable from the load cell to the control panel should be shielded and run in a separate conduit.
5. Erection

5.4 Installation for hydraulic assemblies

5.4.1 Integrated axial hydraulics
The assembly is complete (prepped) and contained within the machine body. The oil reservoir should be filled per paragraph 8.4 and 16.2.

Oil should be filtered through a 10 micron absolute prefilter. Care should be taken during this procedure so as not to introduce foreign material.

Electrical components including motors, solenoid valve and pressure switch should be connected with flexible conduits.

5.4.2 Stand alone axial hydraulics
The unit is separate from the machine and hydraulic interconnections must be made. End connections at the centrifuge should be a minimum of 3' flexible hoses. Distances over 10' should be made with tubing and flexible end connections.

The location of this unit should be at the same level as the machine or lower, so that the drain oil from the hydraulic cylinder on the machine can flow unimpeded.

Filling of oil and electrical connections should be made in accordance with paragraph 5.4.1.

It is mandatory that the hydraulic interconnections be flushed free of contamination prior to start up.

5.4.3 Axial and rotational hydraulics
The same procedure as in paragraph 5.4.2 is required.

![Diagram of inverting filter centrifuge and stand alone axial hydraulic system](image_url)
6. Installation

The installation plan (ill. 5) is typical of a recommended installation.

Connections to the centrifuge must be flexible.

When equipped with feed control, the flexible length must be dimensioned in such a way that the weighing accuracy of the load cell is not affected. In order to avoid air backpressure in the filtrate chamber of the centrifuge, it is urgently recommended to provide a filtrate cyclone which should be installed directly at the filtrate outlet of the machine. In the case of gas-light machines, the air should either be exhausted from the filtrate cyclone or returned to the solids housing. Thus, it is assured that the pressure in the filtrate housing is slightly lower than that in the solids housing or that both chambers have the same pressure.

At reverse pressure conditions droplets may build up in the solids chamber.

A sight glass in the feed and filtrate line should be provided.

Min. pipe diameter at cyclone:

<table>
<thead>
<tr>
<th></th>
<th>HF 300 (mm) / (inch)</th>
<th>HF 600 (mm) / (inch)</th>
<th>HF 800 (mm) / (inch)</th>
<th>HF 1000 (mm) / (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtrate outlet</td>
<td>65 / 2</td>
<td>100 / 4</td>
<td>125 / 5</td>
<td>125 / 5</td>
</tr>
<tr>
<td>Air outlet</td>
<td>65 / 2</td>
<td>100 / 4</td>
<td>125 / 5</td>
<td>125 / 5</td>
</tr>
</tbody>
</table>

It is recommended to install a hoist at least four (4) feet above the machine and parallel to it along the center line. Supporting loads, see paragraph 12.
7. Operation

7.1 Centrifuge

The Inverting Filter Centrifuge is a special centrifuge design which differs from conventional discontinuously working centrifuge types (e.g. peeler or three-column basket centrifuges) by the discharge method.

A cycle can, for instance, be as follows:

- The machine is accelerated to the desired filling speed.
- The suspension is fed in through the feed pipe.
  When operated with feed control, the drum is filled until the preset max. weight is reached. Then the filling valve shuts off the filling process. An indicating instrument permits the visual control of the feeding process. Additional filling is possible.
  When operated automatically without feed control, the filling process is controlled with the aid of a timer.
- The machine is accelerated to the desired spinning speed. The mother liquid is removed during the preselected spinning time.
- Washing media is fed in either by presetting the quantity or the time.
- Subsequent centrifuging processes are possible by presetting the time.
- The machine is decelerated to the desired discharging speed.

In order to avoid premature wear of the machine and the filter cloths, the discharging speed should be kept as low as possible.

The following max. speeds must not be exceeded:

<table>
<thead>
<tr>
<th>HF 300 (rpm)</th>
<th>HF 600 (rpm)</th>
<th>HF 800 (rpm)</th>
<th>HF 1000 (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>950</td>
<td>600</td>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>

The solids are discharged into the solids housing by extending the drum insert and thereby turning the filter cloth inside-out while the drum is rotating. From there they are directed off to the bottom. The filter cloth is now clean again and ready for the next batch.

7.2 Feed control

The feed control is based on the weighing principle.

The centrifuge presses via a pivot point (rubber buffer) onto a load cell at the end of the machine. Before each filling process the weight of the machine is set to “0”. At the same time the feed control transmits a signal to the filling valve and the suspension flows into the drum until the max. weight, which can be freely set, is reached and the filling valve closes again.

Simultaneously a timer is activated. If the min. weight, which can also be freely set, is reached before the time set has elapsed, the filling valve reopens until the max. weight causes the valve to close again.

This process can be repeated over and over again until the set time has elapsed without the minimum weight being reached.

The actual filling weights can be read off from an indicating instrument provided at the switchboard panel or the control panel.
7. Operation

The max. filling weights depend on the specific weights of the suspension, the mother liquor or the solids to be processed.

When dewatering, a set point may be entered in kg/s/min., which represents the filtration rate of the product. The lower this set point the lower the residual moisture.

The useful drum capacities are:

<table>
<thead>
<tr>
<th>HF 300 (dm³) (US-Gallons)</th>
<th>HF 600 (dm³) (US-Gallons)</th>
<th>HF 800 (dm³) (US-Gallons)</th>
<th>HF 1000 (dm³) (US-Gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5</td>
<td>52</td>
<td>119</td>
<td>201</td>
</tr>
<tr>
<td>1.75</td>
<td>14</td>
<td>32</td>
<td>54</td>
</tr>
</tbody>
</table>

7.3 Main rotational drives

7.3.1 Hydrostatic drive
The hydrostatic drive permits to set and realize any speed between “0” and max. speed. At the pump unit of the hydrostatic drive there is a servo valve installed which allows a stepless speed setting by a 4-20ma signal out of the control panel. Even the numbers of set points is not limited.

The hydraulic motor is installed on the centrifuge and drives the hollow shaft (on which the drum is mounted) via a V-belt and pulley. Through a key, the center shaft (on which the drum insert is mounted) is also driven.

Both shafts run at same speed.

The hydraulic motor with the V-belt pulley and the bearing block is installed on a tension plate. With this tension plate the V-belts are to be sufficiently tensioned.

For manual operation, the speeds can be changed by means of the two push buttons on the operators panel, “Acceleration” and “Deceleration.” For automatic operation, speeds are controlled according to the selected program.

7.3.2 Drive with pole-changing motor and turbo-coupling
This variation permits 2 different speeds (8 and 4 pairs of poles). Furthermore it is possible to use a third speed for discharging. This speed is variably adjustable at the tachometer.

The motor together with the turbo-coupling is installed under the rear casing. The hollow shaft and the drive shaft are driven by V-belts.

Three push buttons are provided at the operators panel for changing the speed.

They are identified:
- low speed (8 pairs of poles = 1/2 speed)
- high speed (4 pairs of poles = max. speed)
- discharge
The desired discharge speed is set at the tachometer and should not exceed the following values:

<table>
<thead>
<tr>
<th>HF 300 (rpm)</th>
<th>HF 600 (rpm)</th>
<th>HF 800 (rpm)</th>
<th>HF 1000 (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>950</td>
<td>600</td>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>

When operated manually, the discharge speed is obtained as follows:

At max. speed press the push button “low speed,” thus decelerating to half speed. Then press the push button “discharge,” and the motor will, in counterclock operation, slow down to discharging speed. The discharging speed is signalled by an indicator light. Now the discharging process can be initiated. In automatic operation, this is controlled automatically.

### 7.3.3 Drive with AC variable frequency drive (VFD)

The drive permits speeds to be set between “250” and “max.” rpm’s via a 4-20mA signal from the control panel. The number of set points is not limited.

The motor is located under the rear casing on a tension plate directly at the centrifuge. The hollow shaft and the drive shaft are driven by V-belts. When operated manually, the different speeds can be chosen by actuating the corresponding push buttons (acceleration/deceleration).

### 7.4 Axial hydraulic system

The hollow shaft and the center shaft form at the rear end a hydraulic cylinder. This hydraulic cylinder is fed by an independent hydraulic unit through a rotary distributor.

This hydraulic cylinder:
- moves the center shaft, on which the drum insert is mounted, in the axial direction thus inverting the filter cloth (discharging the drum)
- keeps the drum closed during the working cycles (filling, washing, spinning).

The end positions of the axial displacement are controlled by proximity switches mounted on the shaft assembly and they are signalled by indicator lights.

When a proximity switch fails, the axial movement is limited by fixed mechanical stops thus avoiding damage to the machine.

### 7.5 Pressure switch

The machine is equipped with a pressure switch on the axial hydraulics unit to prevent an acceleration of the speed with an open drum.

There is a lower hydraulic pressure required to open the drum than to keep the drum closed. The control panel uses the signal of the lower pressure to block any signal to the rotational drive for acceleration.

### 7.6 Centrifugal valve

Inside the non rotating very back end of the centrifuge hydraulic cylinder (rotary distributor) there is a centrifugal valve installed which blocks, mechanically, any oil flow to open the drum above a certain speed.
8. Commissioning

8.1 Feed control
Depending on your order and with a variation of different control units available, each control unit may require a different calibration and set up for the filling control.

Please check with Heinkel for your particular procedure sheet.

8.2 Main rotational drives

8.2.1 Hydrostatic drive
- Check rotation direction of motor.
- Check V-belt tension.
- The separately erected hydrostatic drive unit should be connected to the hydrostatic constant motor at the machine with high-pressure hoses or, in the case of longer distances, with tubes. The connections to the oil motor and to the hydrostatic drive unit, however, must always be flexible.
- When determining the dimensions of the connecting tubes, always bear in mind the hydraulic losses in the tubes due to elbows etc. The pressure within the system is 180-300 bars (psi 2570-4280) depending on the size of the drive.
- Should, after some time, the speed of the drive gear be no longer synchronous with the speed of the machine, check pressure and adjust accordingly.
- The electric regulating device at the hydrostatic drive will be controlled by a 4-20ma signal from the controller.

Take care that the axial hydraulic and the hydrostatic drive unit are installed on the same level or lower than the centrifuge for drain oil purposes.

8.2.2 Drive with pole-changing motor and turbo coupling
- Check rotation direction of motor.
- Check V-belt tension.
- Check oil level in turbo coupling.

This is done by draining the oil through the oil outlet screw into a clean container.

The coupling must be filled with sufficient oil.

For oil quantities see para. 17.2.2.

8.2.3 Drive by AC variable frequency drive (VFD)
- Check rotation direction of motor.
- Check V-belt tension.
- Set desired speeds at the control panel.

8.3 Speed sensor
A toothed gear mounted on the drive shaft rotation is sensed without contact by a proximity switch. An indicating instrument shows the actual drum speed.

The distance between the proximity switch and the toothed gear is exactly adjusted by the manufacturer and must not be changed since otherwise the tachometer will show wrong values.
8. Commissioning

8.4 Axial hydraulic system

■ Check rotation direction of motors.

■ Fill in oil through oil inlet pipe with built-in screen. See paragraph 5.4.1.

The following oil quantities are required:

<table>
<thead>
<tr>
<th></th>
<th>HF 300 (litres)</th>
<th>HF 600 (litres)</th>
<th>HF 800 (litres)</th>
<th>HF 1000 (litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil quantities</td>
<td>40 (US-Gallons)</td>
<td>120 (US-Gallons)</td>
<td>150 (US-Gallons)</td>
<td>300 (US-Gallons)</td>
</tr>
</tbody>
</table>

To these quantities the volume of the hydraulic piping line system must be added.

■ Check hose and pipe connections for tightness. Do not tighten loose connections while the system is under pressure.

Control oil pressure at pressure gauge:

<table>
<thead>
<tr>
<th></th>
<th>HF 300 (bars)</th>
<th>HF 600 (bars)</th>
<th>HF 800 (bars)</th>
<th>HF 1000 (bars)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(psi)</td>
<td>(psi)</td>
<td>(psi)</td>
<td>(psi)</td>
</tr>
<tr>
<td>With drum</td>
<td>70</td>
<td>90</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td>closed</td>
<td>1000</td>
<td>1285</td>
<td>930</td>
<td>785</td>
</tr>
<tr>
<td>With drum</td>
<td>70</td>
<td>50</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>opened</td>
<td>1000</td>
<td>712</td>
<td>570</td>
<td>430</td>
</tr>
</tbody>
</table>

■ De-aerate the entire hydraulic system at the highest spot.

■ If the required pressure is not built up with drum closed, it may be possible that there is an air cushion on the pressure side of the pump. This must be removed by loosening the screw connection next to the pressure side of the pump. When oil is visible, retighten the screw connection firmly.

Please bear in mind that with increasing distances between the unit and the machine, the losses of pressure also increase considerably. In such a case, this should be compensated for by using larger tubing.

■ After some hours of operation (appr. 20 hours) the insert of the oil filter cartridge should be removed and cleaned.

■ The oil temperature in the container should be appr. 50°C (122°F), but must never exceed 70°C (158°F).
8. Commissioning

8.5 Electrical installation
The electrical main circuit connection should be accomplished in accordance with the information on the nameplate on the control panel. The connecting lines from the control panel to the machine and to the units are to be wired as shown on the wiring diagram. In order to avoid electrostatic charging of the centrifuge, the regulations of the trade association must be observed.

- All current-conducting parts of the plant, where charges could build up due to static induction or the working process must be grounded.
- Installation and examination of ground wire.
  The ground wire must have sufficient mechanical strength to withstand the stresses exerted during the operation.

The ground wire system must be checked immediately upon completion and thereafter at regular intervals.

- Centrifuge and electric motors must be grounded individually.

Whenever there is a doubt, check the resistance to ground by measuring in order to be sure that it remains under $10^5$ Ohms during operation. When intrinsic safety barriers are utilized in conjunction with electrical devices located in a hazardous area, the resistance between the barrier ground and system ground should not exceed 1 Ohm.

Attention: Do not lay the shielded cable of the load cell together with other current-carrying cables.

8.6 Centrifuge
- Install filter cloth (see instructions for changing the filter cloth, para. 10).
- Check drum seals for damage and proper installation (if necessary, install new seals as described in para. 9).
- Close drum.
- Close solids housing.
- Check connections. All connections to and from the centrifuge must be flexible.
- Check anchoring.
- Initiate either manual or automatic operation as desired.

Direction of rotation: Looking at the centrifuge drum from the front, it must turn in clockwise direction. The direction of rotation of the auxiliary motors is marked with an arrow.
9. Replacing O-Rings in drum insert

- Turn selector switch to manual operation
- Turn on master switch
- Press push button "axial hydraulic on" The corresponding light goes on.
- Check if light "drum closed" is on; if not, press push button "drum closed" until this light is on.
- If necessary, disconnect filling and washing lines.
- Open solids housing.
  - The red light "housing open" goes on. The drive cannot be started.
- Actuate push button "drum open"
  - The light "drum open" goes on and when the drum is completely open, the light "drum empty" lights.
- Disconnect power supply and secure master switch in such a way that nobody can switch it on accidentally.

To obtain a perfect sealing effect, only use endless O-rings (i.e. no glued and no vulcanized ones).
- Lubricate O-rings with silicone grease and push them over the front plate of the drum insert.
- As the front plate forms a circle of 360°, press the O-ring into the groove starting at "0".
- Then the O-ring is pressed into the groove at 90°, then at 180° and at 270°. Use a blunt piece of hardwood for pressing in. Under no circumstances, insert O-rings with a hammer (not even with a rubber or plastic hammer).

While pressing, the O-ring becomes slightly longer, but the preselected 90° division will prevent excessive buckling.
- When both O-rings have been filled into the groove, turn the drum insert by hand at the same time pressing the piece of hardwood firmly against the O-rings.
- Before closing the drum, the O-rings (particularly the radially sealing one) should be slightly wetted in order to facilitate sliding by the large clamping ring holding the filter cloth.
- Only when drum is perfectly closed, the O-rings will be properly seated in their grooves.
- Close housing and secure it.
- If necessary, reconnect the filling and washing lines.
10. Changing the filter cloth

- Proceed as described under para. 9, steps 1-8, concerning the replacing of O-rings.
- Remove socket-head cap screws from the filter cloth clamping ring.
- Remove clamping ring as follows:
  Screw in rods (from tool kit) to prevent the clamping ring from falling onto the shaft. Remove clamping ring with a suitable pulling-off tool and leave it on the guide bolts (see ill. 7). Use of the guide bolts also ensures proper alignment of match marked components for balancing.
- Strip off filter cloth.
- Now the smaller clamping ring, which was concealed by the cloth, becomes accessible. Remove the socket-head cap screws. Screw in guide bolts from tool kit to prevent the clamping ring from falling onto the shaft. The clamping ring will come off without having to use tools. (see ill. 7a).
10. Changing the filter cloth

- The filter cloth can now be slipped over the plates of the drum insert and removed.
- For installing the new filter cloth, proceed as follows:
  
  Use the filter cloth stretcher included in the tool kit for expanding the cloth large diameter (see ill. 7b).
  
  Filter cloths of felt should be laid in water for 3-4 hours before stretching and filter cloths of fabric for appr. 15 minutes. The cloth is stretched until the marking on the stretcher is reached and should be left in this expanded state for appr. 10 min. The expansion obtained holds on for appr. ¼ hour and then the cloth will slowly shrink again to its original diameter. Therefore no time should be wasted between stretching the cloth and its installation. Some filter cloths do not require stretching and can be placed directly on the machine.

- A filter cloth of felt to be inserted is tailored at its smaller diameter and furthermore fitted with a sewn in O-ring. Place this ring into the groove of the small clamping ring and then screw on the clamping ring and remove the guide bolts.

- A woven cloth has a sewn in cord at its smaller diameter. Place the cloth into the groove of the drum insert and pull the cord until the cloth is firmly secured. Now knot the cord. The folds appearing in the cloth due to contracting should be equally distributed over the whole circumference. Then screw on the clamping ring and remove the guide bolts.

- When using a filter cloth with longitudinal seam, arrange it so that the seam is placed on the undrilled portion of the perforated plate (screen) of the bowl.

- The previously expanded larger diameter is placed over the shoulder of the drum flange. The end seam should lie flat on the flange and butt against the backwall. It should not ride up on the wall. After that the ring is screwed on and the guide bolts are removed. The holes for the guide bolts are closed with socket-head cap screws.

- Check the clamping ring for true running.

  Pay special attention to the fact that there must be a clearance of appr. 1 mm (1/16-1/32") between the white teflon band and the clamping ring over the whole circumference.

- Close and secure solids housing.

- If necessary, reconnect the filling and washing lines.

**Attention:** Clamping rings, drum and drum insert have balance markings which must coincide.
11. Dismantling of drum and drum insert

- Proceed as described under para. 9, steps 1-8.
- Attach drum insert with rope on hook of crane. (see ill. 8a)
- Remove socket-head cap screws holding the drum insert on the shaft.
- The drum insert can be removed without any special pulling-off tool.
- Turn on the axial hydraulic and move back the shaft by pressing the push button “drum closed”.
- Disconnect switchboard panel again.
- Remove the partition wall between filtrate housing and solids housing by removing the socket head cap screws.
- Secure drum with the aid of the drum holding device (from the tool kit) against falling. (see ill. 8).
- Remove screws holding the drum on the hollow shaft.
- The drum can be pulled out from the housing without special tools.

Transport weights:

<table>
<thead>
<tr>
<th></th>
<th>HF 300 (kg) / (lbs)</th>
<th>HF 600 (kg) / (lbs)</th>
<th>HF 800 (kg) / (lbs)</th>
<th>HF 1000 (kg) / (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum</td>
<td>25 / 55</td>
<td>100 / 220</td>
<td>235 / 520</td>
<td>470 / 1035</td>
</tr>
<tr>
<td>Drum insert</td>
<td>12 / 27</td>
<td>85 / 190</td>
<td>210 / 470</td>
<td>450 / 990</td>
</tr>
</tbody>
</table>