DESMI Guidelines

For pump installations

DESMI
Make life flow

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Congratulations on your new DESMI pump. We are proud that you chose us as your pump supplier, and will do our utmost to meet your expectations.

You are always welcome to contact us at desmi@desmi.com or +45 96 32 81 11 should you have any questions concerning your pump or anything else.

Remember that DESMI supplies pumps for installations of all sizes.

This brochure contains a number of recommendations for pump installation with DESMI centrifugal pumps concerning mechanical and electrical aspects.

For details on operation and maintenance, please refer to the pump manual for the relevant pump at www.desmi.com

Optimum pump installation

For final design and installation of pumps supplied by DESMI, use DS information DS/CEN/TR 13930 (recommendations for installing pipe systems) and 13932 (recommendations for installing pumps) as guidelines.

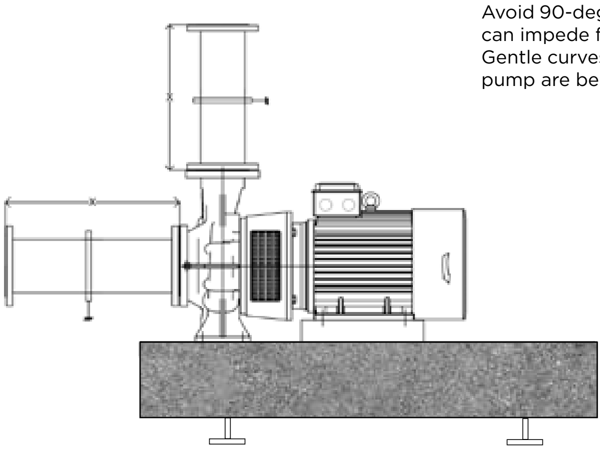
Key elements of pump installation:

- Base plate
- Pipe system
- Pipe support
- Ventilation for installation
- Service areas and lifting points for motor and pump
- Pump medium flow
- Optimum operating range
- Electrical connections (cables and screw assemblies)
- Electrical interference
- Using Common Mode filter for minimising bearing currents

Horizontal Pump

Avoid 90-degree bends, T-pieces or other components that can impede flow on the pump pressure side.
Gentle curves or Y-pieces to ensure optimum flow after the pump are best.

Pipe support to bear load from the pump flanges. Permitted flange forces are specified in the pump manual. Permitted flange forces can be increased by fitting flange reinforcement.



Use shims between pump foot and concrete plinth or base plate to avoid tension in the pump foot

A solid base plate will minimise vibrations and extend service intervals

Pipe system before pump

DS13930/13932 recommends length of suction pipe "X" before the pump is around 5 x pipe diameter. For a DN100 pump, this will be equivalent to X= 500 mm. This rule of thumb ensures laminar flow before and after the pump that will give optimum operating conditions. But in practice, there are many good installations where this has not been fulfilled.

X = minimum length of suction pipe before flow-changing components

Flow-changing components:

- Compensators
- Valves
- Filters
- Bends
- Orifice plate
- Etc.

Optimum pump installation

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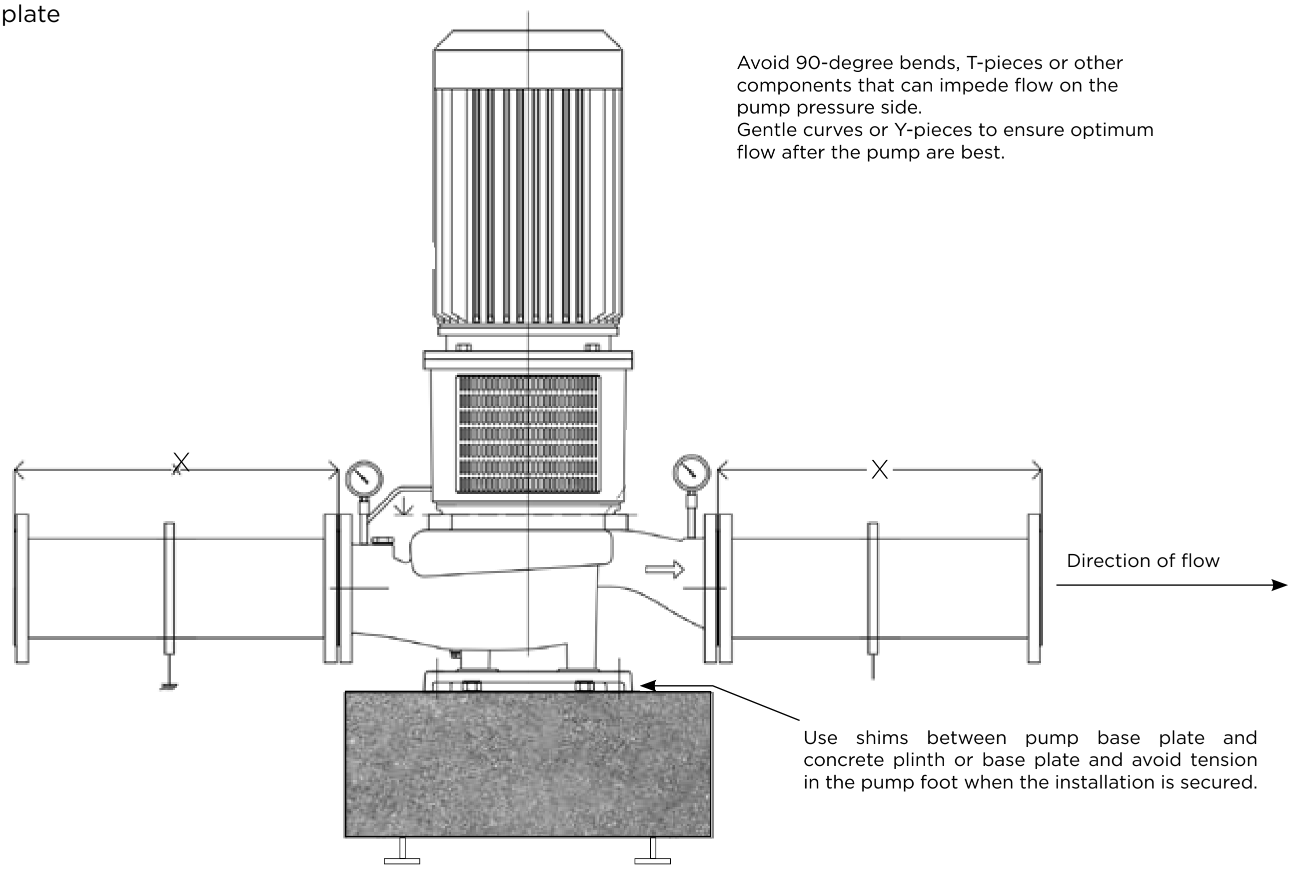
Vertical Pump



Before startup

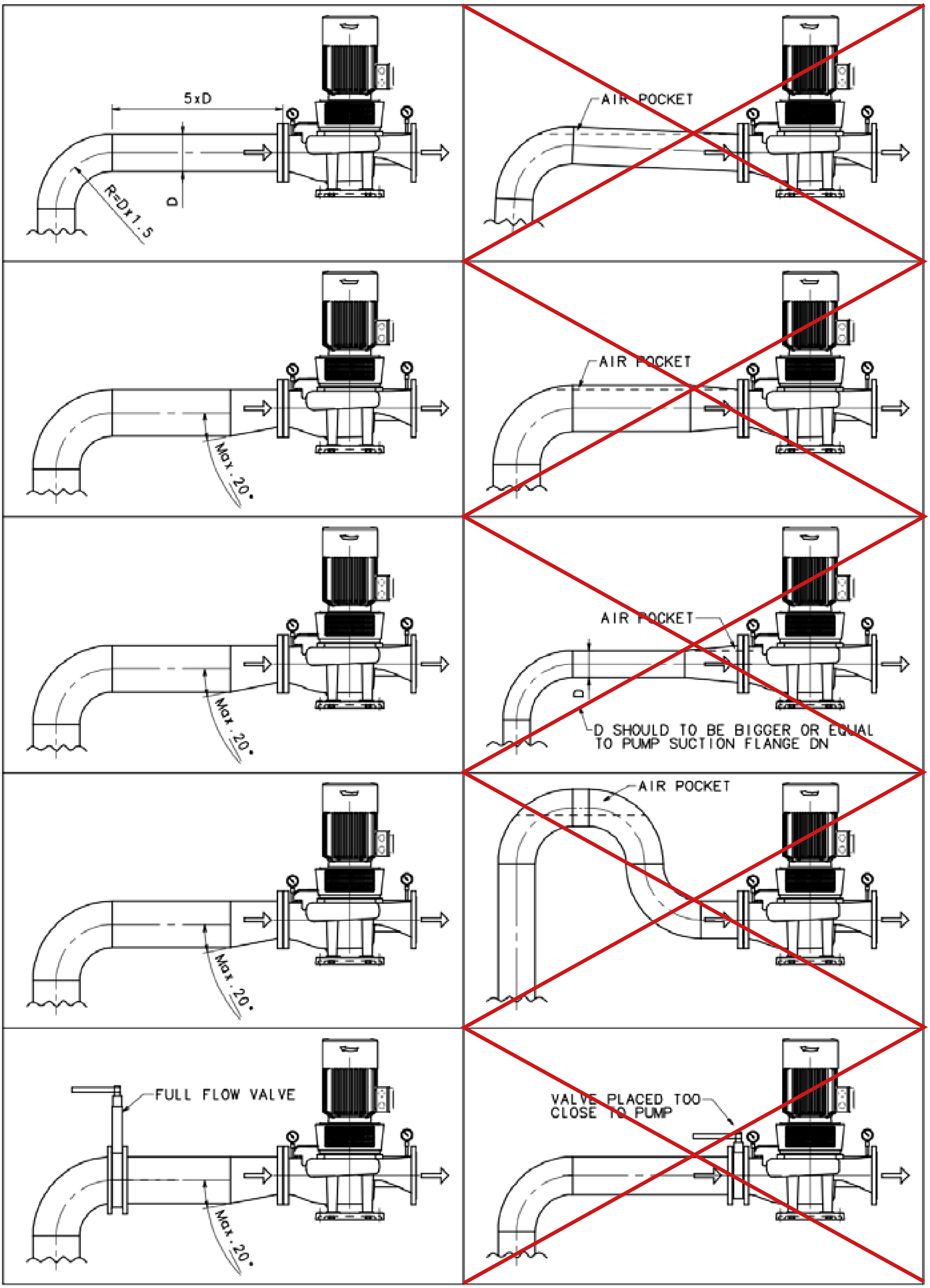
1. Check that the pump can rotate by turning it by hand
2. Check alignment of pipe system
3. Check bearings are lubricated before startup or no later than immediately afterwards
4. Check that the pump is filled with the correct medium and bled
5. Check that the pump rotates in the correct direction and has no abnormal noises or vibrations
6. Check differential pressure (discharge pressure - suction pressure) and compare with calculated operating point for the installation

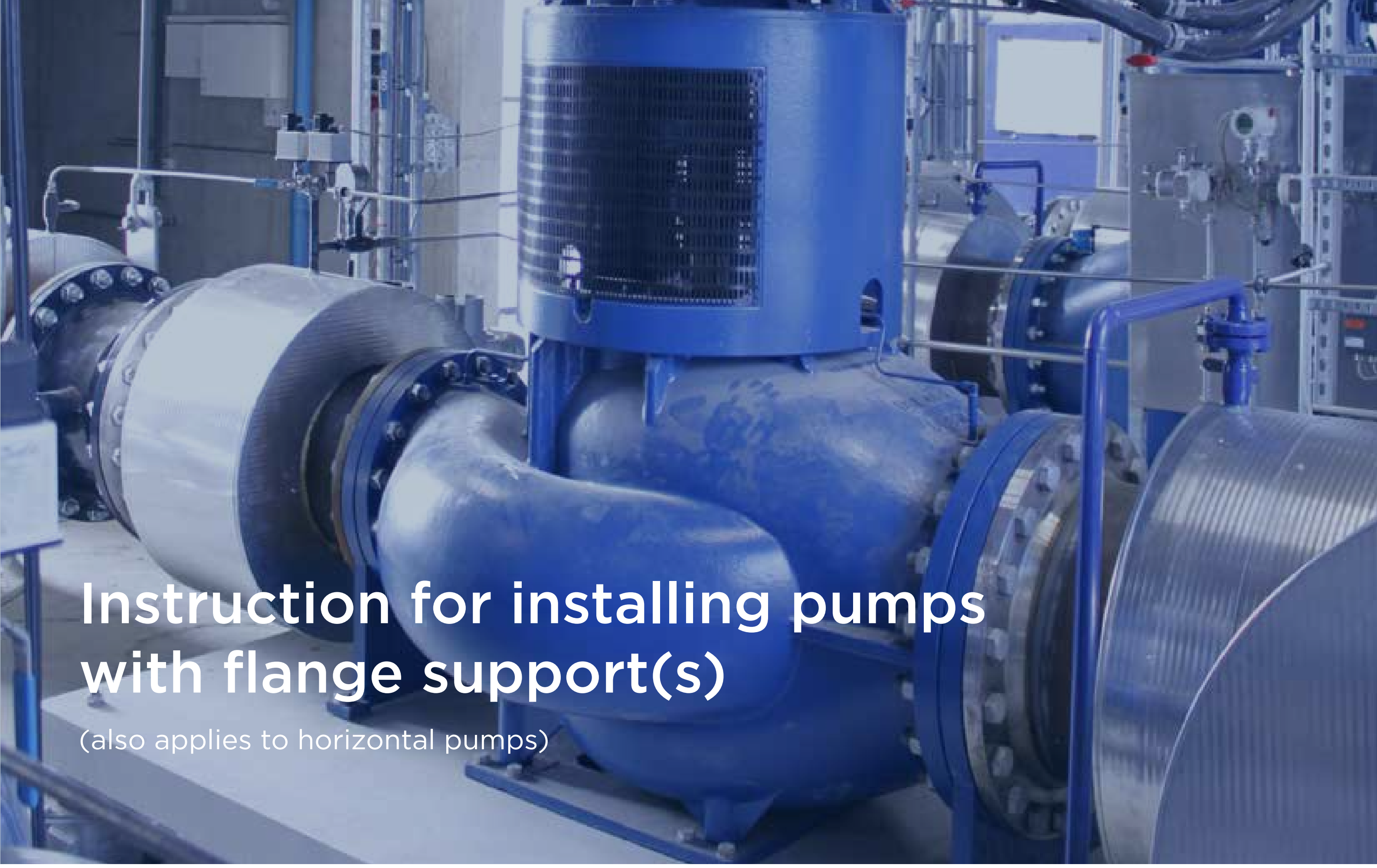
If differential pressure is too high or too low, the pump may be damaged or have impeded efficiency. High flow must be reduced either by reducing RPM or constricting the discharge valve or installing an orifice plate on the discharge side. Alternatively, change the pump hole diameter - contact DESMI.

Recommended design of pipes on suction side

Good installation

Poor installation





Instruction for installing pumps with flange support(s)

(also applies to horizontal pumps)

1. Fasten the pump to the underlying structure (= foundation / concrete plinth / floor) and check that the pump is level.
2. Check that the pump shaft can be rotated freely - i.e. by hand without noise and abnormal resistance.
3. Place flange support(s) at the pump's flange(s) and check that the bolt holes are aligned and that the gasket surfaces are parallel.
4. If the underlying structure is not level (plane), it may be necessary to shim under either the pump footplate or under the flange support(s).
5. Insert gasket(s) between pump and flange support(s) and hold together and parallel with 4 temporary bolts 90° offset in each flange.
6. Check that the flange support(s) have full contact with the underlying structure (if there is more than a 0.5 mm air gap under the feet, shims must be placed underneath)
7. Bolt flange support(s) to underlying structure.
8. Remove the 4 temporary bolts and mount the pipe system flange(s) and gasket(s) against the flange support(s).
9. Check that the bolt holes are aligned and that the gasket surfaces are parallel.
10. Bolt the piping system flange(s) together with the pump and flange support(s).
11. Check that the pump shaft still can be rotated freely (sound and resistance must not have changed according to point 2).
12. If the temperature of the pipe system changes significantly (up or down) after commissioning the pump and consequent thermal stresses / movements in the pipe system, if any, can be transferred to the pump, it should be checked again that the pump shaft still can rotate freely at actual upper/lower temperature limits.
13. If the pump cannot rotate freely under all operating conditions, the pipe system must be better supported - alternatively, compensator(s) must be installed between the pump and pipe system.

Allowable vibration levels on DESMI centrifugal pumps and motors

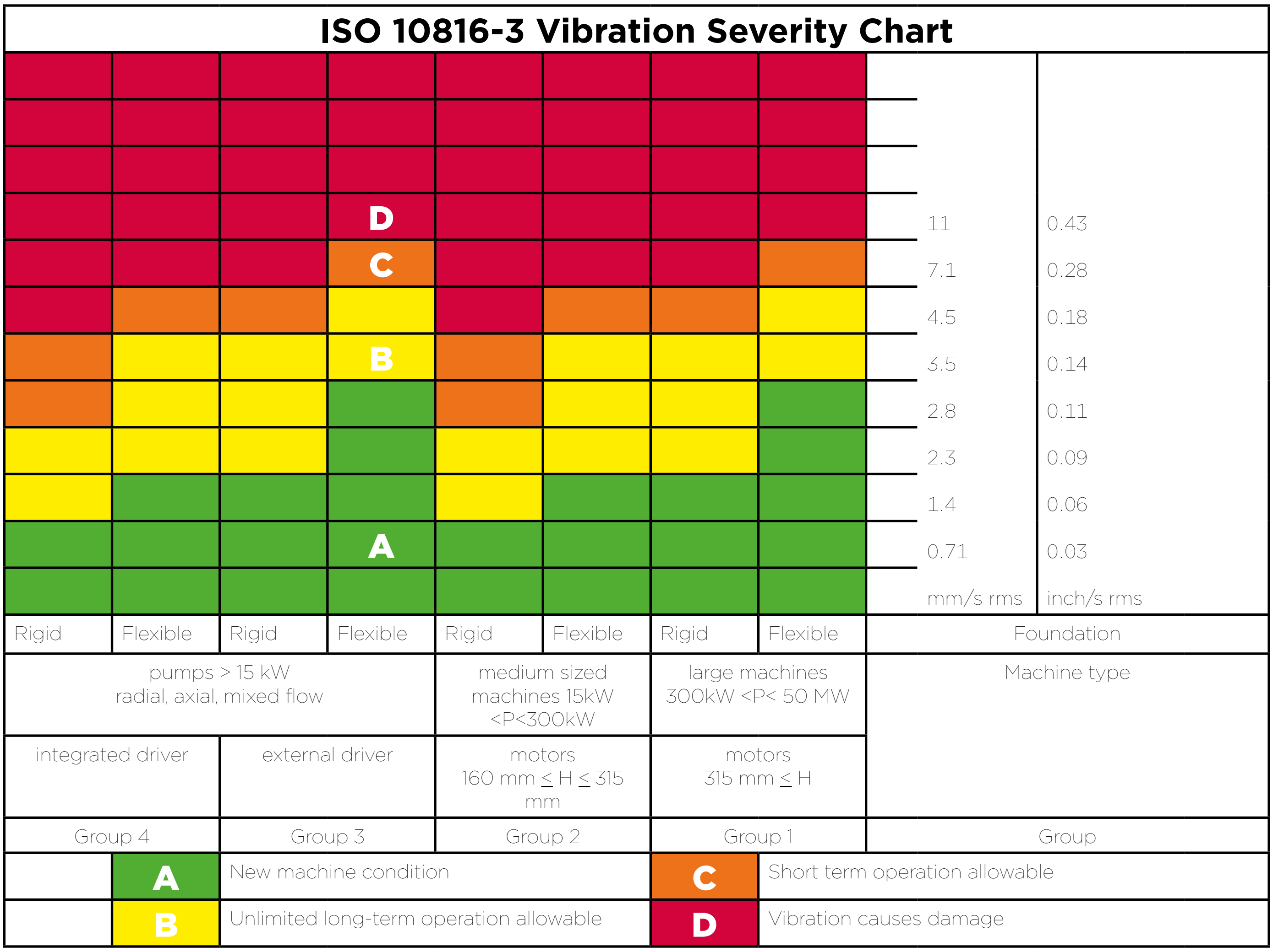
As standard DESMI centrifugal pumps with electric motor generate less than 2.8 mm/s vibration velocity (measured in 3 directions at motor flange level on vertical pumps) during a factory test.

The pump and electric motor industry generally agrees that vibration levels above 7 mm/s are damaging – i.e. this will result in shorter lifetimes of e.g. bearings and/or shaft seals in pumps (and bearings in motors) than normally expected. This agrees with the recommendations in the international standard ISO 10816-3.

But in pump installations on ships external excited vibrations from main engine and/or auxiliary machinery are transferred from ship hull to the pump often resulting in much higher vibration velocities than 7 mm/s.

DESMI recommends the following values for protective settings:

Location	Vibration alarm level (mm/s)	Vibration trip level (mm/s)
Pump	>7	>10
Motor (drive end)	>7	>10
Motor (non drive end)	>10	>15

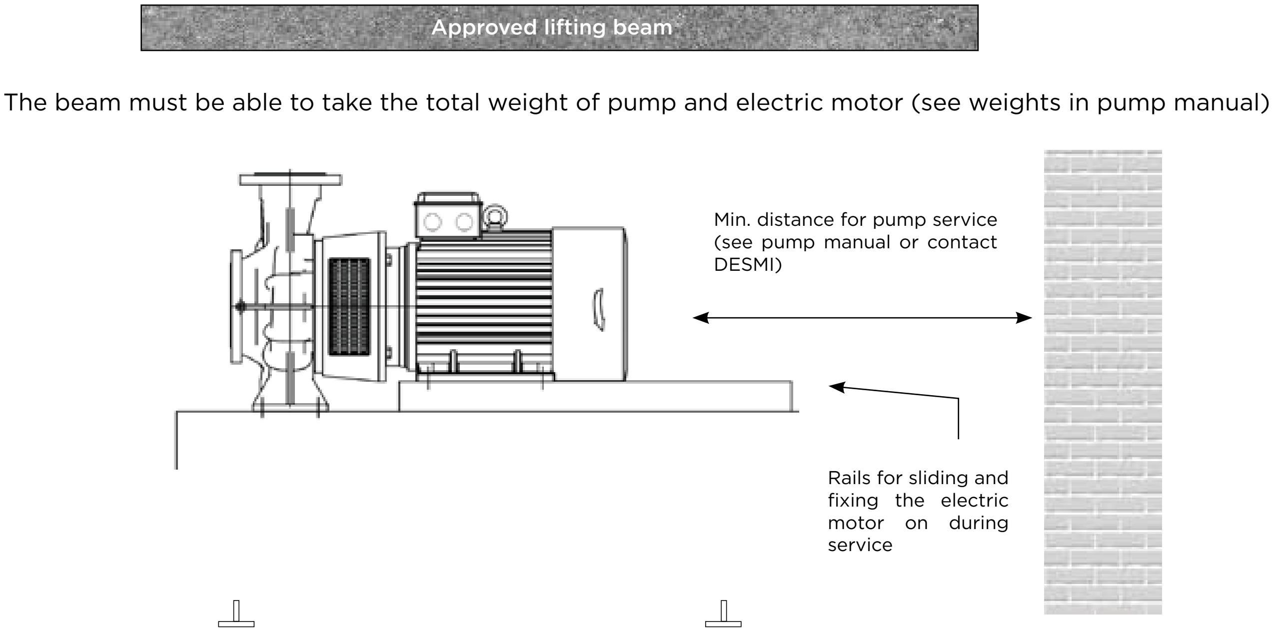


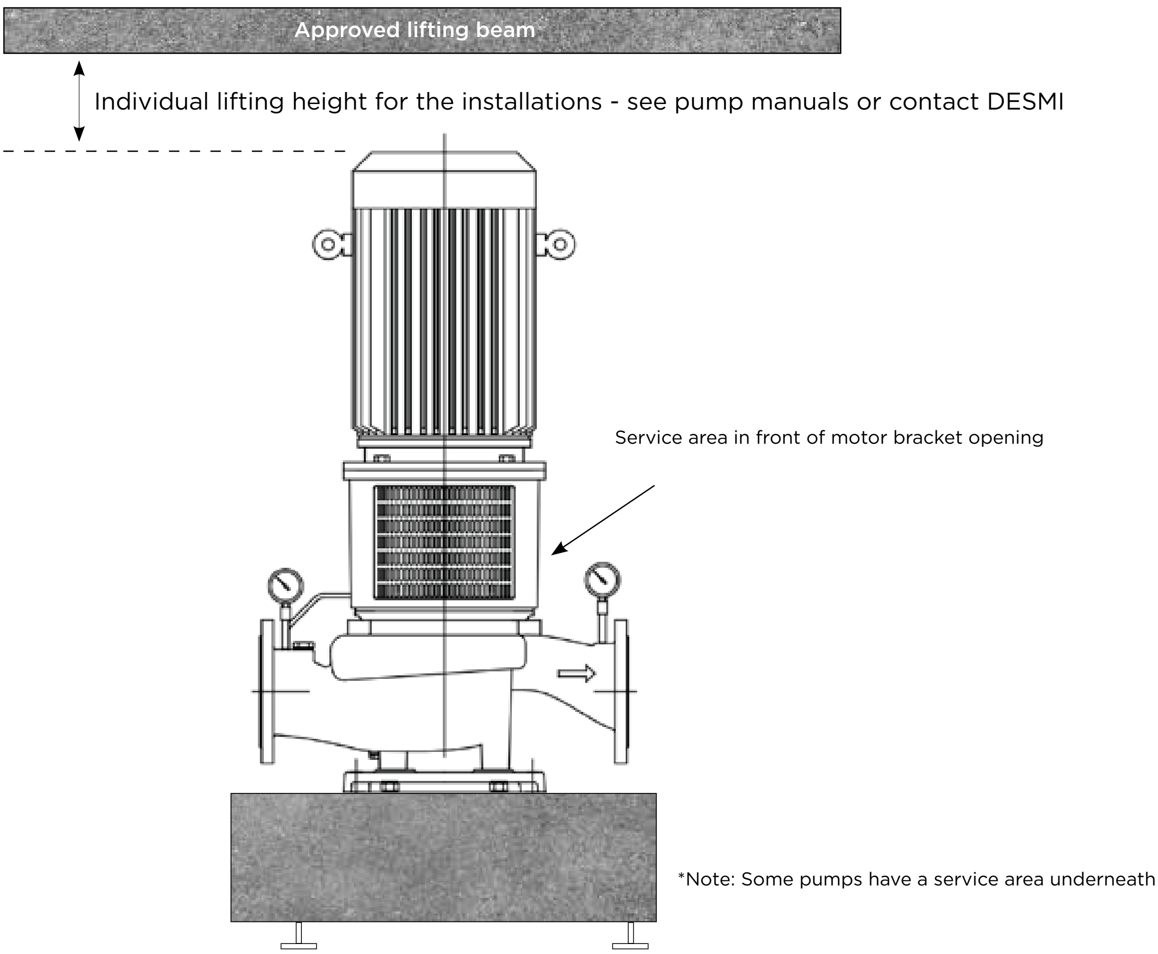
Service areas for horizontal and vertical pumps

To facilitate future servicing of pump and electric motor, lifting gear should be installed, such as access for cranes, lifting points, ceiling beams or other approved equipment for the purpose.

Carefully consider where the pump installation will be placed, as transportable approved lifting gear often needs considerable space.

* If there is no permanently-installed lifting gear, an approved lifting beam is required.

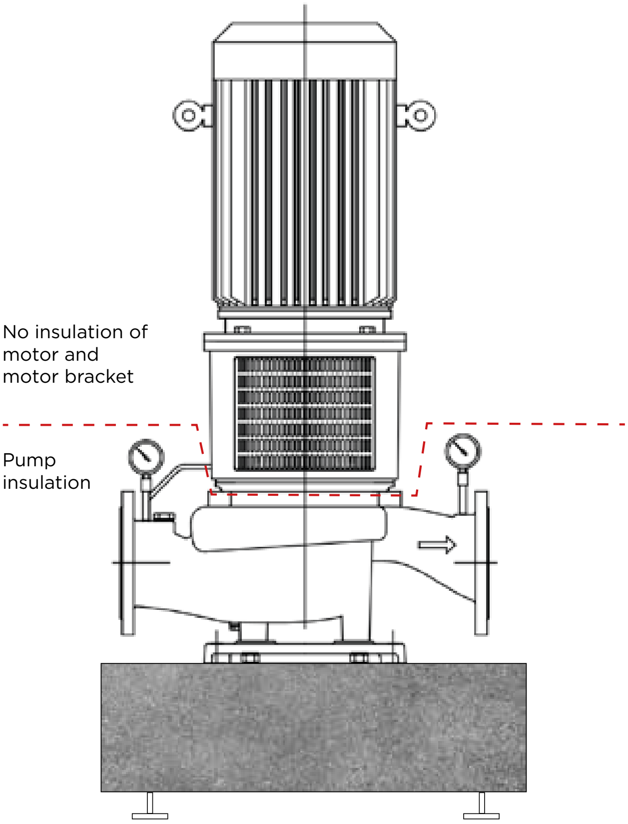


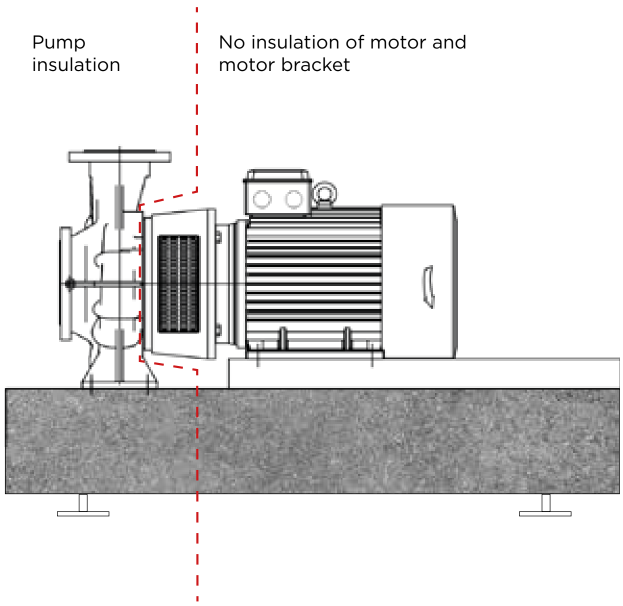


Pumps supplied by DESMI can in general be insulated for heat or cold except at the top of the pump housing – i.e. up to the base flange on the motor bracket as shown on the diagram below. No holes or screen openings on the motor bracket can be covered by insulation.

An electric motor will become hotter if mounted on a fully insulated pump. The ball bearings and/or coils in the motor can overheat if a pump is insulated all the way up to the motor flange.

Unrestricted ventilation of the motor bracket is therefore necessary to provide sufficient cooling of pump and motor bearings – in pumps with bearings (A02 version) and without (A12 version).





Reliable Pump Operation with a Frequency Converter

When a pump is controlled by a frequency converter, voltage spikes may occur. If the installation is not designed correctly, these can cause bearing currents and damage the motor bearings.

DESMI therefore recommends a number of electrical and mechanical measures to reduce the risk of bearing currents and protect the motor.

Electrical Installation
DESMI recommends the use of shielded EMC cables and EMC cable glands, together with correct equipotential bonding. Cable glands and contact surfaces on both the motor and frequency converter must be free from paint and contaminants to ensure proper electrical connection.

Depending on motor size and IE class, a common-mode filter may be recommended to reduce voltage spikes between the frequency converter and motor. In general, the risk of damaging bearing currents increases with motor size and higher IE classes. Motor cable length also influences the selection and sizing of the filter.

Mechanical Installation
A common-mode filter reduces voltage spikes but may not completely eliminate bearing currents. Insulated or ceramic hybrid bearings can therefore be used to provide additional protection.

Ceramic bearings are a more expensive solution but offer a high level of electrical insulation and typically a longer service life than conventional and insulated bearings. DESMI's recommendations for bearing selection are shown in the table.

DESMI Advice on the Complete Solution
When DESMI supplies the pump, electric motor and frequency converter as a complete solution, we provide guidance on correct sizing and installation, taking factors such as bearing currents into account. If commissioning is also included in the scope of supply, the installation will be checked as part of the commissioning process.

When DESMI supplies the pump and motor only, we recommend following the above guidelines when selecting and installing the frequency converter. DESMI is, of course, available to provide further advice.

DESMI also provides general guidance on common-mode, sine-wave and dU/dt filters.

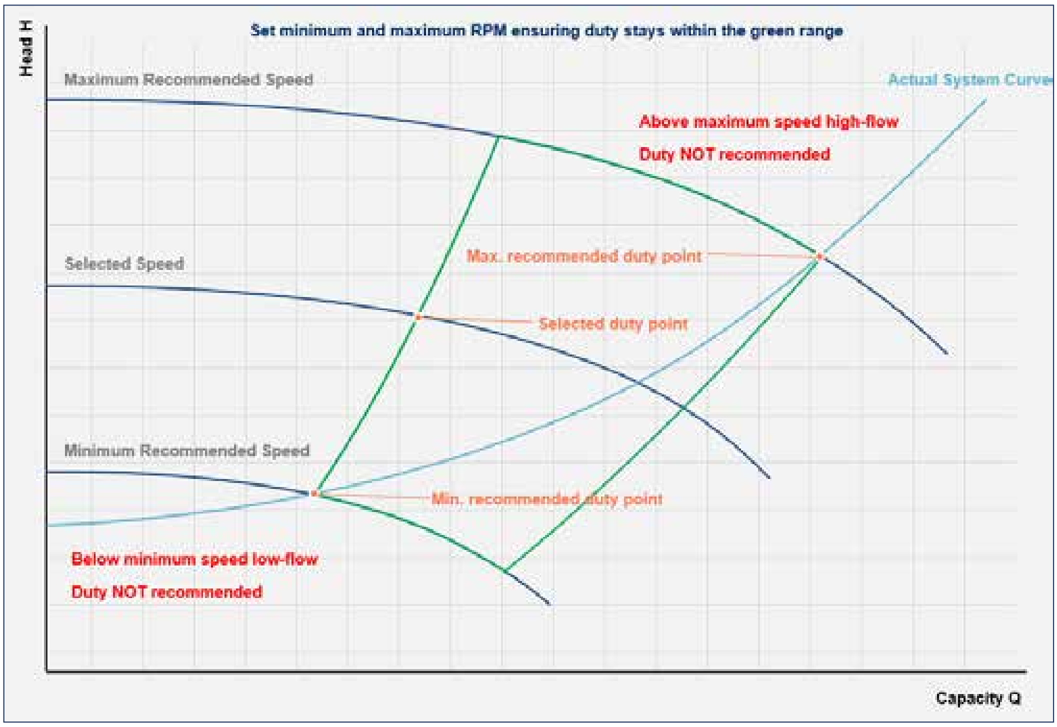
Electrical Noise on the Supply Network
A frequency converter can also generate electrical noise on the power supply network. Depending on the installation, there may be requirements to limit this interference. DESMI Automation can perform measurements and recommend suitable solutions.

DESMI's recommendations concerning use of Common Mode filters and insulated bearings

Motor size [M]	Motor IE class					
	IE2		IE3		IE4	
	Insulated bearings	Common Mode filter	Insulated bearings	Common Mode filter	Insulated bearings	Common Mode filter
M ≤ 4 kW	No	No / Yes	No	No / Yes	No	Yes
5,5 kW ≤ M ≤ 30 kW	No	Yes	No / Yes	Yes	No / Yes	Yes
37 kW ≤ M ≤ 55 kW	No / Yes	Yes	No / Yes	Yes	Yes	Yes
75 kW ≤ M	Yes	Yes	Yes	Yes	Yes	Yes

(The recommendations in the table are based on experience and input from the various suppliers of electric motors and frequency converters)

System Curve, Duty Area and Pump Speed Limits



For a given system condition, the installation establishes the system curve. Changing pump speed shifts the pump curve, so the operating point moves along the system curve. Ensure that the minimum and maximum pump speed stays within the green range.

System curve and permitted speed range

For a given operating condition, the system curve is defined by the installation, including static head and dynamic head from pipe friction and other system losses. The frequency converter changes the pump curve by changing RPM; it does not change the system curve.

The actual operating point is where the pump curve at the selected speed intersects the system curve. Set the minimum and maximum pump speeds so that this intersection remains within the pump's recommended duty area. Speed below the minimum moves the operating point to the low-flow side; speed above the maximum moves it to the high-flow side. The example working area is 70-120% of BEP (Best Efficiency Point).

Cumulative operation at speeds that place the operating point outside the recommended duty area must not exceed 300 hours per year.

Operation outside the permitted range should be limited to exceptional or temporary conditions. Prolonged low- or high-flow operation can cause temperature rise (zero flow through a running pump can quickly result in higher liquid temperatures than shaft seal or pump casing materials allow !), recirculation, cavitation, increased power consumption, and reduced bearing, seal, or impeller life.

During commissioning, verify measured differential pressure and the actual operating point against the calculated values for the installation, and confirm the VFD minimum and maximum speed limits.

Convert the permitted RPM limits to frequency (Hz)

First determine the permitted pump-speed range in RPM from the pump and system curves. Then convert the required RPM limits to frequency for the installed motor. The Hz required for a given RPM depends on the motor pole number.

Approximate synchronous speed at 50 Hz:

- 2-pole: 3000 RPM
- 4-pole: 1500 RPM
- 6-pole: 1000 RPM
- 8-pole: 750 RPM

Actual shaft speed will be slightly lower because of motor slip.

Example: A required pump speed of 2025 RPM is approximately 70 Hz with a 4-pole motor, but approximately 35 Hz with a 2-pole motor.

Define and verify the minimum and maximum limits in RPM first. Then convert them to Hz using the installed motor pole number. Do not copy frequency limits from a motor with a different pole number.

Note: NPSHa vs. NPSHr margin to be checked if pumping higher flows (=> reading lower differential pressure) than expected at a given RPM (pump speed)

We exist to keep your business flowing

DESMI works closely with vessel owners, operators, and shipyards to deliver critical flow processes for diverse marine applications. Our pumps and supporting systems are trusted worldwide for dependability and the lowest total cost of ownership.

No matter which flow challenges you are facing, we can help you overcome them with class-leading equipment, solutions, and services designed specifically for your applications and environment, and with factories in China, India, the US, and Denmark, you benefit from our efficient global supply chain.

Founded in Denmark in 1834, we have provided the expertise, solutions, and aftermarket support our customers need for nearly two centuries. We help you operate more efficiently and reliably, enabling your ambitions for performance, compliance, and growth whilst helping you reduce your climate impact.

Together, we can make a difference, whatever the future holds. Because we, like you, are here to **make life flow**.
For more information, visit **desmi.com**

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