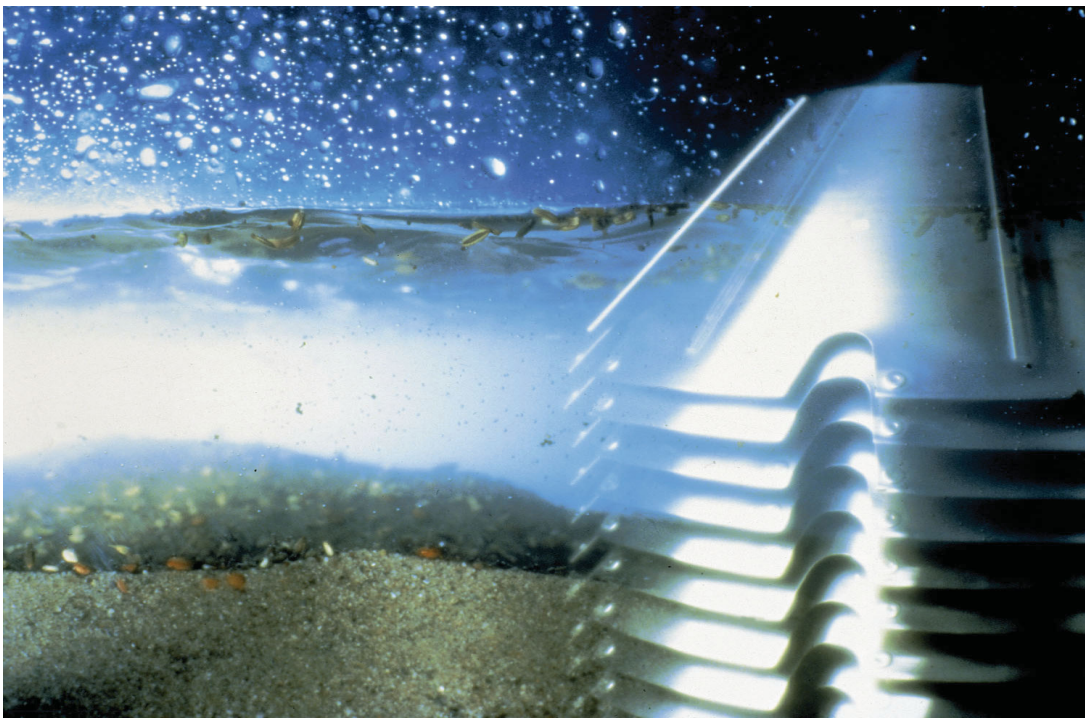
Installation Manual



Tetra Centri®

High Speed Separator

H60

Specification No. 881277-01-01/23
Book No. 9002485-02 Rev. 1
Product No. 881277-12-01
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Tetra Pak

Published By:
Alfa Laval Tumba AB
SE-147 80 Tumba, Sweden

Telephone: +46 8 530 650 00

Telefax: +46 8 530 310 40

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Contents

1 Read this first 7

2 Safety Instructions 9

2.1 Warning signs in text 13

2.2 Environmental issues 14

2.3 Requirements of personnel 15

2.4 Remote start 15

3 Technical Reference 17

3.1 Product description 17

3.2 Directives & Standards 18

3.3 Technical data 19

3.4 Connection list 21

3.5 Basic size drawing 26

3.6 Interface description 28

3.7 Quality requirements 44

3.7.1 Compressed air 44

3.7.2 Quality operating liquid 45

3.8 Px sealing diagram 46

3.9 Pump wheel characteristic 47

3.10 Foundation drawing 53

3.11 Motor specifications 55

3.11.1 Electric motor (22, 25, 30, 37, 42 kW) 55

3.11.2 Motor drive data 58

3.12 Guidelines for frequency converter drives 60

3.13 Dimensioning of a frequency converter 65

3.13.1 Dimensioning and programming of a frequency converter 65

3.13.2 Selecting the motor with correct voltage and frequency for a variable frequency drive 65

3.13.3 Dimensioning of a frequency converter for an actual application 68

3.13.4 Programming the frequency converter 70

3.13.5 Braking methods 71

3.14 Interconnection diagram 75

3.15 Monitoring kit 76

3.15.1 Speed sensor 77
3.15.2 Vibration sensor 79
3.15.3 Temperature sensor 80

3.16 Storage and installation 81

3.16.1 Introduction 81
3.16.2 Storage and transport of goods 81
3.16.3 Planning of installation 84
3.16.4 Foundations 89

3.17 Lifting instructions 91

3.17.1 Separator 91
3.17.2 Bowl 92
3.17.3 Other parts 93





Study instruction manuals and observe the warnings before installation, operation, service and maintenance.

Not following the instructions can result in serious accidents.

In order to make the information clear only foreseeable conditions have been considered. No warnings are given, therefore, for situations arising from the unintended usage of the machine and its tools.



1 Read this first

This manual is designed for operators and service engineers working with Alfa Laval separators.

If the separator has been delivered and installed by Alfa Laval as part of a processing system, this manual is a part of the System Manual. In this case carefully study all the instructions in the System Manual.

The documentation for the separator consist of:

- *Installation Manual (ISM)*
- *Operator´s Manual (OPM)*
- *Service & Maintenance Manual (SEM)*
- *Spare Parts Catalogue (SPC)*

Complementary information for additional system components may be supplied depending on order configuration.

2 Safety Instructions



The centrifuge includes parts that rotate at high speed. This means that:

- Kinetic energy is high
- Great forces are generated
- Stopping time is long



G0010421

Manufacturing tolerances are extremely fine. Rotating parts are carefully balanced to reduce undesired vibrations that can cause a breakdown. Material properties have been considered carefully during design to withstand stress and fatigue.

The separator is designed and supplied for a specific separation duty (type of liquid, rotational speed, temperature, density etc.) and must not be used for any other purpose.

Incorrect operation and maintenance can result in unbalance due to build-up of sediment, reduction of material strength, etc., that subsequently could lead to serious damage and/or injury.

The following basic safety instructions therefore apply:



- **Use the separator only for the purpose and parameter range specified by Alfa Laval. Applies not only to the process but also to cleaning and service liquids.**
- **Strictly follow the instructions for installation, operation and maintenance.**
- **Ensure that personnel are competent and have sufficient knowledge of maintenance and operation, especially concerning emergency stopping procedures.**
- **Use only Alfa Laval genuine spare parts and the special tools supplied.**



Disintegration hazards

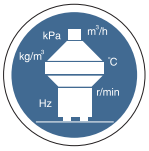
- When power cables are connected, always check direction of motor rotation. If incorrect, vital rotating parts could unscrew.



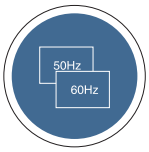
- If excessive vibration occurs, **stop** separator and **keep bowl filled** with liquid during rundown.



- Use the separator only for the purpose and parameter range specified by Alfa Laval.



- Check that the gear/pulley ratio is correct for power frequency used. If incorrect, subsequent overspeed may result in a serious break down.



- If the separator is run by a variable frequency drive, it is extremely important that the frequency does not exceed the allowed maximum, to avoid serious break down by too high speed.
- Wear on the large lock ring thread must not exceed safety limit.Φ-mark on lock ring must not pass opposite Φ-mark by more than specified distance.



- Welding or heating of parts that rotate can seriously affect material strength.



- Inspect regularly for **corrosion** and **erosion** damage. Inspect frequently if process or cleaning liquid is corrosive or erosive.





Entrapment hazards

- Make sure that rotating parts have come to a **complete standstill** before accessing parts inside the machine or starting **any** dismantling work. If there is no braking function the run down time can exceed two hours.



- To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.
  Assemble the machine **completely** before start. **All** covers, connections and guards must be in place.



Electrical hazard

- Follow local regulations for electrical installation and earthing (grounding).
- To avoid accidental start, switch off and lock power supply before starting **any** dismantling work.



Crush hazards

- Use correct lifting tools and follow lifting instructions.



- Do **not** work under a hanging load.



Noise hazards

- Use ear protection in noisy environments.



Burn hazards

- Lubrication oil, machine parts and various machine surfaces can be hot and cause burns. Wear protective gloves.





Skin irritation hazards

- When using chemical cleaning agents, make sure you follow the general rules and suppliers recommendation regarding ventilation, personnel protection etc.
- Use of lubricants in various situations.



Cut hazards

- Sharp edges, especially on bowl discs and threads, can cause cuts. Wear protective gloves.



Flying objects

- Risk for accidental release of snap rings and springs when dismantling and assembly. Wear safety goggles.



Health hazards

- Risk for unhealthy dust when handling friction blocks/pads. Use a dust mask to make sure not to inhale any dust





2.1 Warning signs in text

Pay attention to the safety instructions in this manual. Below are definitions of the three grades of warning signs used in the text where there is a risk for injury to personnel.



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



NOTE indicates a potentially hazardous situation which, if not avoided, may result in property damage.



2.2 Environmental issues

Unpacking

Packing material consists of wood, plastics, cardboard boxes and in some cases metal straps.

Wood and cardboard boxes can be reused, recycled or used for energy recovery.

Plastics should be recycled or burnt at a licensed waste incineration plant.

Metal straps should be sent for material recycling.

Maintenance

During maintenance oil and wear parts in the machine are replaced.

Oil must be taken care of in agreement with local regulations.

Rubber and plastics should be burnt at a licensed waste incineration plant. If not available they should be disposed to a suitable licensed land fill site.

Bearings and other metal parts should be sent to a licensed handler for material recycling.

Seal rings and friction linings should be disposed to a licensed land fill site. Check your local regulations.

Worn out or defected electronic parts should be sent to a licensed handler for material recycling.



2.3 Requirements of personnel

Only **skilled** or **instructed** persons are allowed to operate the machine, e.g. operating and maintenance staff.

- **Skilled person**: A person with technical knowledge or sufficient experience to enable him or her to perceive risks and to avoid hazards which electricity/mechanics can create.
- **Instructed person**: A person adequately advised or supervised by a skilled person to enable him or her to perceive risks and to avoid hazards which electricity/mechanics can create.

In some cases special skilled personnel may need to be hired, like electricians and others. In some of these cases the personnel has to be certified according to local regulations with experience of similar types of work.

2.4 Remote start

If the separator is operated from a remote position where the separator cannot be seen or heard the power isolation device shall be equipped with an interlock device to prevent that a remote start command could result in liquid being fed to the separator when it is shut down for service.

The first start after the separator has been taken apart or been standing still for a long time shall always be manually supervised locally.



3 Technical Reference

3.1 Product description

Alfa Laval ref. 589389 Rev. 5

Application:	**Dairy**	
Product specification:	**881277-01-01**	
Directives & Standards:	Sanitary class: ISO	Sanitary class: 3–A / 3–A+
	588839	588840

Technical design:

Bowl material: 2398
Sealing available in Nitrile
Variable discharge system (OWMC)
Stainless steel frame bottom part
Water cooled jacket
Hermetic inlet design
Hermetic- and Open- outlet design

	H, C & W	BM
Hydraulic capacity:	max. 90 m^3/h	max. 75 m^3/h

Restrictions:

Max. bowl speed: 4600 rpm
Only land based installation permitted
Bowl must be kept filled during stopping sequence
Risk for corrosion and erosion have to be investigated in each case by the application centre.

3.2 Directives & Standards

ATEX: No / Sanitary class. No

Alfa Laval ref. 588839 Rev. 0

Complies with the essential health and safety requirements of:

98/37/EC	Machinery Directive
2004/108/EC	Electromagnetic Compatibility Directive
2006/95/EC	Low Voltage Directive
EC 1935/2004	Material traceability

To meet these requirements the following standards have been used:

EN 12547	Centrifuges-Common safety requirements. (including several other EN- standards)
EN ISO 14121-1	Safety of machinery - principles of risk assessment
EN ISO 9001/2000	Quality management systems requirements
EN ISO 14000	Environmental Management System

3.3 Technical data

Alfa Laval ref. 587796 Rev. 4

Max allowed bowl speed	4600	r/min
Critical speed interval (bowl)	600-1100 2500-3000	r/min
Set frequency (synchronic)	65	Hz
Gear ratio M18	85:36	
Max. set motor shaft speed	1948	r/min
Hydraulic capacity		
- H1, H2, H3, H4, H5, H6, C1, D1, D2, D3, W1, BB1	90	m^3/h
- BM1	75	m^3/h
Max. density of sediment / feed	1317 / 1050	kg/m^3
Max./Min feed temperature	0 / 100	°C
Max. density of operating liquid	1000	kg/m^3
Min./Max. discharge volume	10 / 35	litres
Min./Max. discharge interval	1 / 60	minutes
Max. Bowl inner diameter	644	mm
Bowl volume	72	litres
Sludge volume	17	litres
Bowl weight	Up to 1150	kg
Bowl body material	AL 111 2398-05	
Weight of separator (without motor)	Up to 2200	kg
Weight motor	215-230	kg
Motor power		
- HMRPX, CMRPX	32,37,42 or 52	kW
- BMRPX		kW
- DMRPX		kW
Power consumption (idling)	18,5	kW
Power consumption (at max. capacity)	See "Pump wheel characteristics"	
Jp reduced to motor shaft	481	kgm^2
Min. starting time	10	minutes
Min. stopping time without brake (average)	90	minutes
Min. stopping time with brake (average)	10	minutes
Max. running time without feed flow	60	minutes
Lubricating oil volume	12,5	litres
Sound power/sound pressure level	9,5 / 78	Bel(A) dB(A)

Alarm levels:		
Alarm levels for vibration monitor		
Connection 750 (pre-warning)	7,1	mm/sec.
Connection 750 (shut down)	9	mm/sec.
Alarm level 750 can be 50% more at critical speed		
Max. neck bearing temperature (pre-warning)	120	°C
Max. neck bearing temperature (shut down)	140	°C
Recommended max. oil temperature (pre-warning)	80	°C
Recommended max. oil temperature (shut down)	90	°C

3.4 Connection list

Alfa Laval ref. 583227 Rev. 7

Connection No.	Description	Requirements/limits
201	Inlet process liquid - Maximum allowed density - Flow HMRPX; CMRPX - Flow BMRPX; DMRPX - Temperature - Max. allowed inlet pressure - Required inlet pressure	 See 3.3 Technical data Max. 90 m³/h Max. 75 m³/h 0°C to +100°C Max. 700 kPa See "Pump wheel characteristics"
220	Outlet light phase, clarified liquid - Max allowed back pressure - Max available back pressure - Minimum required back pressure	 700 kPa See "Pump wheel characteristics" See "Pump wheel characteristics"
221	Outlet heavy phase - Max allowed back pressure - Max available back pressure - Minimum required back pressure	 700 kPa See "Pump wheel characteristics" See "Pump wheel characteristics"
222	Outlet from cyclone - Discharges - Sealing liquid from connection 635 - Possibly flushing liquid from 821a	Drain by gravity 10 – 35 l/discharge Maximum 60 discharge / hour 60 litres/h
303a	Flushing under the bowl (nozzle pointing towards centre) Normally used only in the discharge sequence and/or for cleaning - Pressure - Pressure (recommended) - Flow (momentary at rec. pressure) - Consumption	Water or CIP-liquid 100-600 kPa 300 kPa 460 litres/h 0-6 litres/discharge
303b	Additional Flushing under the bowl (nozzle pointing from centre)	Normally delivered plugged. Can be equipped with the same nozzle as 303a
304	Flushing in sediment outlet Normally used only in the discharge sequence and/or cleaning - Pressure - Pressure (recommended) - Flow (momentary at rec. pressure) - Consumption	Water or CIP-liquid 300-700 kPa 300 kPa 3 m³/h 0-25 litres/discharge

Connection No.	Description	Requirements/limits
375	Inlet for discharge and make-up liquid - Quality requirements - Density Make-up liquid: - Pressure - Flow requirements - Consumption Discharge liquid: - Consumption	 See 3.7.2 Quality operating liquid 1000 kg/m³ 25–50 kPa 500 litres/hour Min 5 litres/hour 1,5 litre/discharge
377	Outlet for operating liquid	Should be possible to drain liquids by gravity.
405	Inlet for cooling liquid, frame part - Recommended pressure - Flow at recommended pressure - Pressure - Temperature	 20 kPa 200 litres/h Max 50 kPa 0 – 100 °C
406	Outlet for cooling liquid, frame part	Flow as connection 405
409	Inlet for cooling oil cooler - Pressure - Recommended pressure - Flow at recommended pressure - Temperature	 Max 200 kPa 20 kPa 80-100 litres/h 0 – 50 °C
410	Outlet for cooling/heating oil cooler	Flow as connection 409
461	Drain of cooling jacket	Normally plugged Only used at service.
462	Drain of frame top part, lower	Should be possible to drain liquids by gravity.
463	Drain of frame top part, upper	Outlet for used operating water and flushing liquid from connection 305. Valve in this line should be avoided. Should be connected to a liquid seal. Should be possible to drain liquids by gravity. Maximum gas back pressure 20 kPa.
506a	Inlet compressed air to OWM - Quality requirements - Pressure, must be adjustable	 See 3.7.1 Compressed air" 300-700 kPa

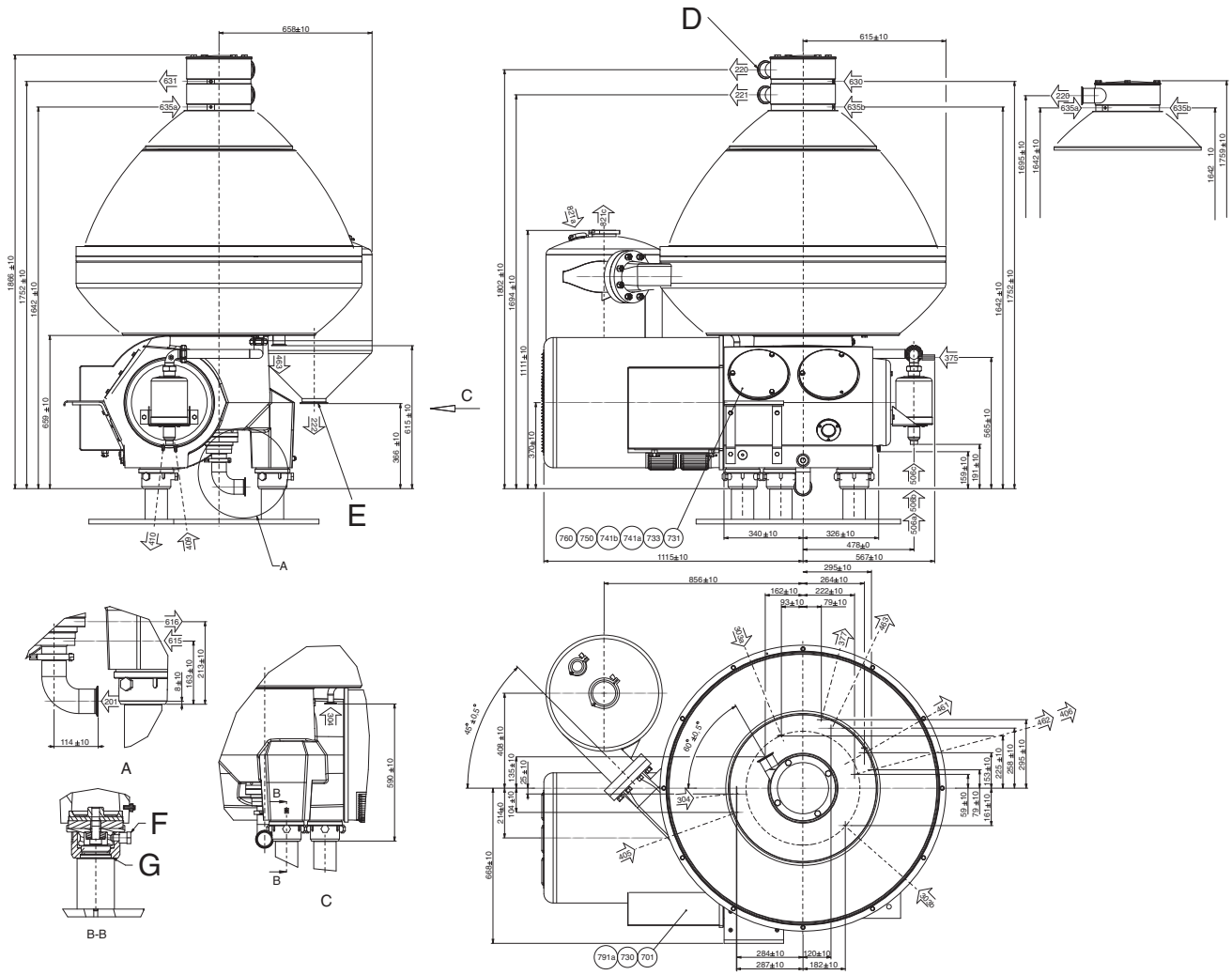
Connection No.	Description	Requirements/limits
506b	Inlet for activating a small discharge - Quality requirements - Pressure range	 See 3.7.1 Compressed air 400-700 kPa
506c	Inlet for activating a large discharge - Quality requirements - Pressure range	 See 3.7.1 Compressed air 400-700 kPa
615	Inlet sealing liquid for product inlet - Recommended pressure - Flow at recommended pressure - Required flow - Temperature	See 3.7.2 Quality operating liquid 300 kPa 60 l/h 60-90 l/h (corresponds to 300-700 kPa) 0 – 50 °C
616	Outlet sealing liquid	Free outlet without back pressure
630	Inlet for sealing liquid for the outlet seal between the two media - Recommended pressure - Flow at recommended pressure - Required flow - Temperature	See 3.7.2 Quality operating liquid 350 kPa 60 l/h 60-90 l/h (corresponds to 350-750 kPa) 0 – 50 °C Should be connected via a check valve
631	Outlet for sealing liquid	Flow as connection 630 Available pressure: as connection 630 minus 350 kPa
635a	Inlet for sealing liquid for the seal between the media and the bowl casing - Recommended pressure - Flow at recommended pressure - Required flow - Temperature	See 3.7.2 Quality operating liquid Also used as flushing above bowl 300 kPa 60 l/h 60-90 l/h (corresponds to 300-700 kPa) 0 – 50 °C
635b	Additional Inlet for sealing liquid for the seal between the media and the bowl casing	Normally plugged
701	Motor for separator	For variable frequency drive (VFD)
730	Temperature sensor for motor winding - PTC thermistor	Connected to VFD Tripping temperature 150 °C
731	Temperature sensor, Neck bearing holder	Pt 100 class A
733	Temperature sensor, Lubricating oil	Pt 100 class A

Connection No.	Description	Requirements/limits
740	Speed sensor for bowl speed - Inductive proximity switch, Type - Supply voltage, nominal. - With sensor activated (close to metal). - With sensor not activated (far from metal). - Pulses per revolution - Inductive proximity switch, Type - Supply voltage, nominal. - With sensor activated (close to metal). - With sensor not activated (far from metal). - Pulses per revolution	 NAMUR 8 V ≤ 1 mA ≥ 3 mA 1 PNP U_s: 12-30 V ~U_s(U_s – ≤ 3 v) 0 V 1
741	Speed sensor for motor speed - Inductive proximity switch, Type - Supply voltage, nominal. - With sensor activated (close to metal). - With sensor not activated (far from metal). - Pulses per revolution - Inductive proximity switch, Type - Supply voltage, nominal. - With sensor activated (close to metal). - With sensor not activated (far from metal). - Pulses per revolution	 NAMUR 8 V ≤ 1 mA ≥ 3 mA 1 PNP U_s: 12-30 V ~U_s(U_s – ≤ 3 v) 0 V 1
750	Unbalance sensor, vibration - Supply voltage - Frequency response - Output signal Output signal corresponds to	 10 – 32 VDC 2 Hz – 1 kHz 4 – 20 mA 0 – 25 mm/s RMS
760	Cover interlocking switch (Optional) - Type - Switch rating, resistive load max	 Mechanical Switch with one opening and one closing contact AC 500 V, 5000 VA DC 125 V, 400 W
791a	Earthing connection (motor)	Shall be connected to installation earth with insulated copper conductor with the area of at least 6 mm^2, maximum 25 mm^2.
791b	Earthing connection (frame)	Shall be connected to installation earth with insulated copper conductor with the area of at least 6 mm^2, maximum 25 mm^2.
821a	Plugged connection on cyclone - (Can be used for level sensor or spray nozzle)	
821b	Not in use	

Connection No.	Description	Requirements/limits
821c	Plugged connection on cyclone - (Can be used for ventilation or sight glass)	
821d	Not in use	
821e	Not in use	

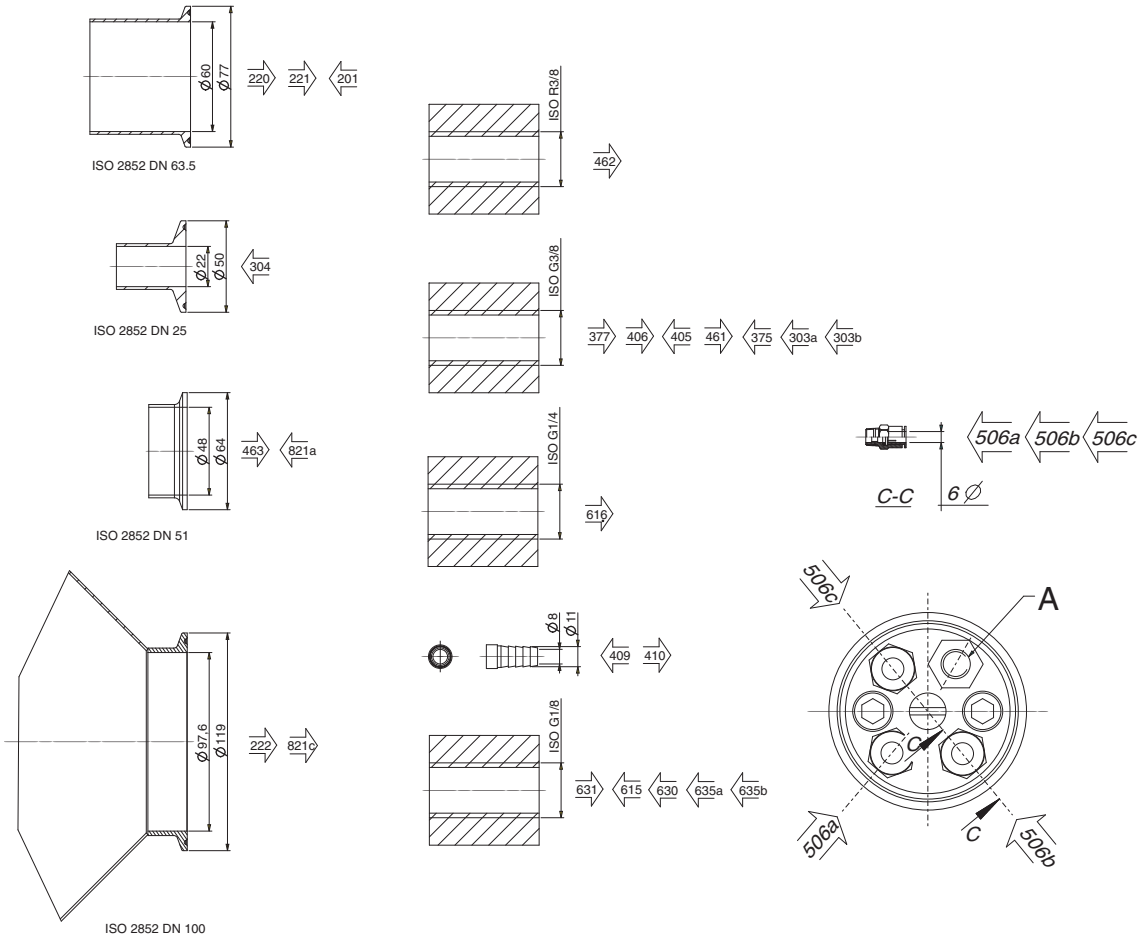
3.5 Basic size drawing

Alfa Laval ref. 589400 Rev. 0



G1008081

Connections 201 turnable 360°.	
Connections 220 and 221 turnable 360° in 90° steps.	
Data for connections, see Connection list	
All connections to be installed non-loaded and flexible.	
D. Maximum horizontal displacement at the outer connections during operation ±20 mm	G. Adjust washer max. 4 cs. / foot
E. Maximum vertical displacement at the cyclone connection during operation ±20 mm	F. Tightening torque 100 Nm



G1008091

A. Needle valve	

3.6 Interface description

Alfa Laval ref. 584758 Rev. 3

Scope

This document gives information, requirements and recommendations about operational procedures and signal processing for safe and reliable operation of a separator. It is intended to for designing auxiliary equipment and control system for the separator.

References

This *Interface Description* is one complementary document to the separator. Other such documents that contain necessary information and are referred to here are:

- *Interconnection Diagram*
- *Connection List*
- *Technical Data*
- *Motor Drive Data*
- *Guidelines for frequency converter drives*
- *Dimensioning of a frequency converter drive*

Standards referred to are:

- EN 418 Safety of machinery - Emergency stop equipment, functional aspects - Principles of design
- EN 1037 Safety of machinery - Prevention of unexpected start-up

Definitions

For the purpose of this document, the following definitions apply:

- **Synchronous speed:** The speed the machine will attain when it is driven by a three-phase squirrel-cage induction motor and there is no slip in the motor and the drive system.
- **Full speed:** The synchronous speed minus normal slip.

Goal

To eliminate situations that can cause harm, i.e. injury, damage to health or property and unsatisfactory process result are e.g.:

Situation	Effect
Unbalance caused by uneven sediment accumulation in the bowl. Too high bowl speed.	Too high stress on bowl and bearing system which might cause harm. Too high stress on bowl which might cause harm.
Access to moving parts.	Can cause injury to person who accidentally touches these parts.
Insufficient cleaning of separator.	Unsatisfactory product quality.
Bowl leakage.	Product losses.

Information and instructions given in this document aim at preventing these situations.

Control and supervision can be more or less comprehensive depending on the type of used control equipment. When a simple control unit is used it would be impossible or too expensive to include many of the functions specified here while these functions could be included at nearly no extra cost when a more advanced control unit is used. For this reasons functions that are indispensable or needed for safety reasons to protect the machine and/or personnel are denoted with *shall* while other functions are denoted with *should*.

Description of separator modes

Separator modes

For control purposes the operation of the separator should be divided into different modes.
The normally used modes are described below but other modes might exist.
It is assumed that: If conditions are not fulfilled the separator is not ready for operation

- The separator is correctly assembled.
- All connections are made according to Connection List, Interconnection Diagram, Motor Drive Data and Interface Description.
- The separator control system is activated.

STAND STILL means

- The power to the separator motor is off.
- The bowl is not rotating and some connection is open to the surrounding to prevent vacuum in the system at temperature changes.

STARTING means:

- The power to the separator motor is on.
- The bowl is rotating and accelerating.

RUNNING means:

- The power to the separator motor is on.
- The bowl is rotating at full speed.

RUNNING is a collective denomination for a number of sub modes which e.g. can be:

- *STAND BY:* Separator is in a waiting mode and not producing. Two sub modes: *STANDBY WET* and *STANDBY DRY* exists and depends on if stand by liquid is supplied or not.
- *PRODUCTION:* Separator is fed with product and producing.
- *CLEANING:* Separator is fed with cleaning liquids with the intention to clean the separator.

STOPPING means:

- The power to the separator motor is off.
- The bowl is rotating and decelerating.

STOPPING is a collective denomination for a number of sub modes which e.g. can be:

- *NORMAL STOP:* A manually or automatically initiated stop.
- *SAFETY STOP:* An automatically initiated stop at too high vibrations.
- *EMERGENCY STOP:* A manually initiated stop at emergency situations. This stop will be in effect until it is manually reset.

Transition between different modes

A figure in the appendix shows which transitions between different modes that are possible.

Remote control of the separator

The separator can be started and controlled from a remote location if the separator is equipped with a “cover interlock kit”, a “speed sensor” and an “unbalance sensor”. However, during first start after service or if the separator has been unused for a long time, the starting shall be manually supervised locally.

Handling of connection interfaces

Electrical connections

701 Separator motor.

The separator is equipped with a 3-phase standard motor. The motor intended to be driven from a Variable Frequency Drive (VFD). Guidelines for selecting and adjusting a suitable VFD are given in the documents:

- *Guidelines for frequency converter drives*
- *Dimensioning of a frequency converter drive*

The VFD should have a system that initiates a *NORMAL STOP* of the separator if the frequency goes above the values given in the Connection list. There shall be an emergency stop circuit designed according to EN 418 and a power isolation device according to EN 1037.
There should be a start button close to the separator that should be used for first start after assembly of the separator.
There should be a counter to count number of running hours.
There should be a possibility to indicate the motor current.

730 Temperature sensors, motor winding.

The separator motor is equipped with three thermistor sensors, one in each winding. The sensors are connected in series and have a fixed tripping level that is given in the Connection list. They shall be connected to a separate thermistor relay or a suitable input on the VFD.
If the tripping level has been reached following should happen:

Signal processing in *STAND STILL* and *STOPPING*:

- The signal should trigger an alarm and interlock start.

Signal processing in any other mode:

- The signal shall trigger turn over to *NORMAL STOP*.

731 Temperature sensor, Neck bearing holder

The bearing system unit is equipped with a temperature sensor for the neck bearing holder. The sensor of Pt 100 type shall be connected to a transmitter that gives a signal when the temperature exceeds the values given in Technical Data. It should also be possible to monitor the temperature continuously.
Signal processing in *STAND STILL* and *STOPPING*

The pre-warning signal should trigger an alarm and interlock start.

Signal processing in any other mode:

- The pre-warning signal shall trigger an alarm.
- The shut down signal shall trigger an alarm and turn over to *NORMAL STOP*.

733 Temperature sensor, Lubricating oil

The gear house equipped with a temperature sensor for the lubricating oil. The sensor of Pt 100 type shall be connected to a transmitter that gives a signal when the temperature exceeds the values given in Technical Data. It should also be possible to monitor the temperature continuously.
Signal processing in *STAND STILL* and *STOPPING*

- The pre-warning signal should trigger an alarm and interlock start.

Signal processing in any other mode:

- The pre-warning signal shall trigger an alarm.
- The shut down signal shall trigger an alarm and turn over to NORMAL STOP.

741 a, b Speed sensor

A proximity sensor of inductive type according to DIN 19234 (Namur) standard is giving a number of pulses per revolution of the motor shaft (see Connection List). The gear ratio is also given in the connection list and that means that a signal that represents the bowl speed can be produced. It is very important that bowl too high bowl speed is avoided and for that reason two independent systems shall supervise this speed. One system could e.g be the frequency supervision system in the VFD and the other the speed measuring system. There are two speed sensors but normally only one is used. If however frequency supervision in the VFD is not available then both sensors have to be used to get two independent systems.
Signal processing in *STARTING*:

- The separator should be stopped automatically according to *NORMAL STOP* procedure and an alarm should be given when the time to reach full speed is longer than the time set in the VFD. An abnormal start time indicates some malfunction of the separator equipment and should be investigated.
  An alarm should be given if the time to reach full speed is shorter than the minimum time specified in Technical Data.
- If the speed exceeds ”Maximum allowed speed” in Technical Data the separator shall be stopped automatically by *NORMAL STOP* and a high speed alarm shall be given.
- The speed monitoring system shall be checked continuously (e.g. by checking that pulses are coming). In case of failure indication the separator shall be stopped automatically by *NORMAL STOP* with a timer controlled stop sequence and an alarm for speed monitoring system failure shall be given.
- The acceleration should be supervised to ensure that a certain speed (e.g. 100 r/min) has been reached within a certain time (e.g. 30 seconds).

Signal processing in *RUNNING*:

- If the speed exceeds ” Maximum allowed speed” in Technical Data the separator shall be stopped automatically by *NORMAL STOP* and a high speed alarm shall be given.
- If the speed falls more than 5% below the synchronous speed for a period longer than 1 minute, a low speed alarm should be given. Low speed indicates some malfunction of the separator equipment and shall be investigated.
- The speed monitoring system shall be checked continuously (e.g. by checking that pulses are coming). In case of a failure indication an alarm for speed monitoring system failure shall be given and the separator shall be stopped by *NORMAL STOP.*

Signal processing in STOPPING:

- *STAND STILL* shall be indicated when no pulses are detected within 30 seconds.
- Stopping the separator when alarm for speed monitoring system failure is active, shall cause a timer controlled stop. (See ”Stopping time” in Technical Data.)

750 Unbalance sensor

For indication of any abnormal unbalance and to be able to perform appropriate countermeasures, the separator has been equipped with an accelerometer on the separator frame. The signal from the accelerometer shall be monitored and two alarm levels according to the vibration alarm levels in Technical Data should be set. The vibration level shall be high for 3 seconds to generate an alarm. The first level is only used to generate an alarm while the second level shall stop the machine.
The vibration monitor shall include self-check function to be performed at least at initiation of *STARTING*.
If vibrations exceed the second alarm level the separator shall be stopped the quickest way possible and it shall not be restarted until the reasons for the vibrations have been found and measures to remove them have been taken.
Normally a rotating separator can be restated in *STOPPING* but if it has been stopped by high vibrations and is in mode *SAFETY STOP* then restart should not be possible before the separator has reached *STAND STILL*.
Signal processing in *STARTING*:

- If vibrations exceed the second alarm level the separator shall be stopped automatically by *SAFETY STOP*.
- The vibration level should be supervised during starting of the separator. The alarm might be blocked or set to a higher level when passing through the critical speed interval(s) (see Technical Data).
- If the self-check system triggers, an alarm shall be given and an automatic stop by *NORMAL STOP* shall be initiated.

Signal processing in *RUNNING*:

- If vibrations exceed the first alarm level an alarm should be given. Vibrations of this magnitude will reduce the expected lifetime of the bearings and should therefore be eliminated.
- If vibrations exceed the second alarm level the separator shall be stopped automatically by *SAFETY STOP*.
- If the self-check system triggers, an alarm shall be given.

Signal processing in *STOPPING:*

- If the self-check system triggers, an alarm shall be given.

Signal processing in *NORMAL STOP:*

- If vibrations exceed the second level the system shall turn over automatically to *SAFETY STOP*.

760 Cover interlocking switch (optional)

Signal processing in *STAND STILL:*

- The interlocking switch should be connected in such a way that starting of the motor is prevented when the separator cover is not mounted.
- Signal processing in *STARTING* and *RUNNING*. If the circuit is broken the separator should be stopped automatically by *NORMAL STOP*.

791a Earth connection

See Connection list

791b Earth connection

See Connection list

.2 Fluid connections

Complementary information is given in the document Connection List.

201 Inlet

Processing in *STAND STILL:*

- Shall be closed.

Processing in *STARTING:*

- Should be closed. Bowl will be open and empty or closed and filled depending on if start is done from *STAND STILL* or *STOPPING*.

Processing in *RUNNING:*

- Could be closed or open.
- Shall be open at discharges.
- If bowl is running at full speed without feed flow for a long time it might be overheated if cooling is not on. For that reason a time limitation is given in Technical Data for running without feed flow. If cooling media supply to the cooling jacket is supervised no such limitation is needed.

Processing in *CLEANING:*

- A sequence of cleaning liquids should be fed to the separator. The flow rate should be as high as possible and preferably not less than the production flow rate.

Processing in *NORMAL STOP* or *EMERGENCY STOP:*

- Could be closed or open but the bowl should be filled unless the stop is initiated in STARTING.

Processing in *SAFETY STOP:*

- Could be closed or open but the bowl shall be filled unless the stop is initiated in *STARTING*. It is of advantage to have a water flow on during stopping to ensure that the bowl is filled and to decrease the run down time.

220 and 221* Outlets

* Only for 2 liquid phase machines

Processing in *STAND STILL:*

- Could be closed or open.

Processing in other modes:

- Shall be open but some back pressure might be required (see Connection list)

222 Outlet for solids

Processing in all modes:

- No back pressure as solids are drained by gravity. If the outlet is connected to a closed system then there should be a level switch to give an alarm and prevent new discharges if this space is filled up.

303 and 304 Flushing connections

Processing in *RUNNING:*

- Could be used at any time but is normally used only in connection with discharges and in many cases only at discharges in *CLEANING*.
- When flushing is used it should not be on continuously but in short pulses. It is possible to flush at all connections at the same time but it is an advantage if each connection can be controlled individually as flushing time then can be adapted to actual requirements.
- When flushing is used at discharges, a normal procedure is to make a short flush (e.g. 3 seconds) before the discharge to wet the surfaces. Then wait until the discharged material has left the sludge drain (e.g. 20 seconds) and then make a new flush (e.g. 10 seconds).
- Flushing can be done with water or CIP-liquids.

Processing in other modes:

- Flushing should not be used.

Processing in *RUNNING:*

- Could be closed or open.
- Shall be open at discharges.
- If bowl is running at full speed without feed flow for a long time it might be overheated if cooling is not on. For that reason a time limitation is given in Technical Data for running without feed flow. If cooling media supply to the cooling jacket is supervised no such limitation is needed.

Processing in *CLEANING:*

- A sequence of cleaning liquids should be fed to the separator. The flow rate should be as high as possible and preferably not less than the production flow rate.

Processing in *NORMAL STOP* or *EMERGENCY STOP:*

- Could be closed or open but the bowl should be filled unless the stop is initiated in *STARTING*.

Processing in *SAFETY STOP:*

- Could be closed or open but the bowl shall be filled unless the stop is initiated in *STARTING*. It is of advantage to have a water flow on during stopping to ensure that the bowl is filled and to decrease the run down time.

375 Inlet for discharge and make-up liquid

Processing:

- It is recommendable to supervise the supply pressure. If pressure is too low (see Connection List), start should be interlocked and if it happens in *PRODUCTION* or *CLEANING* turn over to *STAND BY* should take place.

STAND STILL:

- Shall be turned off.

STARTING:

- Shall be turned on at about 3000 rpm
- When going from *STARTING* to *STANDBY* a discharge shall be initiated to fill the discharge system with water and remove air pockets.

RUNNING:

- Automatic discharges shall be initiated by timer. Activate input 506b or 506c for 5 seconds, see Connection list. Manual discharge initiation should be possible

- When coming from *PRODUCTION* and going to *STANDBY* a discharge shall be initiated to remove sediments from bowl to avoid problems due to solidification.

NORMAL STOP:

- Discharges shall only be made if the speed is above 80% of full speed.

Signal processing in *SAFETY STOP* and *EMERGENCY STOP:*

- Discharges shall not be made.

377 Outlet for operating liquid

- Should be connected to the same outlet as connection 463. Both 377 and 463 are outlets from the bowl casing but 377 drains the rotating liquid from the periphery of the casing while 463 drains the bottom of the casing.

405 Inlet for cooling of frame parts

Processing:

- Should be on in all modes except *STAND STILL*.
- If bowl is running at full speed without feed flow for a long time it might be overheated if cooling is not on. For that reason a time limitation is given in Technical Data for running without feed flow. If cooling media supply is supervised no such limitation is needed.

406 Outlet for cooling of frame parts

- Always open.

409 Inlet for cooling

- Should be on in all modes except *STAND STILL*.

410 Outlet for cooling coil

- Always open.

461 Drain of cooling jacket

- Plugged connection. Only used for draining jacket at service.

462 Drain of frame top part, lower

- This is drain and gear house ventilation from the space between the top bearing and the paring disc for the operating water. Shall always be connected to an open drain.

463 Drain of frame top part

- Always open either direct or via a seal leg. Seal leg shall be used if contact between product and air is to be avoided.

615 Inlet sealing liquid for product inlet (single seal)

Processing in *STAND STILL:*

- Shall be closed.

Processing in *STARTING*, and *STOPPING:*

- Shall be open.

Processing in *RUNNING:*

- Should be open. The seal can be cooled by the product which means it is not absolutely necessary to have the sealing liquid on if there is a product flow.

616 Outlet for sealing liquid for product inlet (single seal)

- Always open and no back pressure.

630* Inlet for sealing liquid for the outlet seal between the two media

* Only for 2 liquid phase machines

Processing in *STAND STILL:*

- Shall be closed.

Processing in *STARTING*, *RUNNING* and *STOPPING:*

- Shall be open.

631* Outlet for sealing liquid for the outlet seal between the two media

* Only for 2 liquid phase machines

Processing in *STAND STILL:*

- Shall be open.

Processing in *STARTING*, *RUNNING* and *STOPPING:*

- Shall be open and arranged to give a back pressure of 50-150 kPa.

635a Inlet for sealing liquid for the seal between the media and the bowl casing

Processing in *STAND STILL:*

- Shall be closed.

Processing in *STARTING*, and *STOPPING:*

- Shall be open.

Processing in *RUNNING:*

- Should be open. The seal can be cooled by the product which means it is not absolutely necessary to have the sealing liquid on if there is a product flow.

635b Additional inlet for sealing liquid for the seal between the media and the bowl casing

Processing in *CLEANING:*

- Should be periodically on.

Processing in all other modes:

- Shall be closed.

Gas and ventilation connections

Compressed air for OWMC
The separator is equipped with an Operating Water Module Compact.
The OWMC is equipped with following connections.
506a Inlet for compressed air to OWMC
506b Inlet for activating a small discharge
506c Inlet for activating a large discharge
See connection list for inlet pressures.

- When going from *STARTING* to *STANDBY* a discharge shall be initiated to fill the discharge system with water and remove air pockets.

Signal processing in *RUNNING:*

- A discharge is activated by opening inlet 506b or 506c for 5 seconds.
- After a discharge has been triggered the motor current or bowl speed should be monitored to indicate if there comes a current peak or a sudden drop in speed. The absence of such indication means that the discharge has failed and corrective action should be taken (e.g. trigger a new discharge). Absence of a discharge may result in problems due to solidification of the sediment.
  That the current returns to original value after discharge could also be supervised. If current is much higher after the discharge this might be an indication that the bowl has not closed properly after the discharge.

- The size of the large discharge is depending on the pressure at connection 506a. It is possible to control this pressure by an I/P-converter in the control system. Then the discharge can always be initiated by 506c and the size of the discharge is set by the control system. Normally the size of the discharge will increase with increasing product flow rate. By adjusting the pressure depending on the flow rate it is possible to get the size of the discharge independent of the flow rate.
- For service purposes there should be a counter to count number of discharges.
- Discharges can be initiated automatically or manually. Automatic discharges can be initiated by e.g.: Timer A certain product volume has passed the separator. A certain turbidity has been reached

Signal processing in *STAND BY:*

- When coming from *PRODUCTION* a discharge shall be initiated to remove sediments from bowl to avoid problems due to solidification.

Signal processing in *NORMAL STOP:*

- The separator should normally not be stopped when there is product and/or sludge in the bowl. For that reason that reason the system should be designed in such a way that *NORMAL STOP* can not be initiated from *PRODUCTION* or *CLEANING* but from *STAND BY* (see the figure in the appendix). When going to STAND BY the solids in the bowl shall be discharged. Normally no discharges shall be done in *NORMAL STOP* but in the case where an automatic stop has been initiated by an alarm when there was solids in the bowl it is acceptable to make a discharge provided that speed of the bowl is above 80% of full speed and that safety water to fill up the bowl is available.

Signal processing in *SAFETY STOP* and *EMERGENCY STOP:*

- The separator bowl shall be kept filled and discharges shall be blocked.

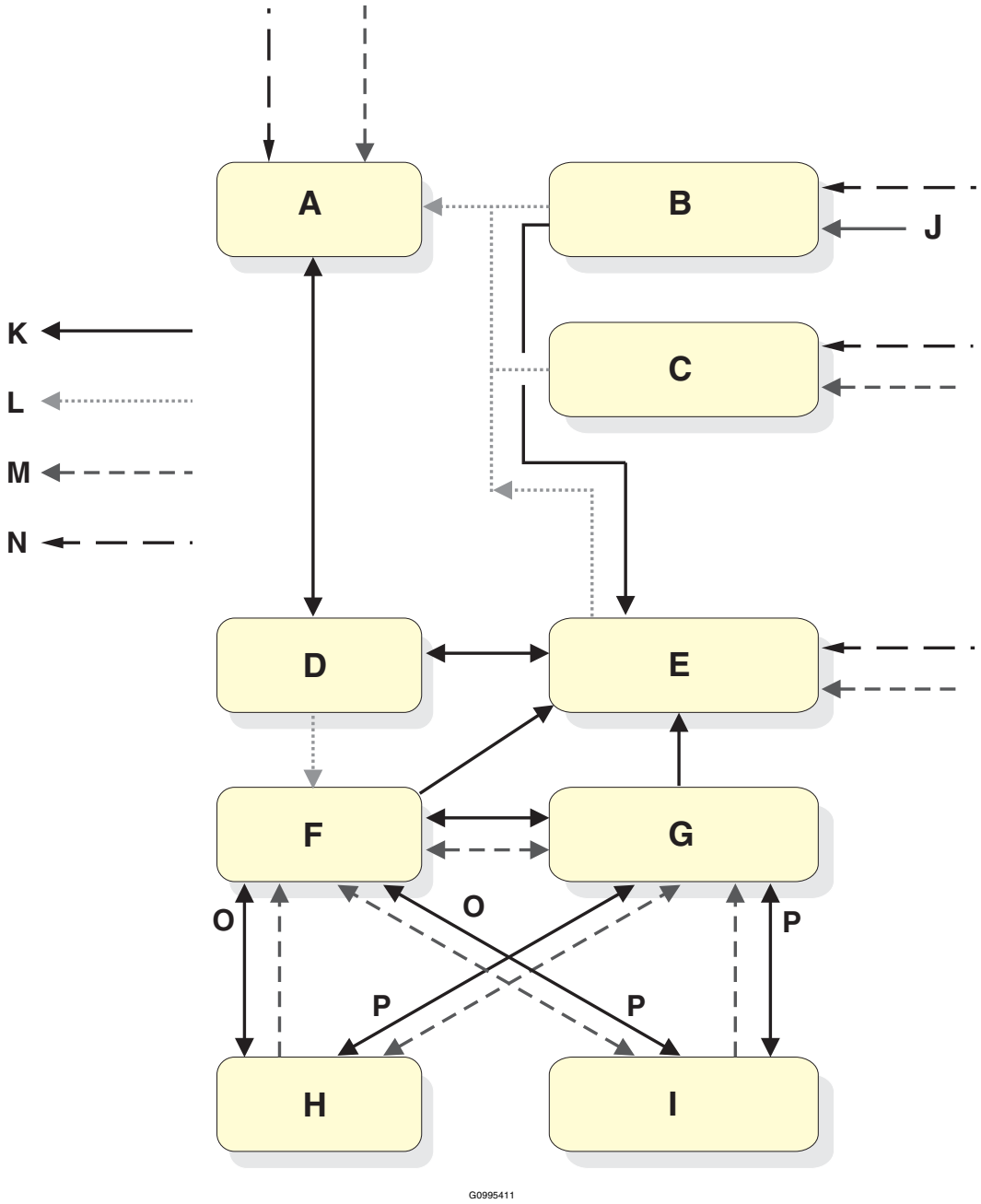
Other connections

821a Plugged connection on the cyclone

This connection can e.g. be used to fit a level switch to give an alarm for too high level. If there is a pump under the cyclone this pump should be started at each discharge and run for a certain time to empty the cyclone. If it comes a signal for too high level then the pump should be started. If the high level signal does not disappear within a certain time, an alarm should be given and if the mode is *STANDBY WET*, *PRODUCTION* or *CLEANING* then the system should automatically be turned over to *STANDBY DRY*.

821c Plugged connection on the cyclone

- Plugged connection that e.g. be used to fit a cleaning turbine in the cyclone.



A. Stand Still
B. Stop Emergency
C. Stop Safety
D. Start
E. Stop
F. Standby Dry
G. Standby Wet
H. Production
I. Cleaning
J. Alarm
K. Operator transition
L. Automatic transition
M. Automatic transition by alarm
N. Power on
O. Only if acceptable by process
P. Transition condition might be used.
E.g. making a transition discharge

3.7 Quality requirements

3.7.1 Compressed air

Alfa Laval ref. 553407 Rev. 5

The supply of compressed air to separator discharge system, valve actuators, positioners, instruments etc. must be of such a quality that satisfactory function is ensured for a reasonable time.

To this end three conditions must be fulfilled:
1. Dirt in the form of solid particles down to a size below 10 micron (0,01 mm) must be removed from the air. This is preferably done by means of special filters or reducing valves provided with filters.

2. Oil is always transferred to the compressed air from oil-lubricated compressors and must be removed to the highest possible degree. It constitutes a serious contamination, which it is difficult to remove from the instruments. Special filters or oil separators must, therefore, be provided before the instruments. In small plants, oil-free compressors can be used as an alternative.

3. In the compressed-air system a condensation takes place at various rates, depending on the moisture content at the air inlet, the temperature before and after the compressor, partially lower temperature in any cold zone passed by the pipe (outdoor, cellar etc.) and the like.

The air must thus be dried with regard to the lowest temperature existing after the drying device, so that condensate in the instruments is avoided. Note that the air will also be cooled through expansion after passing constrictions and nozzles in the instruments, with condensation as a result. In view of the above, the following must be observed: At the inlet to an instrument, the dew point of the compressed air should lie at least 10 °C below the lowest ambient temperature. This is usually obtained by using an absorption drier of suitable capacity.
If the air contains much water, provide a primary separator before the filter.
Air filters should be placed so as to be easily serviceable and accessible in order to facilitate daily condition checks, and exchange of the filter cartridge.



Alfa Laval accepts no liability for consequences arising from unsatisfactorily purified compressed air supplied by the customer.

3.7.2 Quality operating liquid

Alfa Laval ref. 583409 Rev. 0

Operating water is used in the separator for several different functions: e.g. to operate the discharge mechanism, to lubricate and cool mechanical seals.
Poor quality of the operating water may with time cause erosion, corrosion and/or operating problem in the separator and must therefore be treated to meet certain demands.

The following requirements are of fundamental importance

1.1 Turbidity free water, solids content <0,001% by volume
Deposits must not be allowed to form in certain areas in the separator

1.2 Max. particle size 50 µm

2. Total hardness 105-180 mg $CaCO_3$ per litre, which corresponds to 6-10°dH or 7.5-12.5°E
Hard water may with time form deposits in the operating mechanism. The precipitation rate is accelerated with increased operating temperature and low discharge frequency. These effects become more severe the harder the water is.

3. Chloride content max 100 ppm NaCl (equivalent to 60 mg Cl/l)
Chloride ions contribute to corrosion on the separator surface in contact with the operating water, including the spindle. Corrosion is a process that is accelerated by increased separating temperature, low pH, and high chloride ion concentration.
A chloride concentration above 60 mg/l is not recommended.

4. pH>6 Increased acidity (lower pH) increases the risk for corrosion; this is accelerated by increased temperature and high chloride ion content.



Alfa Laval accepts no liability for consequences arising from unsatisfactory purified operating water supplied by the customer

3.8 Px sealing diagram

How to use the bowl sealing diagram

The diagram illustrates the operational conditions required under which satisfactory sealing can be expected in solids-ejecting PX-type centrifugal separators.

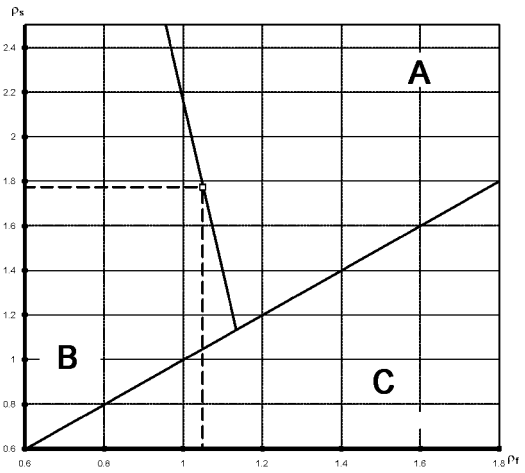
No aspects of separation capabilities are included in the diagram.

The Y-axis shows the density of the sediment, i.e. the density of the solids/liquid mixture that accumulates at the bowl periphery during operation. Accordingly, this is a lower value than that of the density of the solid particles only.

The X-axis shows the density of the feed. The triangular area called “Operational envelope” illustrates the permissible combinations of densities where no leakage should occur.

P_s = Sediment density
P_f = Feed density

A = Sealing not possible within this area
B = Admitted operational area
C = Non physical area (feed density higher than sediment density)



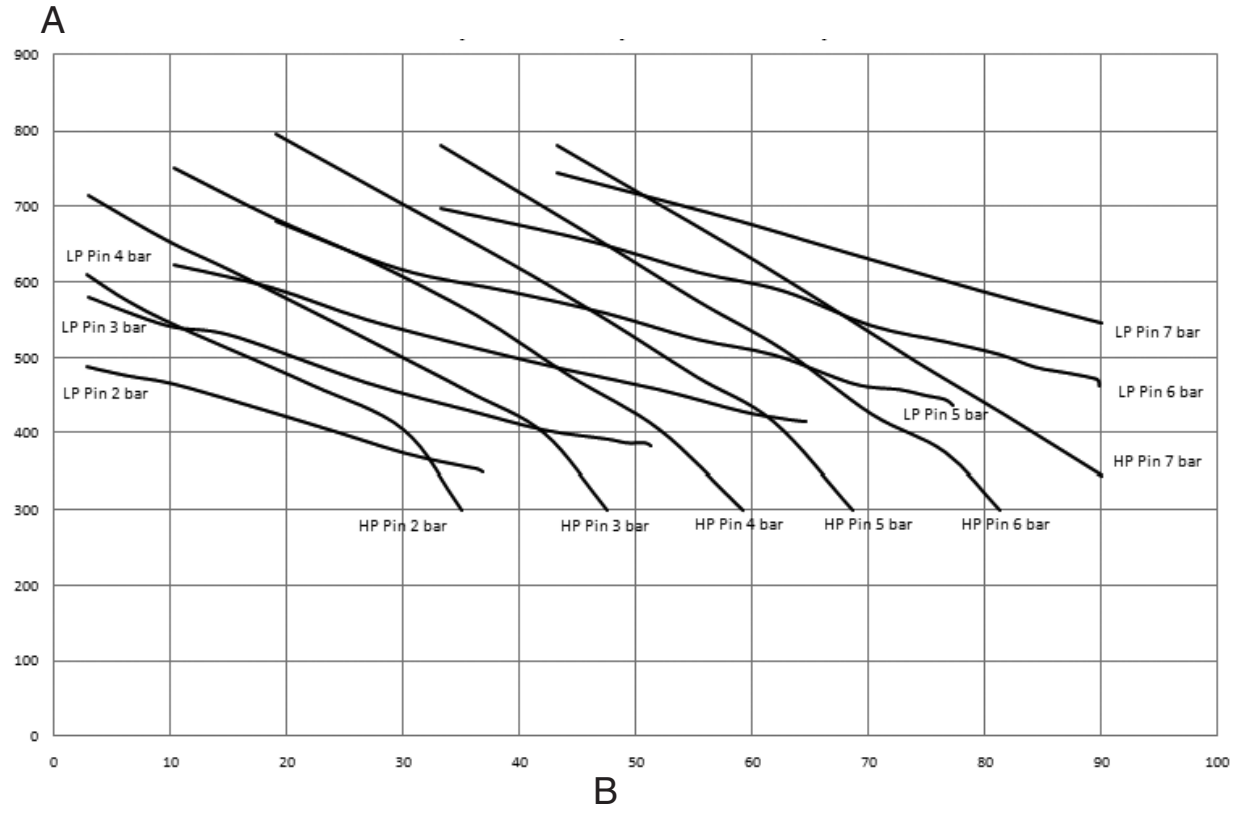
g0649441

Reference density for FEED: 1050 kg/m³
Reference density for WET SOLIDS: 1772 kg/m³
NOTE: Max allowed operating liquid density: 1000 kg/m³

3.9 Pump wheel characteristic

Alfa Laval ref. 589253 Rev. 1

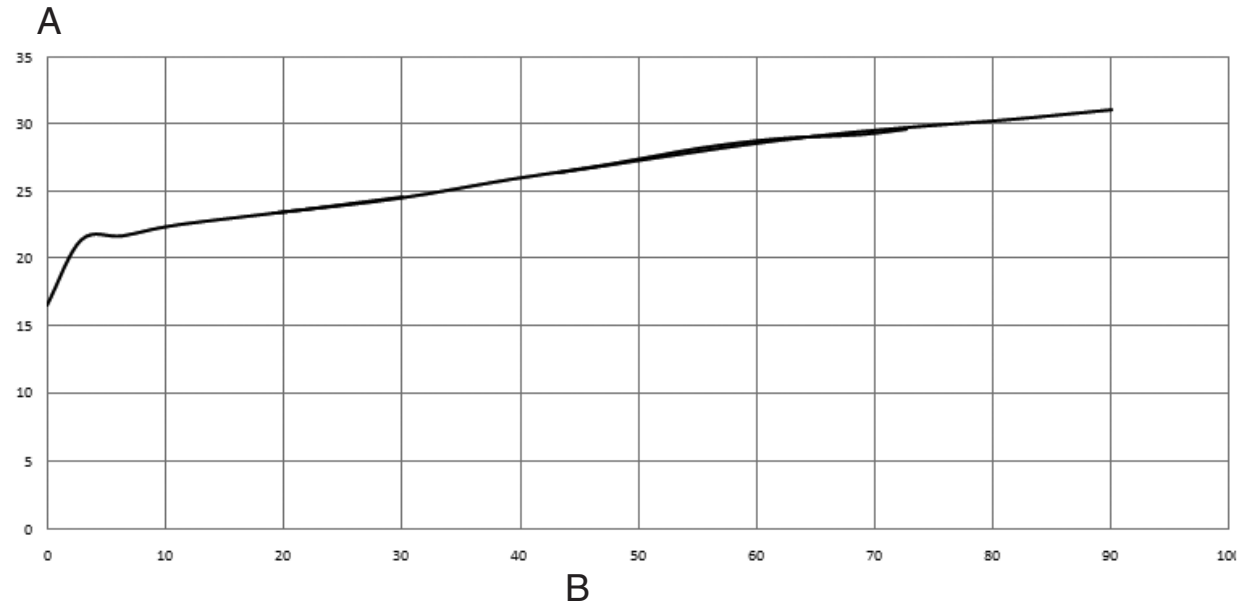
Pump curve Impeller dia 120/110 mm, 4600 rpm



G1029931

A. Pressure (kPa)
B. Flow m^3/h

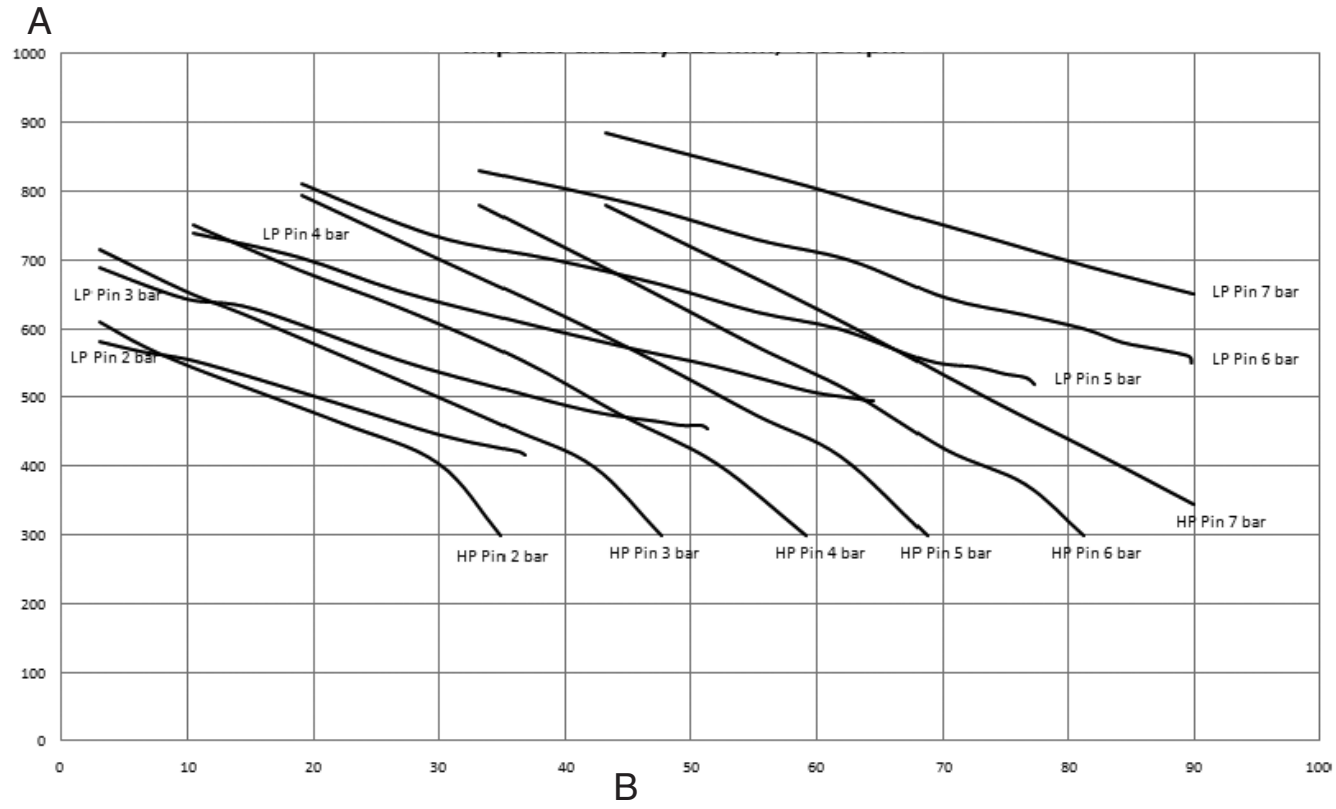
Power consumption



G1029941

A. Effect (kW)
B. Flow m^3/h

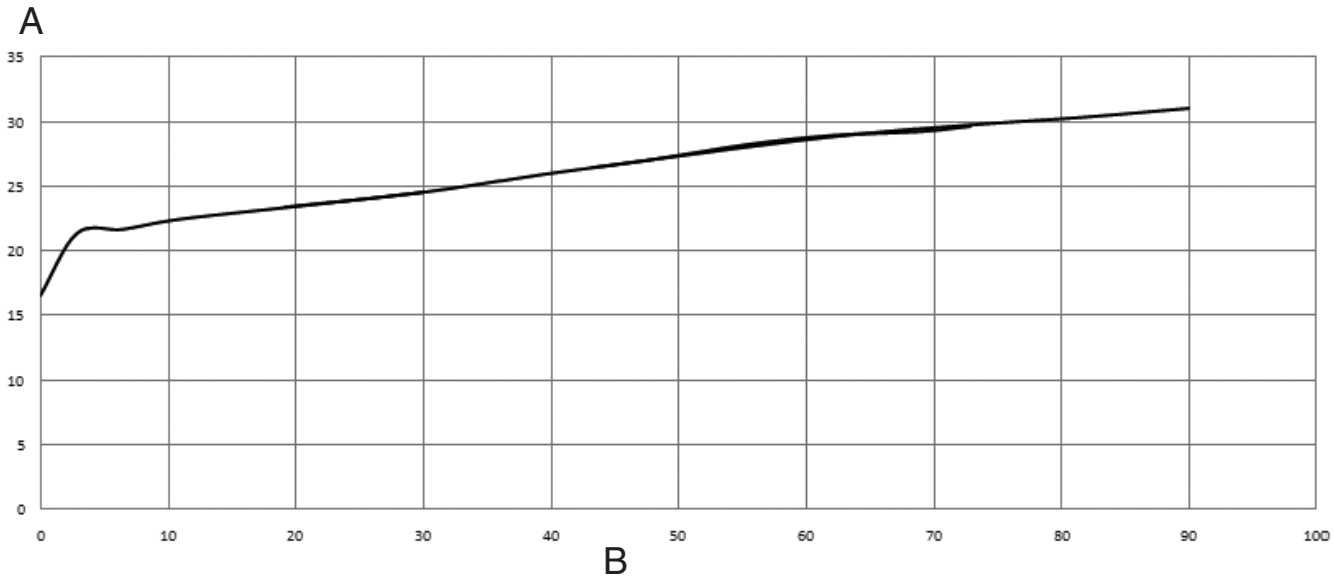
Pump curve Impeller dia 120/120 mm, 4600 rpm



G10299B1

A. Pressure (kPa)
B. Flow m^3/h

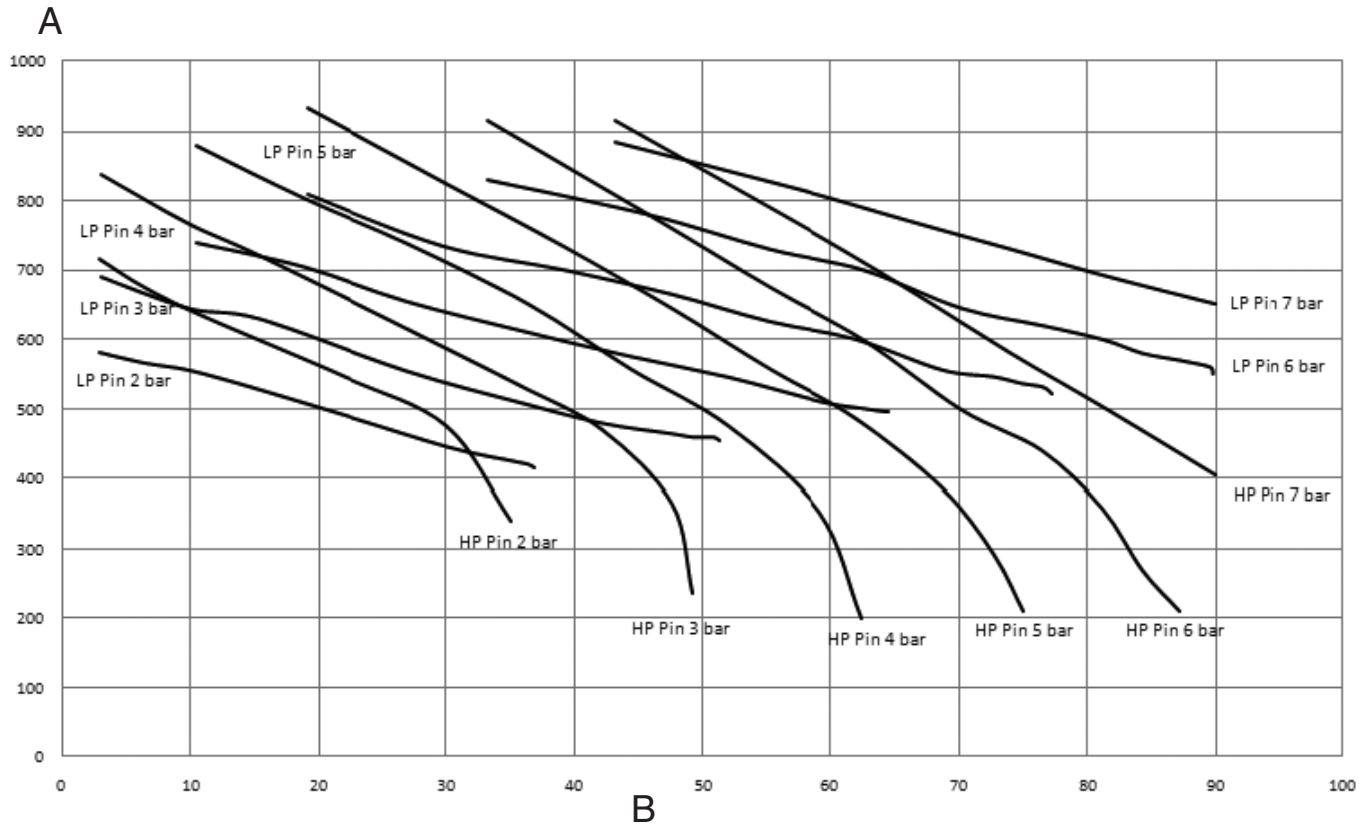
Power consumption



G10299c1

A. Effect (kW)
B. Flow m^3/h

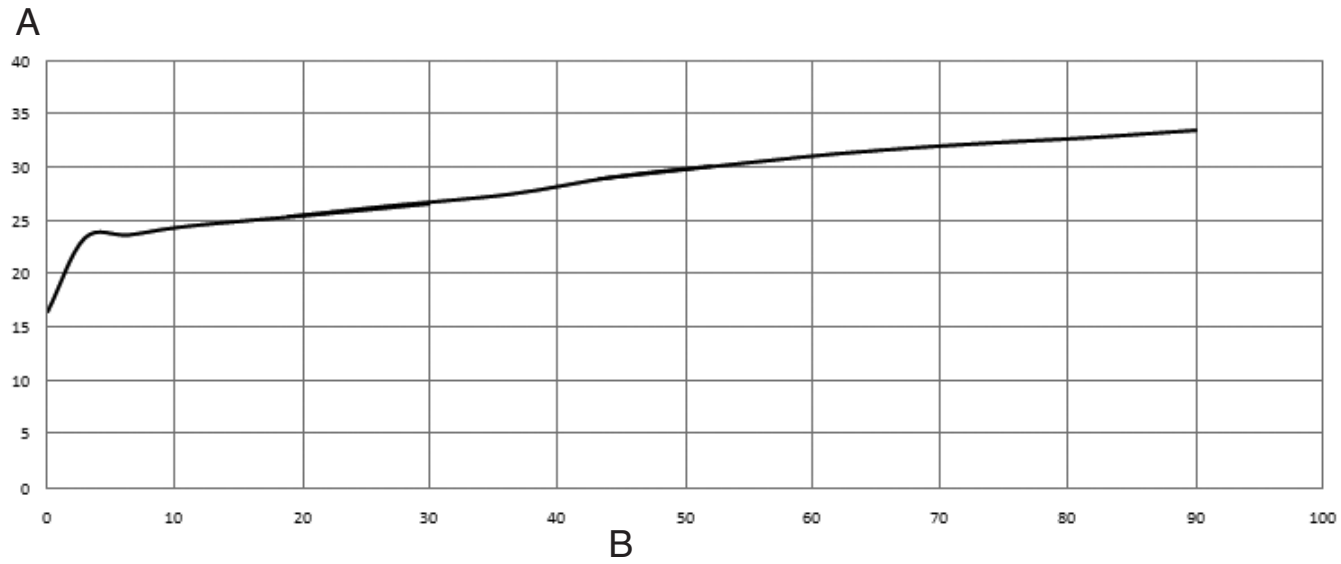
Pump curve Impeller dia 130/120 mm, 4600 rpm



G10299j1

A. Pressure (kPa)
B. Flow m^3/h

Power consumption

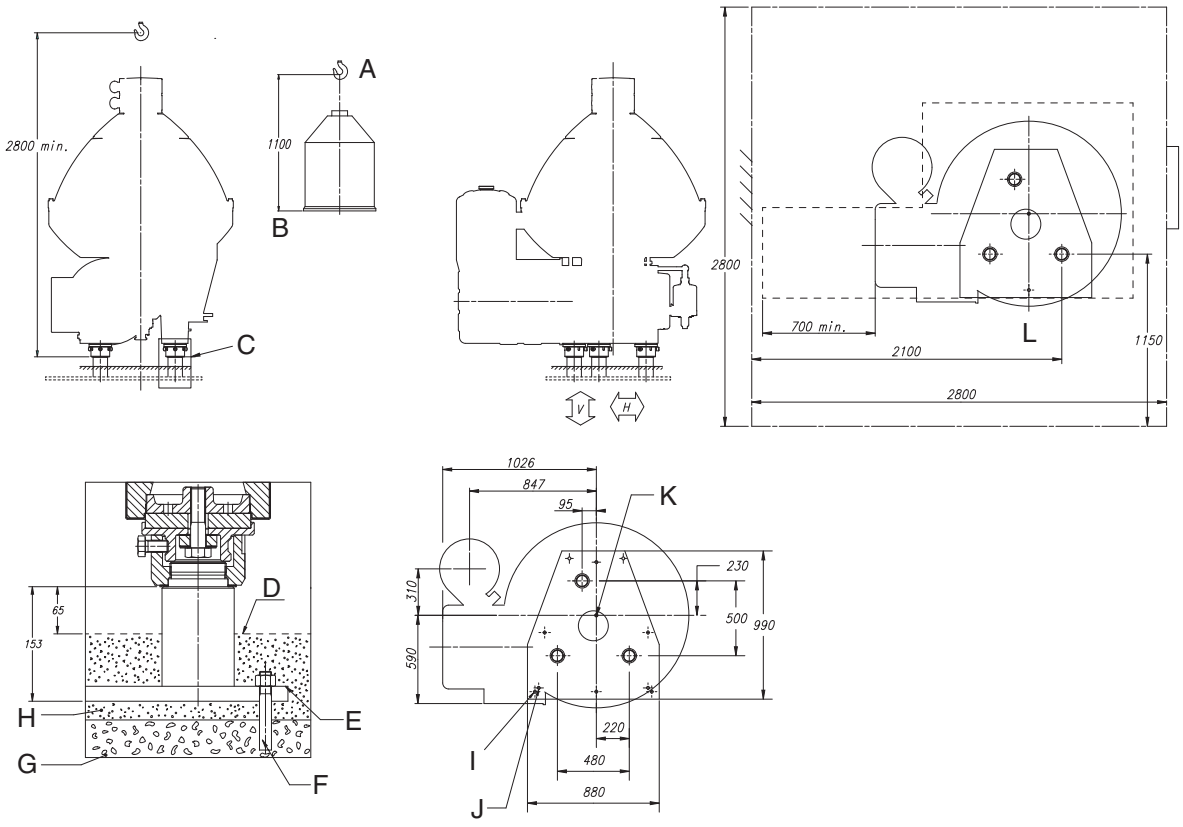


G10299k1

A. Effect (kW)
B. Flow m^3/h

3.10 Foundation drawing

Alfa Laval ref. 585217 Rev. 1



G1009711

A. Min. lifting capacity required when doing service is 1500 kg.
B. Max. height of largest component including lifting tool.
Recommended speed for lifting:
- Low speed 0,5 - 1,5 m/min
- High speed 2 - 6 m/min
C. Horizontal max. deviation is 0,4°
D. Floor level
E. Foundation plate
F. Anchor bolt
G. Structural concrete
H. Expanding concrete
I. 7 holes, Ø20 for anchorage
J. 3 holes, M20 for horizontal adjustment
K. Centre of separator bowl
L. Service side

—·—·—·— Recommended free floor space for unloading when doing service

- - - - - - - - - - No fixed installations within this area



Vertical dynamic forces ± 30kN/foot
(Static forces are excluded)



Horizontal dynamic forces ± 30kN/foot
(Static forces are excluded)

Total vertical dynamic instantaneous foundation forces (sum of all feet) ±30 kN
(Static forces are excluded)

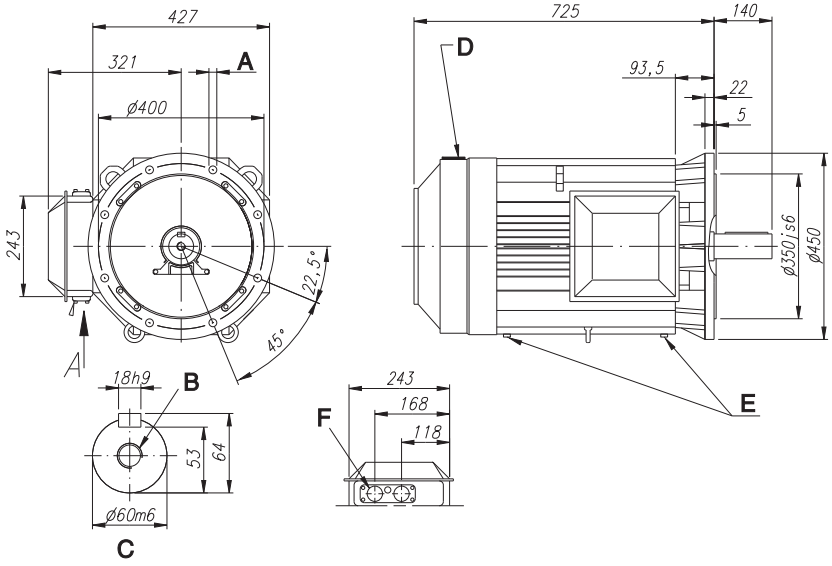
Total horizontal dynamic instantaneous foundation forces (sum of all feet) ±30 kN
(Static forces are excluded)

3.11 Motor specifications

3.11.1 Electric motor (22, 25, 30, 37, 42 kW)

Alfa Laval ref. 566300 Rev. 12

ATEX protection: No



A. 8 holes, Ø19
B. M20 x 42 deep
C. Shaft dimensions
D. Metal plate with relubrication information

E. Drain holes with closable plastic plugs (IP 55 with open plugs) For horizontal mounting IM 3001, the motor has to be mounted with the drain holes facing downwards.

F. Flange FL 13 with 2xM40+1+M16

Stainless steel nipples are acc. to variant code +798

Manufacturer	ABB Motors
Manufacturers drawing	Cat. BA/M3000 GB 01-2002
Standards	IEC 34-series, 72-1, 85
Size	IEC 225 M
Type	M3AA 225 SMA 4 B5
Weight	215 kg
Poles	4
Bearings	D-end 6313/C3 N-end 6212/C3
Method of cooling	IC 411 (IEC 34-6)
Insulation class	F
Specification	Totally enclosed 3-phase standard motor for frequency converter drive.
Vibration level	Balanced with half key, quality grade N according to ISO 2373 (max. 2,8 mm/s RMS)
Lubrication	The motor is equipped with grease nipples. Relubrication information is to be found on a separate plate on the motor frame and in the table on page .
Thermistor trip. temp.	150 °C
Noise level	Mean sound pressure level is 66 dB(A) at 50 Hz and 70 dB(A) at 60 Hz. Tolerance +3 dB(A).

Type of mounting (IEC 34-7)		Degree of protection (IEC 34-5)
 G0541511	IM 3061	IP 23

Relubrication instructions:

Mounting	Frequency	Intervals in hours at ambient temperature of max. 40 °C		Grease quantity, grams per bearing		Type of grease
	Hz	**D-end [1]**	**N-end [1]**	**D-end [1]**	**N-end [2]**	
IM 3001	50	8000	8000	50	50	Esso Unirex N2 [3]
	60					
	70					

[1] D-end = driving end [2] N-end = non driving end

The following high performance grease can be used: [3]

- Esso — Unirex N2, N3 or S2 (lithium complex base)
- Mobil — Mobilith SHC 100 (lithium complex base)
- Shell — Albida EMS 2 (lithium complex base)
- SKF — LGHQ 3 (lithium complex base)
- Klüber — Klüberplex BEM 41-132 (special lithium base)
- FAG — Arcanol TEMP90 (calsium polyurea base)
- FAG — Arcanol TEMP110 (lithium complex base)

NOTE

For complete information about motor variants, please contact your Alfa Laval representative.

NOTE

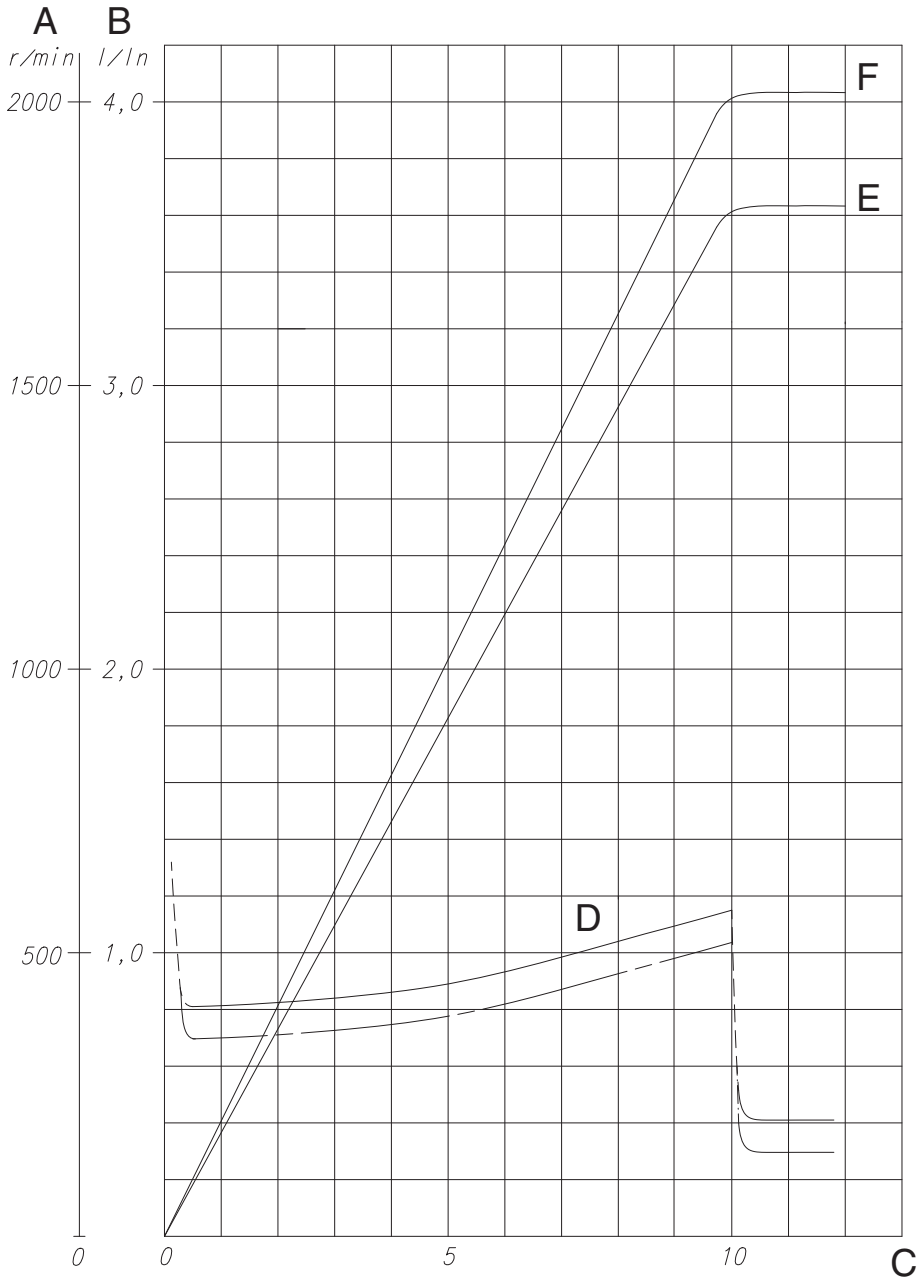
Motor for 18,5 kW wound as motor for 22 kW. Motor for 25 kW and 30 kW wound as motor for 37 kW.
Individual serial number shall always be stamped on rating plate acc. to variant code +003

Voltage restrictions for motor winding insulation and variant codes

Voltage restrictions for motors with standard insulation system	
Voltage rise time (us)	Max allowed peak voltage (V)
< 0,1	850
< 0,2	1000
< 0,4	1130
< 0,6	1250
< 0,8	1350

Voltage restrictions for motors with standard insulation system	
Voltage rise time (us)	Max allowed peak voltage (V)
< 0,1	850
< 0,2	1300
< 0,4	1500
< 0,5	1600
< 0,6	1700
< 0,7	1800

3.11.2 Motor drive data



G1009811

Current- and speed curves at start with frequency converter.
Calculated curves.
Acceleration time 10 minutes

A. Speed (r/min)
B. Current (I/In)
C. Time (minutes)
D. I/In
E. Motor speed (4300 r/min)
F. Motor speed (4800 r/min)

NOTE

The motor and the main cables must be dimensioned acc. to local safety regulations. Shielded symmetrical motor cables is recommended.

Drive data for 37 kW, ATEX protection: No

Alfa Laval ref. 585607 Rev. 0

Motor AL No.	Output kW	Manufacturer	Type	No. of poles	Efficiency, (%)	Power factor (cos φ)
566300	37	ABB	M3AA225SMA	4	93,6	0,84
Moment of inertia, 86 kgm^2 (bowl)						

Bowl speed max. (r/min)	Motor synchronous speed (r/min)	Frequency Hz	Machine idling power consumption (motor input) kW	Rated torque, M_n Nm
4800	2032	68	18,5	175
4300	1821	60,7	14,3	194

Voltage V	Rated current A	Cable size (copper) mm^2		Fuse (mains) A
		motor	mains	
400	68	16	25	80
200	132	35	50	160

3.12 Guidelines for frequency converter drives

Alfa Laval ref. 563692 Rev. 3

Frequency converter.

For dimensioning and programming of a frequency converter see Dimensioning of a frequency converter:

When choosing the rated power for the converter, regard must be paid to the motor current peaks, which occur during the automatic discharges of centrifuge.

When dimensioning an electrical brake it is essential to be aware of the current of the motor. The current should not exceed the nominal current for the motor.

The start of the centrifuge shall be carried out using a suitably adjusted acceleration ramp. The acceleration period is to be chosen with regard to the moment of inertia of the rotor, and the rated torque of the motor.

The limit of current during start should be below 140% the rated current for the motor. The main reasons are heat in the motor and the stress on the transmission.

If there are adjustable parameters, which set the level for over speed, it is required, that a password and/or a hardware lock protect the parameter adjustment function. In order to avoid unintentional altering of the parameter settings, two separate operations must be performed before parameter adjustment is enabled. Examples of interlocks are password, hardwiring with jumpers and disconnecting of control panel.

When the frequency converter will be installed in the process area, the code of protection of the enclosure shall be at least IP54. When installed in a special room, an electrical operation area, the enclosure can be of IP20.

The frequency converter is to be set for one direction of rotation only and the motor connected for correct direction of rotation with the use of this setting. The direction is to be found on the machine plate.

The possibility of changing the direction of rotation of the motor through adjustment of the converter should be prevented. It is required that password and/or a hardware lock protect the parameter adjustment function. In order to avoid unintentional altering of direction, two separate operations must be performed before adjustment is enabled. Examples of interlocks are password, hardwiring with jumpers, disconnecting of the control panel.

The frequency converter shall be able to function in such a way that it can 'catch' a rotating load - 'flying start'. If, for example, the centrifuge has stopped because of a power supply failure to the factory, and the operator restarts the centrifuge before it has reached stand still, then the converter must have the capability to synchronize to the present rotor speed and start from there. The acceleration should be in accordance with the pre-set acceleration ramp.

It is recommended to choose a frequency converter with the possibility to monitor the chosen maximum output frequency. If the frequency exceeds the maximum allowable frequency, and then the converter should stop the centrifuge.

Centrifuge.

The rotor must not exceed 'Maximum allowed speed'. Too high rotor speed or frequency shall stop the centrifuge with automatically initiated stop. The stop shall be in effect until it is manually reset.

Maximum allowed speed and if applicable the minimum allowed speed for the rotor could be found in Technical Data for the centrifuge.

To reduce the hazard for overspeed there shall be two systems for supervision of the rotor speed, which are independent from each other.

One system can for example, be the supervision system in the VFD and the other should be the speed supervision of the rotor. When the speed monitoring system is used as a part of an over speed protection system, it shall be designed in accordance with EN 954 Category 3, with continuous checking of the function.

Control systems

The control system of the centrifuge should be connected to the frequency converter so that start and stop of the centrifuge can be initiated from the control panel. Furthermore, the control system should monitor the rotor speed via a speed sensor mounted in the centrifuge. The control system should stop the centrifuge if the speed exceeds or falls below the allowed speed limits, which are stated in the documentation for the corresponding centrifuge.

The emergency stop should break the power supply to the frequency converter.

The restart should not be possible during safety stop or emergency stop.

The starting sequence for the centrifuge should be interrupted if the speed supervision system or the frequency supervision system is not in operation.

The electric motor

The nominal frequency for the motor has to preferably be chosen as close as possible to the chosen frequency for the centrifuge. Deviation of more than -20% is not recommended, as the available motor torque is decreased when operating below or above the nominal frequency. A closer description is found in Dimensioning of a frequency converter.

The motor winding is available with standard or reinforced insulation strengthening system, which can be combined with du/dt filter and/or insulated bearings depending on the motor size/type and voltage.

Closer description and choosing criteria can be found in motor and/or frequency converter documentation.

If a standard motor is used, then it is recommended that the motor is equipped with thermistors in the stator windings. The tripping temperature for the thermistors should be the maximum allowable operating temperature for the corresponding insulation class. CT motors used by Alfa Laval are already provided with thermistors in the stator windings - these should therefore be connected to the motor's monitoring equipment when frequency converter drive is used.

The motor cable should be shielded so that approved suppression of electromagnetic radiation can be obtained - as required by the EMC directive or corresponding regulations. The shielding shall be connected to both motor and frequency converter with special cable glands.

Special countermeasures have to be taken regarding cabling and grounding/earthing due to the occurrence of bearing currents in the motor. See the motor manufactures recommendation and installation requirements.

Electrical installation

The installation of the frequency converter shall be in accordance with EC-regulations e.g. EMC Directive. Instructions shall always be supplied together with a frequency converter.

In order to suppress the emitted electromagnetic radiation a correct cabling system shall be used. It consists of symmetric shortest possible power cable equipped with concentric protective copper shield round the phase leads or with concentric Cu/Al-shield round the three symmetrical conductors for protective grounding and the phase leads. The correct supplying cable shall be connected with 360 degrees termination of cable shield at both the motor terminal box end and converter end with shortest possible earth lead to the earthing bolts (PE-terminal) in both ends. Thus unsymmetrical cables can be used up to 10 mm 2 cable size and up to 30 kW motor power, shielded cable is always recommended.

To reduce circuit-bound electrical disturbances to the power supply, the converter shall be supplied with a power supply filter, an RFI-filter.

Attention shall be paid to the motor cable's length, so that tripping-out of the converter because of excessive currents, as well as impaired properties of power supply filter can be avoided. In doubtful cases, the converter's manufacturer should be consulted regarding maximum allowable cable length.

The signal outputs and the control connections of the converter shall conform to the requirements for immunity to electromagnetic disturbances as stated in the EMC directive or corresponding regulations.

SAFETY PRECAUTIONS AND DESIGN REQUIREMENTS

IT IS OF OUTMOST IMPORTANCE THAT THE CENTRIFUGE IS SO DESIGNED AND SAFEGUARDED THAT THE MAXIMUM ALLOWED SPEED FOR THE ROTOR NEVER WILL BE EXCEEDED. OVER SPEED CAN RESULT IN EJECTION OF PARTS. SAFETY-RELATED PARTS SHOULD BE DESIGNED WITH REFERENCE TO EN 954-1.

3.13 Dimensioning of a frequency converter

Alfa Laval ref. 570285 Rev. 2

3.13.1 Dimensioning and programming of a frequency converter

Basic requirements for a frequency converter:
Select correct frequency converter for mains supply voltage and frequency.

Select the frequency converter power according to the initial conditions and the specified motor. Check that the converter's rated output current is similar or higher than the motors nominal rated current.

The frequency converter's capability to produce the maximum required current and power (typically during discharge sequences) has to be checked, use values given for "heavy duty" use in manufacturer's catalogue

When controlled braking is required, select the frequency converter with braking functionality, as described in Braking methods.

Only frequency converter fulfilling requirements in IEC 61508 part 1 "Functional safety of electrical/electronic/programmable electronic safety-related systems", EN 60204-1 "Safety of machinery - Electrical equipment of machines" and EN 61800-3 "EMC Directive" shall be chosen.

For safety precautions of a variable frequency drive see Guidelines for frequency converter drives on page 60.

3.13.2 Selecting the motor with correct voltage and frequency for a variable frequency drive

If the motor with correct voltage and frequency is not already selected or there are several motor alternatives to choose between, the following control calculations for the continuous loadability of the motor should be made, otherwise continue to Dimensioning of a frequency converter for an actual application on page 68.

Controlling the loadability of the motor at actual frequency drive

Example:
Power consumption at maximum capacity, found in Technical Data = 35 kW.
There are 2 motors available in centrifuge specification, 37 kW / 400 V / 50 Hz and 42 kW / 400 V / 60 Hz, both fulfilling the above power requirement, control calculation for motor torque has to be made.
The motor with nominal frequency as close as possible to the actual drive frequency should preferably be chosen.
Set frequency according to Technical Data = 70 Hz, gives motor relative speed = 70 Hz / 50 Hz = 1,4 for 50 Hz's motor and 70 Hz / 60 Hz ~ 1,2 for 60 Hz's motor.
When validating these relative speeds 1,4 and 1,2 in motor loadability curve, it can be seen that 60 Hz's motor is better alternative with higher T / Tn factor, giving ~ 83% of Tn with 70 Hz set frequency.
Motor with 42 kW / 400 V / 60 Hz is therefore selected.
The motor torque can be calculated from speed and mechanical (output) power:
$T = P / w$
T = torque (Nm)
P = power (W)
ω = motor speed (rad/s)
The motor speed is put in the formula in rpm´s instead of rad/s:
$\omega = n \times (2 \times \pi / 60)$
n = actual motor speed (rpm) = relative speed factor x nominal speed
$T = P / \omega = P \times 60 / n \times 2 \times \pi$

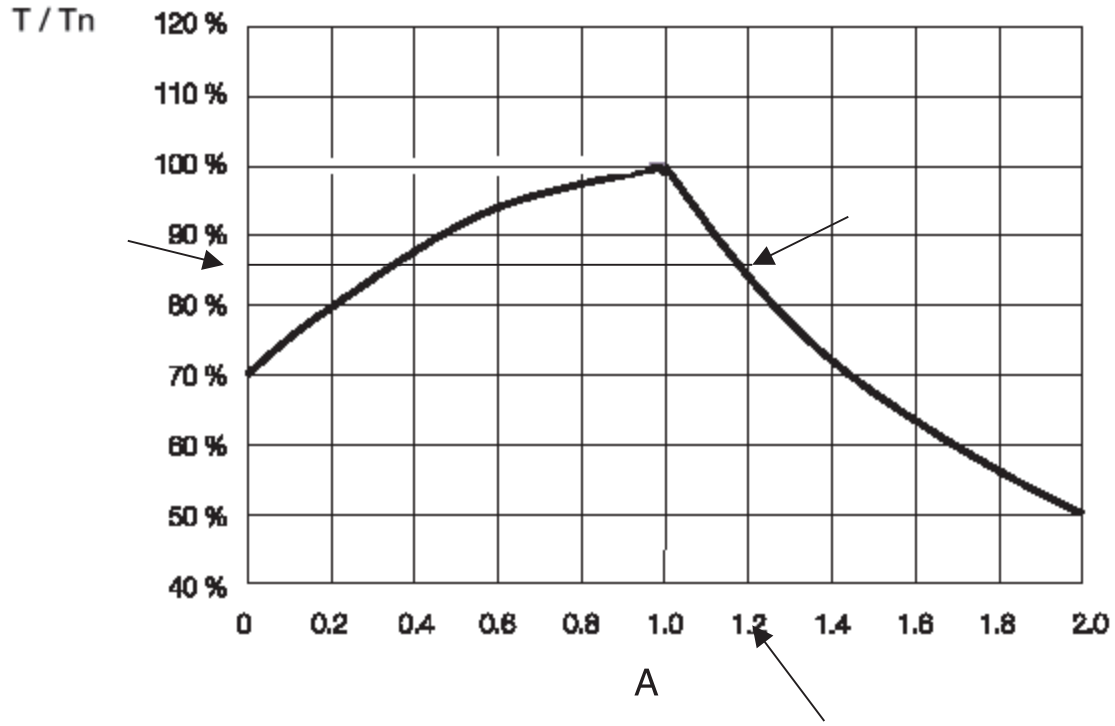
Continuously needed motor torque at maximum capacity = $35000 \times 60 / 1{,}2 \times 1780 \times 2 \times \pi$ = 156 Nm.
During discharges needed motor torque = 70000*) x 60 / 1,2 x 1780 x 2 x π = 313 Nm.

*) If values for maximum current or power during discharges are not known, multiply value for power consumption at maximum capacity by factor 2 → estimated power consumption during discharges = 35 kW x 2 = 70 kW = 70000 W

Controlling continuous available motor torque at 70 Hz = (42000 x 60 / 1780 x 2 x π) x 83% = 188 Nm
Controlling maximum available motor torque at 70 Hz = 188 x 2,5**) = 470 Nm

**) 2,5 is a factor for the relationship between maximum and nominal motor torque, Tmax/Tn, as found in motor catalogue.
Both values are higher than in centrifuge operation needed torque values.
The motor is correct for the application.

Loadability curve for an electric motor in a frequency converter drive.



G0962351

A. Relative speed

T/Tn = Available/nominal motor torque. Relative speed = Actual drive frequency/motor nominal frequency

3.13.3 Dimensioning of a frequency converter for an actual application

Frequency converter shall be dimensioned regarding to maximum needed power and current, overload capacity, which usually occurs during discharge sequences for a centrifuge
The relation between the nominal and the actual motor current in field weakening range (above the motors nominal frequency / speed) can approximately be calculated by:
I m = (P load / P n) x I n
I m = actual motor current (A)
P load = actual needed power by driven machine during discharges (W) *)
P n = motor's nominal power (W)
I n = motor's nominal current (A)

*) If values for maximum current or power are not known, multiply value for power consumption at maximum capacity by factor 2 → estimated power consumption during discharges = 35 kW x 2 = 70 kW = 70000 W

Maximum needed output current (actual motor current during discharges) from the frequency converter = (70000/ 42000) x 78 = 130 A

The frequency converter with capability for this current shall be chosen.

This current is called for maximum monitored output current, short-term overload current or peak current, and it is usually limited to 150% of nominal output current.

This current is usually limited for a short time only periodically (ex. 1 minute every 5 minutes or 2 seconds every 15 seconds), which should be taking in consideration when deciding discharge intervals and speed regaining time after discharge.

Speed regaining time can also be prolonged by converter's maximum output power, normally limited to 150% of converter's nominal output power.

Control the frequency converter's nominal output current, it should be similar or higher than the motors nominal current, in this case, at least 78 A.

Values to be used when selecting the converter:

Nominal output current D 78 A.
Overload current (short time) D 130 A.

These values, when looking into manufacturer's catalogues, should give a converter for heavy-duty use of 45 kW.

3.13.4 Programming the frequency converter

Since parameter setup and programming interface are different from manufacturer to another, detailed instructions cannot be given here, only the most important programmable parameters for starting-up and running the centrifuge will be explained!

See frequency converter instruction for use for detailed information

- Enter the motor data from the motor nameplate, including nominal power, voltage, current, speed, frequency and eventually power factor (cosinus φ).
- Optionally and if available, select motor identification run for fine adjustment of the motor data, choose between standard/extended or reduced.
  NOTE! During standard/extended identification run the motor will rotate and has to be off-loaded from the centrifuge!
- If available, select the torque control mode (variable or pump/fan characteristics) for controlling of the motor.
- Check and, if necessary, change the direction of rotation of the motor
- Set the minimum motor speed or frequency, should be 0 rpm or 0 Hz respectively
- Set the actual motor speed or set frequency, values given in Technical Data

IT IS OF UTMOST IMPORTANCE THAT THIS SETTING HAS TO BE CHECKED. A FAULTY FREQUENCY SETTING CAN LEAD TO OVERSPEEDING, WHICH MIGHT CAUSE HAZARDS.

- Set the start time, value given in Technical data or Motor Drive Data.

3.13.5 Braking methods

NOTE

Not to be used in explosive atmospheres!

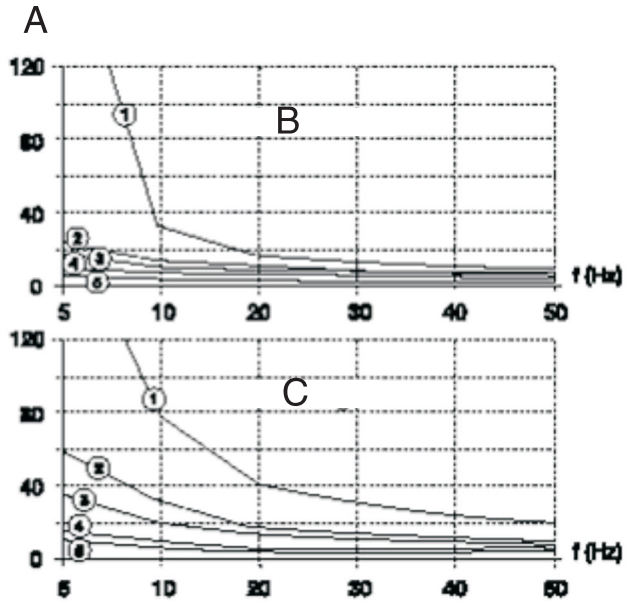
Motor flux braking:

Flux braking is a method based on motor losses. When braking in the drive system is needed, the motor flux and thus also the magnetizing current component used in the motor are increased. The control of flux can be easily achieved through the direct torque control principle (DTC). With DTC the inverter is directly controlled to achieve the desired torque and flux for the motor. During flux braking the motor is under DTC control which guarantees that braking can be made according to the specified speed ramp.

The flux braking method based on DTC enables the motor to shift quickly from braking to motoring power when requested.

In flux braking the increased current means increased losses inside the motor. The braking power is therefore also increased although the braking power delivered to the frequency converter is not increased. The increased current generates increased losses in motor resistances. Typically, in low power motors (below 5 kW) the resistance value of the motor is relatively large in respect to the nominal current of the motor. The higher the power or the voltage of the motor, the less the resistance value of the motor in respect to motor current. In other words, flux braking is most effective in a low power motor.

Rated motor power	
1	2,2 kW
2	16 kW
3	37 kW
4	75 kW
5	250 kW



G0962361

Percentage of motor braking torque of rated torque as a function of output frequency.

A.. Braking torque (%)
B.. No flux braking
C.. Flux braking

The main benefits of flux braking are:

- No extra components are needed and no extra cost, using DTC control method.
- The motor is controlled during braking.

The main drawbacks of flux braking are:

- Increased thermal stress on the motor if braking is repeated over short periods.
- Braking power is limited by the motor characteristics e.g. resistance value.
- Flux braking is useful mainly in low power motors.
- Not recommended in explosive atmospheres.

Brake chopper and braking resistor:

The braking chopper is an electrical switch that connects the DC bus voltage to a resistor, where the braking energy is converted to heat. During deceleration, the motor changes to generator operation and supplies energy back through the inverter. As brake energy cannot be fed back to the supply via the normal diode bridge, the brake chopper will turn on at a certain level and feed energy out via the brake resistor. Here, the energy is converted to heat and wasted, unless a separate heat recovery system is

installed; additional ventilation for the room may be required.

The main benefits of the braking chopper and resistor are:

- Simple electrical construction and well-known technology.
- Low fundamental investment for chopper and resistor.
- The chopper works even if AC supply is lost.

The main drawbacks of the braking chopper and resistor are:

- The braking energy is wasted if the heated air cannot be utilized.
- The braking chopper and resistors require additional space.
- May require extra investments in the cooling and heat recovery system. Braking choppers are typically dimensioned for a certain cycle, e.g. 100% power 1/10 minutes. Longer braking times, require more accurate dimensioning of the braking chopper.

DC braking:



Not to be used in explosive atmospheres!

DC braking can be performed with or without a frequency converter. With a frequency converter, a stop command makes the frequency converter switch to supplying the motor with direct current, developing a braking torque. Same effect can also be achieved using the DC brake unit, for dimensioning of the unit see document "calculation DC brake unit".

The main drawbacks of the DC injection braking are:

- The motor flux control is lost during braking, e.g. no control of adjusted braking time.
- Heat losses in the motor.
- Not recommended in explosive atmospheres.

Regenerative drive - IGBT solution braking:

The IGBT based regeneration is based on the same principles as power transmission within a power network. It has a low amount of supply current harmonics in both, motoring and regeneration, as well as high dynamics during fast power flow changes on the load side. It also offers the possibility to boost the DC voltage higher than the respective incoming AC supply. This can be used to compensate for a weak network or increase the motor's maximum torque capacity in the field weakening area.

The main benefits of the IGTB solution braking are:

- Stable torque even if net voltage is unstable.
- Nominal torque available even in the field weakening area.
- Fast and smooth operation in motoring-regenerating-motoring transition.

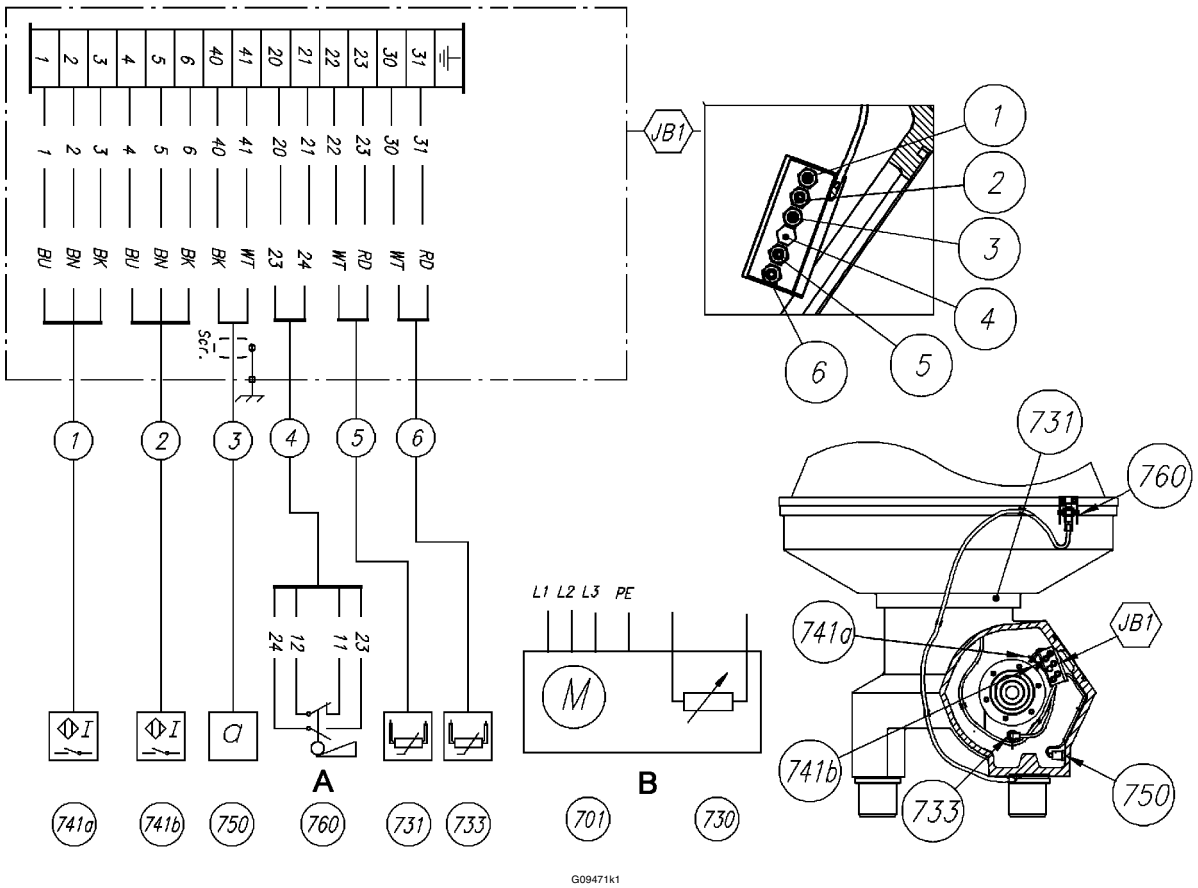
The main drawbacks of the IGTB solution drive are:

- Higher investment cost, up to 2 times of a standard frequency converter cost.
- The braking capability is not available during power supply failure.

3.14 Interconnection diagram

PNP sensor. ATEX protection: no

Alfa Laval ref. 582490 Rev. 0



A. Normally open when cover not fitted
B. Separator motor with thermistor
731. Temperature sensor (neck bearing)
733. Temperature sensor (lube oil)
741a. Speed sensor PNP (Motor shaft speed)
741b. Speed sensor PNP (Motor shaft speed)
750. Vibration sensor
760. Interlocking switch (frame top part)
JB1. Junction box

Wire colour codes:
BK = Black
BN= Brown
BU = Blue
GN-YW = Green-Yellow
WT = White
RD = Red
Scr = Screen

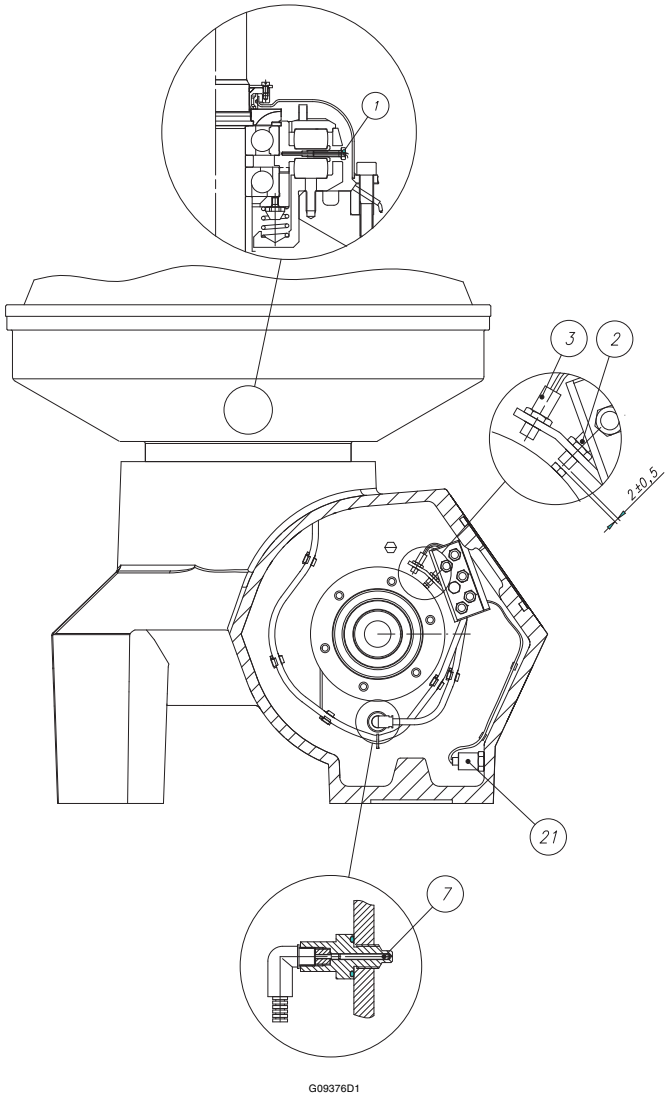
ATTENTION!

All wires to be cut to appropriate length to match respective earth connection terminal.
Wire ends to be marked with "PARTEX" PA01 or PA02 (yellow with black marking) after insulation and fitted with ferrules and/or cable shoes with insulated collar. Loose wire ends to be insulated with shrinking tubing. Items shown in this document are not included in all separators. See product specification.

3.15 Monitoring kit

ATEX protection: no

Alfa Laval ref. 582368 Rev. 4

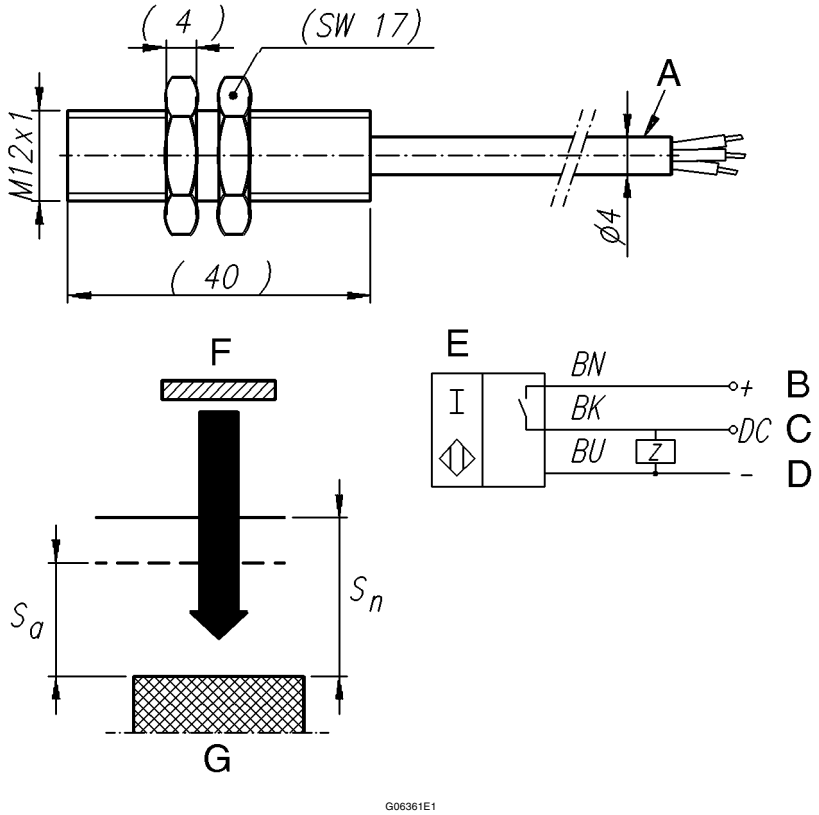


1. Temperature sensor
2. Speed sensor
3. Speed sensor
7. Temperature sensor
21. Vibration sensor

3.15.1 Speed sensor

Type: PNP

Alfa Laval ref. 561858 Rev. 2



A. Cable
B. Brown
C. Black
D. Blue
E. Symbol
F. Test plate
G. Inductive sensor

Electrical data

Working voltage:	12- 30 VDC
Continuos current, I_a	50 mA
Non-load current, I_o	≥12 mA
Voltage drop, U_d	≤3 mA
Switching frequency f max. :	2 kHz

Protected against sustained short-circuit and reverse polarity

Mechanical data:

Ambient temperature:	-25 °C to +100 °C
Protection class:	IP 67
Material;	
- sleeve:	Brass, nickel plated
- cable:	Teflon
Nominal switching range, S_n:	4 mm
Operational switching distance, S_a:	0-5 mm
Max tightening torque:	50 Nm

Ordering details:

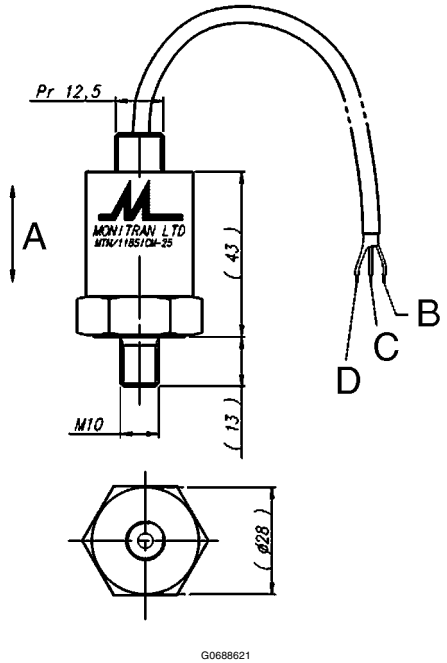
Manufactured by:	Baumer Ident
Type:	IFRM 12P1707, 2M
	Normally open function, DC PNP
Supplier in Sweden:	Baumer Ident AB

Dimensions within ( ) subject to manufacturers changes.

3.15.2 Vibration sensor

ATEX protection: no

Alfa Laval ref. 567112 Rev. 3



A. Sensitive axis
B. Black -
C. White +
D. Screen

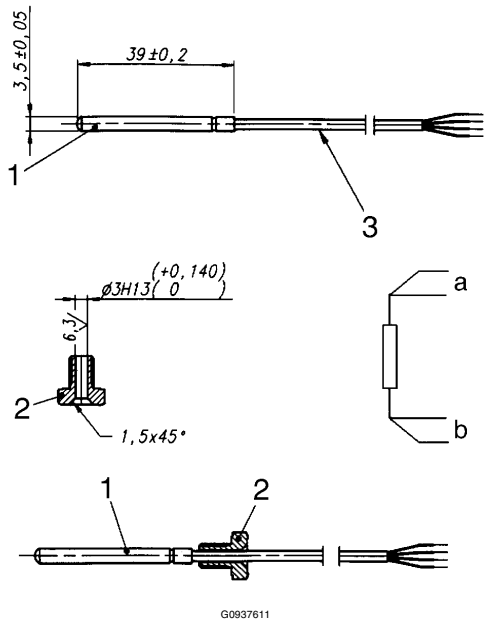
Technical data:

- Frequency response	2 Hz to 1 kHz
- Mounted resonance	18 kHz min
- Measurement range	50 gpeak
- Isolation:	base isolated
- Temperature sensitivity	0,08%/C°
- Electrical noise	0,3 mV max
- Transverse sensitivity	less than 5%
- Supply voltage	10-32 Voltage DC
- Output signal	4-20 mA
- Standard cable	5 metres over braided twin core PTFE
- Case material	Stainless steel
- Weight	150 gms (nominal)
- Sealing	IP 67
- Example of supplier	Monitran Ltd.
Suppliers denomination	MTN/1185CM-25 PG7 (0-25 mm/sec. RMS) MTN/1185CM-50 PG7 (0-50 mm/sec. RMS) MTN/1185CM-100 PG7 (0-100 mm/sec. RMS)

3.15.3 Temperature sensor

ATEX protection: no

Alfa Laval ref. 564433 Rev. 6



1. Temperature sensor
2. Screw
3. Cable length 3 m, diameter 2,5, colour: black
a.. White
b.. Red

Electrical data:

Sensing element: PT 100

Mechanical data:

Materials: - Cable: Teflon
- Sensor body: SIS 2343

Basic values for measuring resistance

°C	°F	Ohm
0	+32	100,00
+20	+68	107,79
+40	+104	115,54
+60	+140	123,24
+80	+176	130,89
+100	+212	138,50
+110	+230	142,29
+120	+248	146,06
+130	+266	149,82
+140	+284	153,58
+150	+302	157,31
+160	+320	161,04

3.16 Storage and installation

3.16.1 Introduction

First of all, ensure that the separator delivered is suitable for the application. Elements that are important to consider are, e.g., process liquid density and temperature, corrosion characteristics, sludge characteristics, solids contents of the process liquid, toxicity, inflammability, degree of automation, etc.

Most of the installation instructions are Specifications, which are compulsory requirements. These specifications are sometimes completed with non-compulsory Recommendations, which could improve the installation quality.

Additional installation information, such as drawings, connection lists and interface description, can be found previous in this chapter.

3.16.2 Storage and transport of goods

Storage

Specification

Upon arrival to the store, **check all components and keep them:**

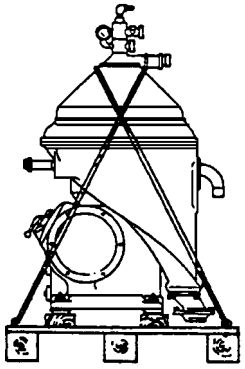
A. Well stored and protected from mechanical damage.

B. Dry and protected from rain and humidity.

C. Organized in the store in such a way that the goods will be easily accessible when installation is about to take place.

A separator can be delivered with different types of protection:

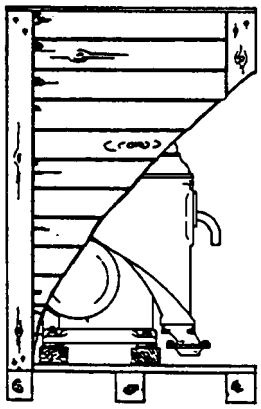
- Fixed on a pallet.
  The separator must be stored in a storage room well protected from mechanical damage as well as from rain and humidity.



G0402721

Fixed on a pallet

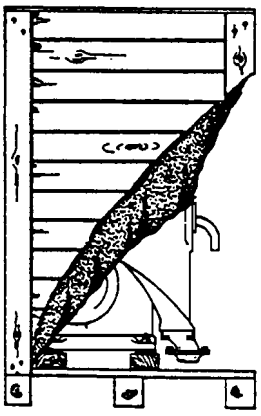
- In a wooden box which is not water tight.
  The separator must be stored dry and protected from rain and humidity.



G0402731

In a wooden box which is not water tight

- In a special water-resistant box for outdoor storage.
  The separator and its parts have been treated with an anti-corrosion agent. Once the box has been opened, store dry and protected from rain and humidity.
  The packaging for outdoor storage is only to special order.



G0402741

In a special water-resistant box for outdoor storage

Transport

Specification

- During transport of the separator, the frame hood and bowl **must always be removed from the machine.**
- When lifting a separator it must always be **hung securely.** See chapter Lifting instructions on page 91.



Crush hazards

Use correct lifting tools and follow lifting instructions.

- During erection, all inlets and outlets to separators and accessories must be covered to be protected from dirt and dust.

3.16.3 Planning of installation

Specification

The installation requires work platforms so that service and operation can be safely carried out. Platforms may be permanent or moveable and must be constructed according to local safety regulations.

Space for separator

The separator shall be placed in such a way that suitable space for maintenance and repair is obtained.

The space required for one or more separators can be calculated by consulting the drawings in the chapters Basic size drawing on page 26, Foundation drawing on page 53 and instructions for ancillary equipment, electrical and electronic equipment and cables.



G0020611

Check the drawings when planning the installation

Specification

- See chapter Foundation drawing on page 53 for the service space required with the separator installed. The spanner for the large lock ring should have sufficient space to make a complete turn without touching any of the ancillary equipment surrounding the separator.

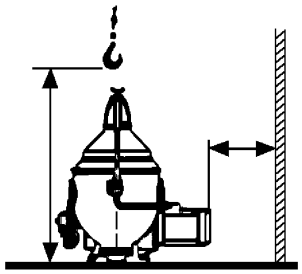
Recommendation

- The spanner for the large lock ring should have sufficient space to make a complete turn without touching any of the ancillary equipment surrounding the separator.

Important measurements

Important measurements are the minimum lifting height for lifting tackle, shortest distance between driving motor and wall, free passage for dismantling and assembly, maintenance and operation.

Plan your installation with sufficient room for the controls and operation so that instruments are easily visible. Valves and controls must be within convenient reach. Pay attention to space requirements for maintenance work, work benches, dismantled machine parts or for a service trolley.



G0020721

Suitable space must be obtained for the maintenance work

Lifting height for transport of bowl

Specification

- A minimum height is required to lift the bowl, bowl parts and the bowl spindle, see chapter Foundation drawing on page 53.

Recommendation

- When two or more separators are installed it is recommended to plan the installation in such a way that parts from one separator do not have to be lifted over another separator.

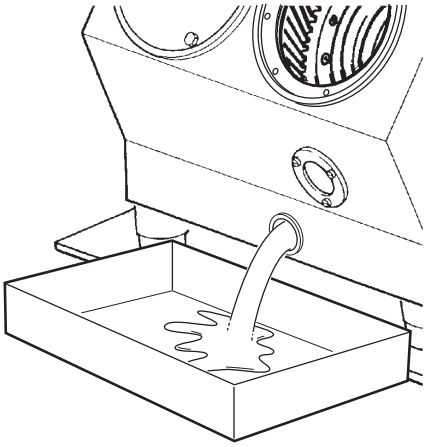
Space for oil changing

Specification

- The plug for gearbox oil draining must not be blocked by floor plate arrangement, etc.

Recommendation

- It should be possible to place a portable collecting tray under the gearbox drain plug for changing oil.



G0484241

Place the separator in such a way that makes the oil change easy

Connections to surrounding equipment

Specification

- If the local safety regulations prescribe that the installation has to be inspected and approved by responsible authorities before the plant is put into service, consult with such authorities before installing the equipment and have the projected plant approved by them.
- Ensure that all service media (compressed air, electric power, operating, cooling and safety liquids etc.) required for the separator have the correct quality and capacity. In cases where supply failure of the service media might cause damage, automatic supervision is recommended. This applies to operating media for solids discharging separators where a failure could cause unbalance or water leakage into the lubricating oil.
- If the starting equipment containing the main switch is placed in such a position that it cannot be seen from the separator, most local safety regulations require that a separate safety switch must be installed in the power supply to the separator motor.
- As the separator stands on soft rubber mountings, **always** design the pipe-work to and from the separator in such a way that there will be sufficient flexibility. Possible vibration should not be allowed to be transmitted via the piping. For specification of flexibility for feed inlet and outlets, see Basic size drawing on page 26.
- Only motors (including necessary monitoring equipment) specified by Alfa Laval may be fitted to the separator. Violation of this can cause severe damage and create a safety risk for the personnel. Motor drives of variable speed must not be used unless approved by Alfa Laval and used in combination with appropriate safety devices.
- Design the system is such a way that there is always an open outlet for liquid from the bowl casing drain outlet (connection 463 in connection list on page 21)
- If the sediment from the separator is discharged into a tank, this tank must be sufficiently ventilated. The connection between the separator and the tank must be of the size and configuration specified. see Basic size drawing on page 26.

- If the solids are discharged from the separator bowl casing into a closed system, ensure that this system cannot be overfilled or closed in such a way that the solids cannot leave the bowl casing. This could cause a hazardous situation.
- Ensure that the pressure of the cooling liquid in the jackets cannot exceed the specified limit in Connection list on page 21.
  Excess pressure will cause damage.

3.16.4 Foundations

NOTE

When lifting a separator it must always be hung securely. See chapter Lifting instructions on page 91.

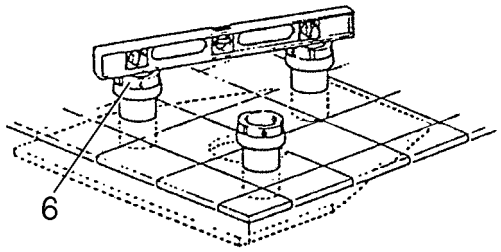
Specification

- The separator should be installed at floor level, see chapter Foundation drawing on page 53 for measures and how to pour the foundation plate in concrete.
- The separator must be installed on a strong and rigid foundation to reduce the influence of vibrations from adjacent machinery.

At delivery the parts 1-5 are fitted on the separator. The screw (5) is locked with Loctite 243 and tightened with **40 Nm.**

Proceed in the following way when mounting the separator onto the feet of the foundation plate (8):

1. Level against the upper face of the three holders (6). Screw the holders to compensate for inclination, if any. Any gap between a holder and a foundation foot (8) must be eliminated by adding one or more adjusting washers (7).



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Level against the upper face of the holders (6)

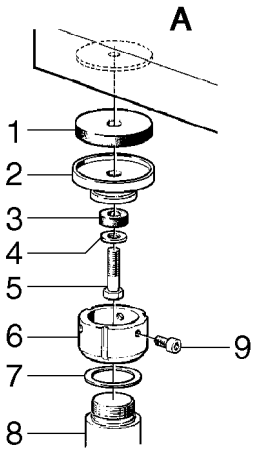
2. Lower the separator into the three holders.

3. Tighten the set screws (9), first by hand (or by a hand tool, if necessary) until all of them are in contact with the frame feet (2).
Then tighten the set screws with 100 Nm.

NOTE

Tighten the set screws before mounting the bowl.

4. Mount the bowl and check that the frame is horizontal by means of a level placed on the outer frame rim.
Make a new adjustment if necessary.



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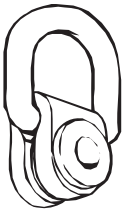
1. *Rubber cushion*
2. *Frame foot*
3. *Rectangular ring*
4. *Washer*
5. *Screw*
6. *Holder*
7. *Adjusting washer*
8. *Foot on foundation plate*
9. *Set screw*

A. *Separator frame*

3.17 Lifting instructions

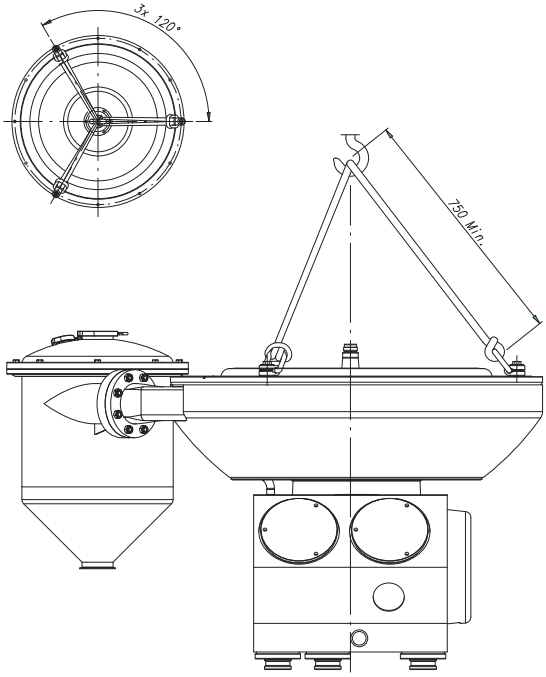
Alfa Laval ref. 585221 Rev. 0

3.17.1 Separator



Attach three endless slings or cables to the lifting eyes (the screws must be tightened with spanner).

Length of each sling must be min. **1,5 metres** in circumference.



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NOTE

Never lift the separator in any other way.

NOTE

Machine weight without frame hood and bowl is approx. 1000 kg.

Do not lift the separator unless the inlet/outlet, frame hood, bowl and motor have been removed.

WARNING

Crush hazards

Use only the three special lifting eyes for lifting the machine, and follow lifting instructions. Do not work under hanging load.

A falling separator can cause accidents resulting in serious injury to persons and damage to equipment.

3.17.2 Bowl

This instruction describes how to lift a complete bowl, which normally is done only during a transport of the separator.

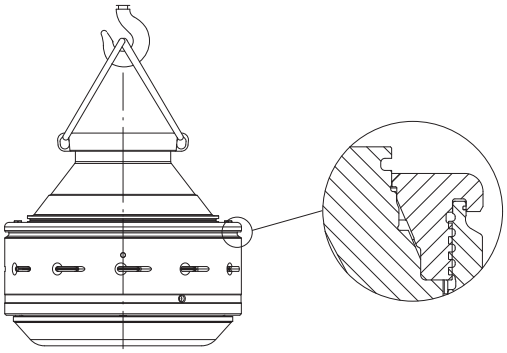
When lifting the bowl, use the special lifting tool fastened on the bowl hood.

NOTE

Check that the lock ring is properly tightened.

Weight to lift is approx. 1160 kg, see 3.3 Technical data on page 19.

When lifting the bowl out of the separator frame, the cap nut fixing the bowl to the bowl spindle and the screws fixing the bowl body to the operating water device must first be removed.



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The lock ring must be properly tightened when lifting the bowl

3.17.3 Other parts

The frame hood and the heavy bowl parts must be lifted by means of a hoist. Position the hoist exactly above the bowl centre. Use endless lifting straps and a lifting hook with safety catch.

Special tools from the tool kit must be used for dismantling and assembly. The special tools are specified in the Spare Parts Catalogue and are shown as illustrations together with the dismantling/assembly instructions.



When lifting parts without weight specifications, always use lifting straps with the capacity of at least 500 kg.