AGREEMENT FOR
STORM WATER SYSTEM MAINTENANCE

This Agreement is made on 27TH, SEPTEMBER, 2018 by J.S. Oakland, LLC, A Michigan Limited Liability Company, of 155 Romeo Street, Rochester, Michigan 48307 and the CITY OF ROCHESTER HILLS (the "City"), whose address is 1000 Rochester Hills Drive, Rochester Hills, MI 48309.

WHEREAS, Developer owns and proposes to develop the Property described in attached Exhibit A; and

WHEREAS, the proposed development of the Property will alter the natural flow of surface and storm water drainage; and

WHEREAS, Developer has proposed, and the City has approved, a storm water drainage and detention system (the "System") comprised of storm water quality treatment facilities and devices, storm sewer pipe, catch basins, manholes, swales and pump station for the property as described and depicted in the Storm Water System Plan attached as Exhibit B; and this agreement to provide for the same.

WHEREAS, the parties will benefit from the proper operation, use and maintenance of the System and enter into this agreement to provide for the same.

THEREFORE, the parties agree:

1. Use of the System:

Components of the System, including any and all water conveyance and water quality treatment facilities and devices, storm sewer pipe, catch basins, manholes, pump stations shall be used solely for the purpose of conveying, and treating storm and surface drainage on the property until such time as:

(i) The City determines and notifies Developer or Developer's successors, grantees or assigns, in writing, that it is no longer necessary to convey, detain or treat the storm and surface drainage; and

(ii) An adequate alternative for conveying and treating storm and surface drainage has been provided which is acceptable to the City and which includes the granting of any easements to the City or third parties as may be required or necessary for the alternative drainage system.

2. Maintenance:

A. Developer shall be responsible for the proper maintenance, repair and replacement of the System and all parts thereof as detailed in the Maintenance Plan attached as Exhibit C.

B. Proper maintenance of the System shall include, but is not limited to:

(i) Removing accumulated sediment, trash and debris from the detention system and at inlet pipes;
(ii) Maintaining storm sewer, structures and safety features;
(iii) Controlling the effects of erosion;
(iv) Inspection and cleaning of the water quality treatment device;
(v) Inspection of inlet and outlet pipes for structural integrity;
(vi) Inspection and cleaning of the storm sewer and catch basins upstream from the detention system; and
(vii) Any other maintenance that is reasonable and necessary to facilitate and continue the proper operation and use of the System.

3. Action by City:

If, at any time, Developer or Developer's successors, grantees or assigns neglect or fail to properly maintain the System or any part thereof, the City may notify Developer or Developer's successors, grantees or assigns. The notice shall be in writing and shall list and describe maintenance deficiencies and demand that they be corrected within thirty (30) days.

The notice shall further specify a date and place for a hearing to be held at least fourteen (14) days after the date of the notice before the City Council, or such other board or official as the City Council may designate. At the hearing, the City Council (or other designated board or official) may affirm or modify the list and description of maintenance deficiencies and, for good cause shown, may extend the time for the deficiencies to be corrected.

Thereafter, it the maintenance deficiencies are not corrected within the time allowed, the City may undertake the necessary corrective actions, and the City may maintain the System for up to one (1) year. Such maintenance of the System by the City shall not be construed to be a trespass or a taking of the Property, nor shall the City's actions vest in

the public any right to enter or use the Property. Thereafter, if Developer or Developer's successors, grantees or assigns do not properly maintain the System, the City may, alter providing similar written notice, schedule and hold another hearing to determine whether the City should maintain the System for another year, and subject to a similar notice, hearing and determination in subsequent years.

In the event the City determines an emergency condition caused by or relating to the System threatens the public health, safety or general welfare, the City shall have the right to immediately and without notice enter the Property and undertake appropriate corrective action.

4. Charges:

The City shall charge to the current owner of the Property the cost of maintenance or other corrective action undertaken by the City under this agreement. plus a ten percent (10%) administrative fee. If not timely paid, the City may place the charges on the City's tax roll, which charges shall be a lien on the real property and shall be collectable and enforceable in the same manner general property taxes are collected and enforced.

5. Notice:

Any notices required under this agreement shall be sent by certified mail to the address for each party set forth below, or to such other addresses as such party may notify the other parties in writing:

To	J.S. Oakland, LLC:	155 Romeo Street, Ste. 300 Rochester, Michigan 48307 Attention: Jeff Schmitz
To	The City:	City Clerk City of Rochester Hills 1000 Rochester Hills Drive Rochester Hills, MI 48309

6. Successors and Assigns:

This agreement shall bind and inure to the benefit of the parties and their respective successors, grantees and assigns. The benefits, burdens, rights, obligations and responsibilities hereunder shall run with the land and shall bind all current and future owners of the Property and any divisions thereof.

7. Recording of Agreement:

This agreement shall be recorded at the Oakland County Register of Deeds.

J.S. Oakland, LLC
A Michigan Limited Liability Company

By: _____
Jeff Schmitz
Its: Managing Member

STATE OF MICHIGAN
COUNTY OF OAKLAND

This agreement was acknowledged before me on SEPTEMBER 27, 2018, by Jeff Schmitz, Managing Member of J.S. Oakland, LLC, a Michigan Limited Liability Company, on behalf of the Company.

_____
Notary Public

Oakland County, Michigan

My Commission Expires 2/15/20

CITY OF ROCHESTER HILLS

By: _____
Bryan K. Barnett, Mayor

By: _____
Tina Barton, City Clerk

STATE OF MICHIGAN }
}SS
COUNTY OF OAKLAND}

This agreement was acknowledged before me on _____, 2018, by Bryan K. Barnett, Mayor, and Tina Barton, City Clerk, of the City of Rochester Hills, a Michigan Municipal Corporation on behalf of the Corporation.

:

_____
, notary public

_____ County, Michigan

My commission expires:

Drafted By:

Nowak Fraus Engineers
Michael Kurmas, P.E.
46777 Woodward Avenue
Pontiac, MI 48342-5032

When Recorded Return To:

City Clerk
City of Rochester Hills
1000 Rochester Hills Drive
Rochester Hills, MI 48309

Premier Academy, Rochester Hills
Exhibit A
STORMWATER MANAGEMENT AGREEMENT

LEGAL DESCRIPTION: PARCEL

Land situated in the City of Rochester Hills, County of Oakland, State of Michigan, more particularly described as:

Part of the NW. 1/4 of Section 8, T.3N., R.11E., City of Rochester Hills, Oakland County, Michigan; Being described as beginning at the NW. Corner of said Section 8; thence S. 88° 55' 00" E., 333.56 feet along the North line of said Section 8; thence S. 01° 14' 37" W., 241.53 feet; thence N. 89° 29' 55" W., 332.54 feet; thence N. 01° 00' 00" E., 244.92 feet to the point of beginning, except the North 60.00 feet of the West 90.00 feet and the South 20.00 feet of the North 80.00 of the West 60 feet taken for road purposes. Containing 74,404 square feet Or 1.708 acres.

#15-08-100-021
#15-08-100-022
& part of 15-08-100-004

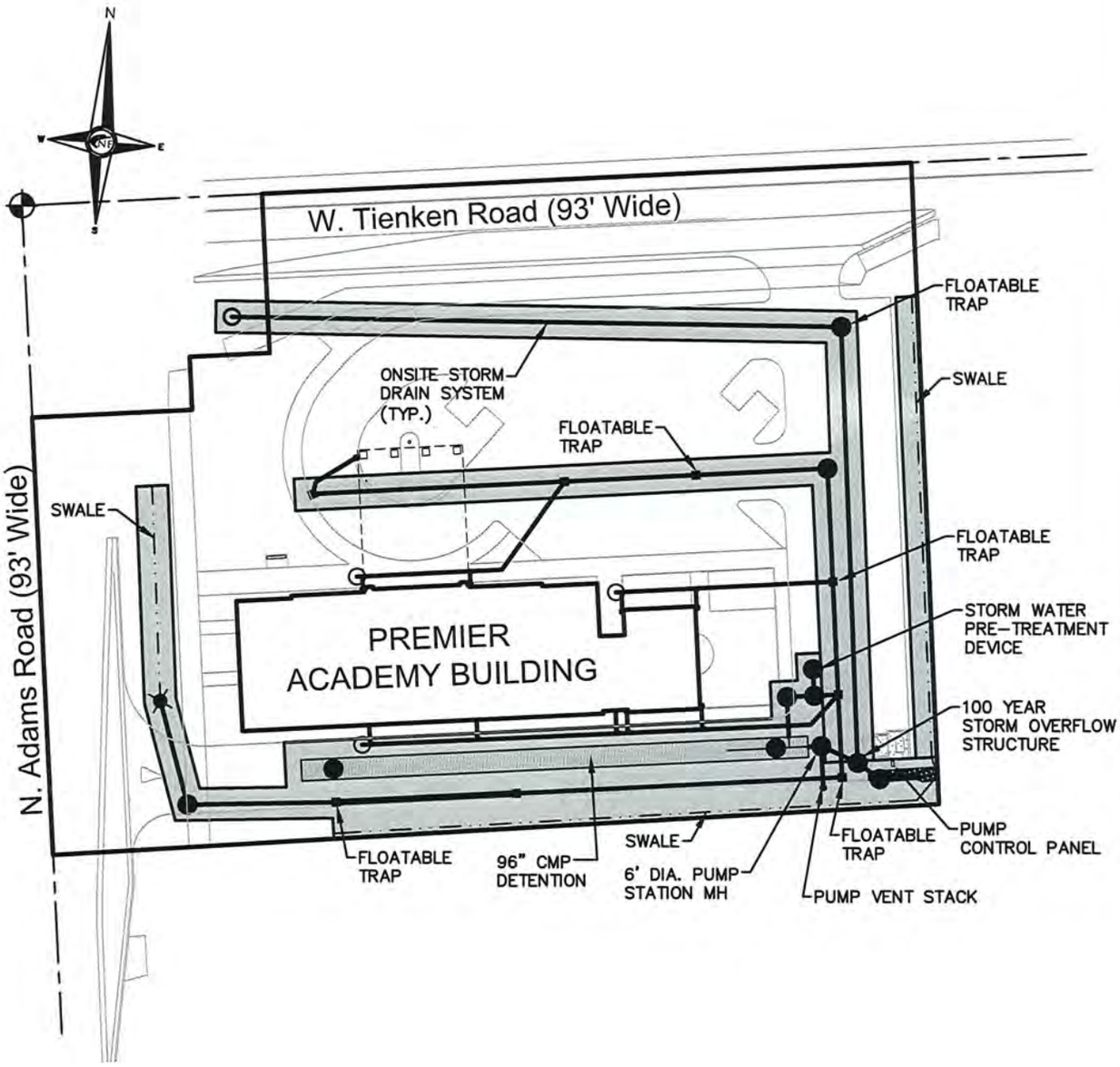
NF ENGINEERS
NOWAK & FRAUS ENGINEERS
46777 WOODWARD AVE.
PONTIAC, MI 48342-5032
TEL. (248) 332-7931
FAX. (248) 332-8257

Scott W. Approved 9/27/18

SCALE	DATE	DRAWN	JOB NO.	SHEET
	09-24-2018	N.N.	J580	1 of 1

Premier Academy, Rochester Hills
Exhibit B

STORMWATER MANAGEMENT AGREEMENT
STORMWATER MANAGEMENT SYSTEM SKETCH



Location Map
N.T.S.

MK APS
9/27/18

STATE OF MICHIGAN
MICHAEL P. KURMAS
ENGINEER NO. 6201064137
LICENSED PROFESSIONAL ENGINEER

ENGINEERS
NOWAK & FRAUS ENGINEERS
46777 WOODWARD AVE.
PONTIAC, MI 48342-5032
TEL. (248) 332-7931
FAX. (248) 332-8257

SCALE	DATE	DRAWN	JOB NO.	SHEET
1" = 60'	09-24-2018	N.N.	J580	1 of 1

EXHIBIT 'C'
OPERATIONS AND MAINTENANCE MANUAL

PREMIER ACADEMY
STORM WATER MAINTENANCE PLAN
ROCHESTER HILLS, MICHIGAN

PROPERTY OWNER:
J.S. Oakland, LLC
155 Romeo Street, Ste. 300,
Rochester, MI 48307
Phone: (248) 650-9850
Contact: Mr. Jeff Schmitz

Prepared by:
Nowak Fraus Engineers
46777 Woodward Avenue
Pontiac, MI 48342-5032
Phone: (248) 332-7931
Contact: Michael Kurmas, P.E.

Ok ARS 9/27/18

OPERATION AND MAINTENANCE MANUAL

INTRODUCTION:

This manual identifies the ownership, operation and maintenance responsibilities for all stormwater management systems including the underground storm sewer system and mechanical pre-treatment devices incorporated into and detailed on the approved Construction Plans as prepared by Nowak Fraus Engineers. In order to comply with the local best management practices (BMP) and requirements, this manual should serve as a minimum performance standard. This manual should be retained intact and read in its entirety by all parties responsible for the operations and maintenance of the on-site BMP's.

OWNER:

J.S. Oakland, LLC,
155 Romeo Street, Ste. 300
Rochester, MI 48307
Phone: (248) 650-9850
Contact: Mr. Jeff Schmitz

PROPERTY INFORMATION:

This Operations and Maintenance Manual covers the storm water systems located at the following subject property:
LEGAL DESCRIPTION: (see Exhibit 'A' of the Storm Water Maintenance Agreement)
Tax ID: 15-08-100-021 & 15-08-100-022 AND PART OF 15-08-100-004

LEGAL DESCRIPTION

Land situated in the City of Rochester Hills, County of Oakland, State of Michigan, more particularly described as:

Part of the NW. 1/4 of Section 8, T.3N., R.11E., City of Rochester Hills, Oakland County, Michigan; Being described as beginning at the NW. Corner of said Section 8; thence S. 88° 55' 00" E., 333.56 feet along the North line of said Section 8; thence S. 01° 14' 37" W., 241.53 feet; thence N. 89° 29' 55" W., 332.54 feet; thence N. 01° 00' 00" E., 244.92 feet to the point of beginning, except the North 60.00 feet of the West 90.00 feet and the South 20.00 feet of the North 80.00 of the West 60 feet taken for road purposes. Containing 74,404 square feet or 1.708 acres.

STORM WATER MAINTENANCE EXHIBIT:

Exhibit 'B' of the Storm Water Maintenance Agreement is the Storm Water System Plan which provides a clear presentation of all components of the storm water system. This system is subject to the long-term operation and maintenance responsibilities detailed in this manual.

The system includes:

- Storm sewer pipes and detention pipe
- Storm sewer structures (manholes, inlets, catch basins etc.)
- Pre-Treatment Device (CDS 2025-5-C)
- Pump Station (Flygt 3069)
- Swales

INSPECTIONS:

The frequency of system inspections outlined in the manual and attached exhibits should be considered the minimum, if no events warrant additional inspections. The frequency of inspections should be fine-tuned over time as system specific conditions are better known and the rate at which certain maintenance operations need to be performed is better understood. Maintenance Inspection Check lists are provided for each of the BMP's in this system. Inspections should be performed by personnel responsible for maintenance and may need to be certified for confined space entry, depending on the component being inspected. Operation of the pre-treatment devices may need to be inspected by a practicing civil engineer familiar with their operation.

Records of all routine inspections and any work performed on the system for maintenance, repair or replacement should be maintained by the owner and kept for a minimum of ten (10) years. A copy of all records should be provided to the City of Rochester Hills Engineering Division. The records should include this manual, all inspection sheets, approved construction plans and as-built documents, a maintenance log of work performed to the system and contact information for the system inspector, civil engineer, landscape architect, geotechnical engineer and contractor involved with the system.

STORM: WATER SYSTEMS MAINTENANCE:

Regular inspection and maintenance of BMP's are necessary if these facilities are to consistently perform up to expectations. Stormwater systems are expected to perform quality and quantity control functions as long as the land use they serve exists. Failure to maintain these systems can create the following adverse impacts:

- Increased pollutants to surrounding surface water features
- Potential loss of life or property resulting from catastrophic failure of the facility
- Aesthetic or nuisance conditions, such as mosquitoes or reduced property values due to a degraded facility appearance.

Most of these impacts can be avoided through proper and timely inspection and maintenance. A major concern associated with these impacts is the general public's expectations related to the quality of life provided, in part, by construction of these systems. Inadequate maintenance means the general public may have a false sense of security. The most common cause of stormwater system failure is the lack of adequate and proper operation, inspection, maintenance and management.

Good design and construction can reduce subsequent maintenance needs and costs, but they cannot eliminate the need for maintenance altogether. Maintenance requires a long term commitment of time, money, personnel and equipment. Monitoring the overall performance of the storm water management system is a major aspect of any maintenance program.

The maintenance responsibilities for these systems lie with the current property owner and transfer with the property in perpetuity. If maintenance of the system is not performed, the City of Rochester Hills reserves the right to enter the property and perform all necessary work at the property owners' cost Refer to the *Agreement for Storm Water System Maintenance* for additional details.

General Maintenance Items:

Parking Lot Sweeping:

Routine sweeping of all paved surfaces provides a more attractive appearance and removes accumulations of sediment and trash that tend to migrate into storm water management systems during rainfall events. Parking lot sweeping should be performed quarterly or as necessary to limit sediment and trash build-up.

Grass Mowing and Maintenance:

Mowing requirements at a facility should be designed to the specific site conditions, grass types and seasonal variations in climate. Grassed areas require periodic fertilizing, de-thatching and soil conditioning in order to maintain healthy growth. Provisions will need to be made to reseed and reestablish grass cover in areas damaged by sediment accumulation, storm water flow, erosion or other causes. Dead turf will need to be replaced after being discovered. Inspection of the grass areas and other landscaping features should be made annually.

Trash and Debris Removal:

Removal of trash and debris from all areas of the property should be performed monthly. Removal of these items will prevent damage to vegetated areas and eliminate their potential to inhibit the operation of any of the storm water management systems. Sediment, debris and trash that are removed and collected should be disposed of according to local, State and Federal regulations at suitable disposal and/or recycling centers.

Stormwater System Maintenance Items:

The following narratives give an overview of the maintenance requirements of the different components of the storm water system. The inspection checklists attached to this report offer a more complete listing of what should be inspected, when inspection should occur and the likely frequency of maintenance activities.

Swales:

The swales should be kept free of trash, debris or any other foreign matter that would inhibit drainage.

Storm Sewer and Structures:

Catch basins, inlets, manholes and sewer pipes should be inspected to check for sediment accumulation and clogging, floatable debris, dead vegetation etc. The structures and sewers should also be observed during a wet weather event to ensure their proper operation. Accumulated sediment and debris should be removed on an annual basis or as needed based on observed conditions. Structural repairs or maintenance should occur as needed based on observed conditions such as cracks, spalling, joint failure, leakage, misalignment or settlement of structures. A civil engineer should be retained if problems are thought to exist.

Stormwater Pre-Treatment Device:

Refer to the attached Owner's manual from the manufacturer for all inspection and maintenance requirements for the CDS structure.

The following pages include inspection checklists for the various devices and components listed above as well as the manufacturer's manual for the storm water pre-treatment structure.

Pump Station:
Refer to the attached Owner's manual from the manufacturer for all inspection and maintenance requirements for the lift pump. The pump station structure shall be maintained in the same manner as the above mentioned storm sewer structures as well as an inspection of the pump and other mechanical components on a 6 month basis.

County Drain Storm Sewer and Structures:
The storm sewer and structures located within the storm drain easement granted to Oakland County shall be cleaned and inspected as part of the Owner's regular maintenance responsibilities. However, any structural repairs of these storm sewers and structures shall be made by Oakland County.

STORM WATER MANAGEMENT SYSTEM – PERMANENT MAINTENANCE
DATE/ TIME OF INSPECTION:_____
INSPECTOR:_____

	System Component				
	Catch Basins, Inlets, Storm Sewers & Outlet Control Structures	Storm Sewer & Detention Pipes	Pump Station	Rip Rap & Swales	
Maintenance Activities					Frequency
Monitoring / Inspection					
Inspect for sediment accumulation and pollutants	X	X	X	X	Annually, Bi-Annually for Pump Station
Inspect for floatable, dead vegetation and debris	X	X	X	X	Annually, Bi-Annually for Pump Station
Inspect all components during wet weather and compare to as-built plans	X	X	X	X	Annually, Bi-Annually for Pump Station
Inspect for erosion				X	Annually
Inspect inside of structures and pipes for cracks, spalling, joint failure, settlement, sagging and misalignment	X	X	X	X	Annually, Bi-Annually for Pump Station
Inspect pump station all components for proper operation			X		Twice a year or every six months
Preventative Maintenance					
Remove accumulated sediment and pollutants (vacuum truck)	X	X	X	X	Annually or as needed, Bi-Annually for Pump Station
Remove floatables, dead vegetation and debris	X	X	X	X	Annually or as needed, Bi-Annually for Pump Station
Service mechanical components of pump station			X		Refer to manufacturer maintenance manual
Remedial Actions					
Repair/stabilize areas of erosion				X	As needed
Structural repairs	X	X	X		As needed
Make adjustments / repairs to ensure proper functioning	X	X	X	X	As needed
Repairs to pump station			X		As needed

SUMMARY:

INSPECTORS REMARKS:_____

_____

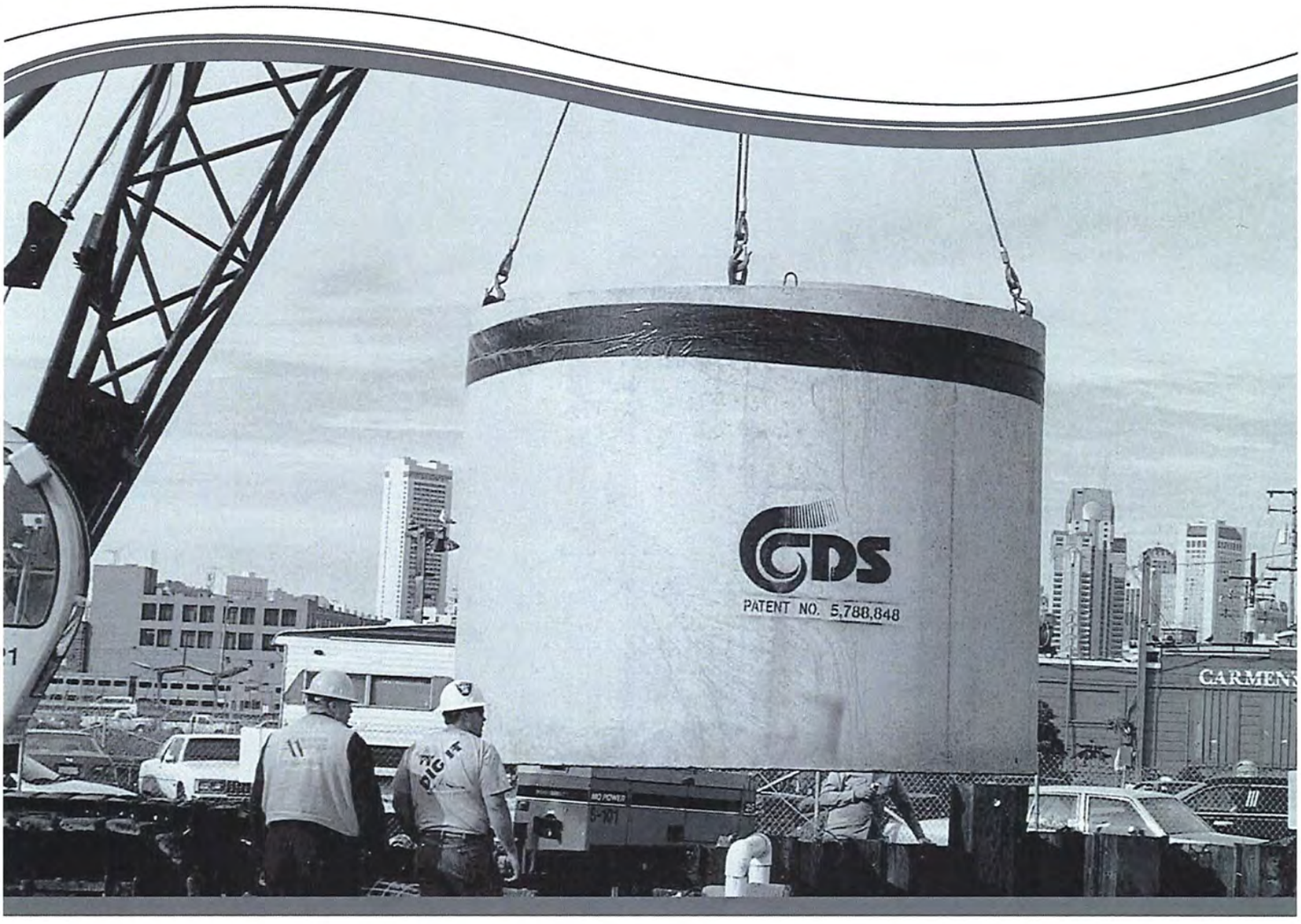
OVERALL CONDITION OF FACILITY:_____

RECOMENDED ACIONS NEEDED:_____

DATES ANY MAINTANCE MUST BE COMPLETED
BY:_____

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance



CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

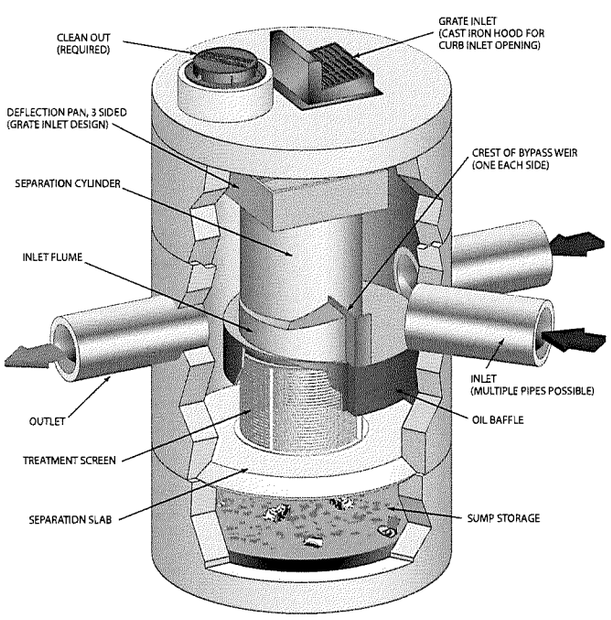
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

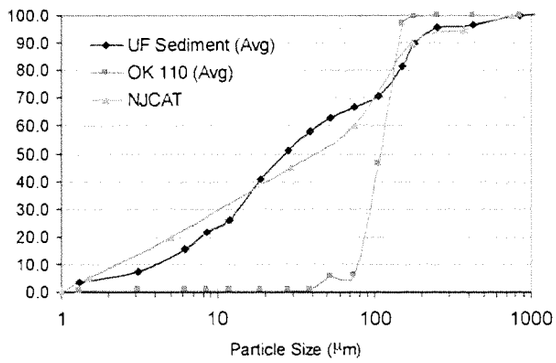


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

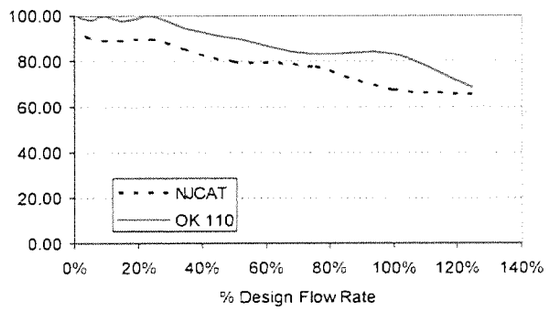


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

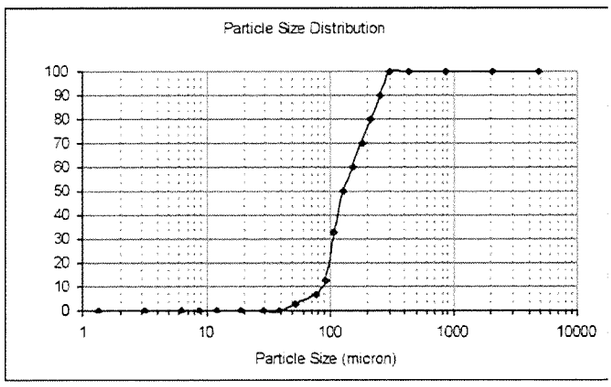


Figure 3. WASDOE PSD

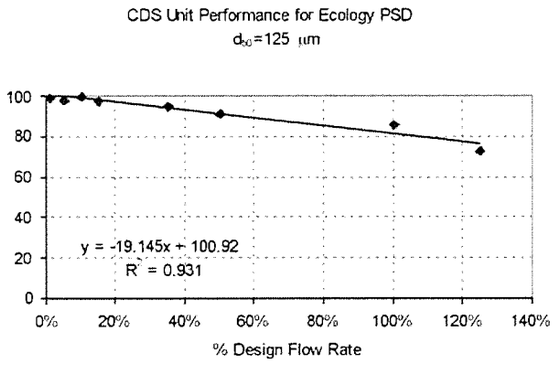


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

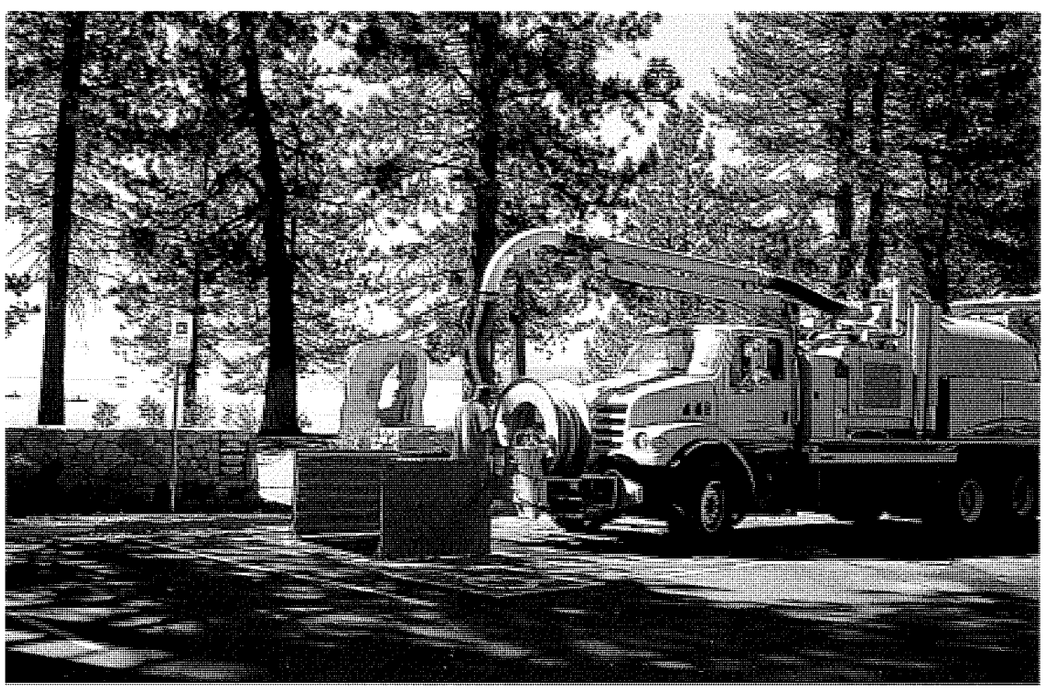
The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

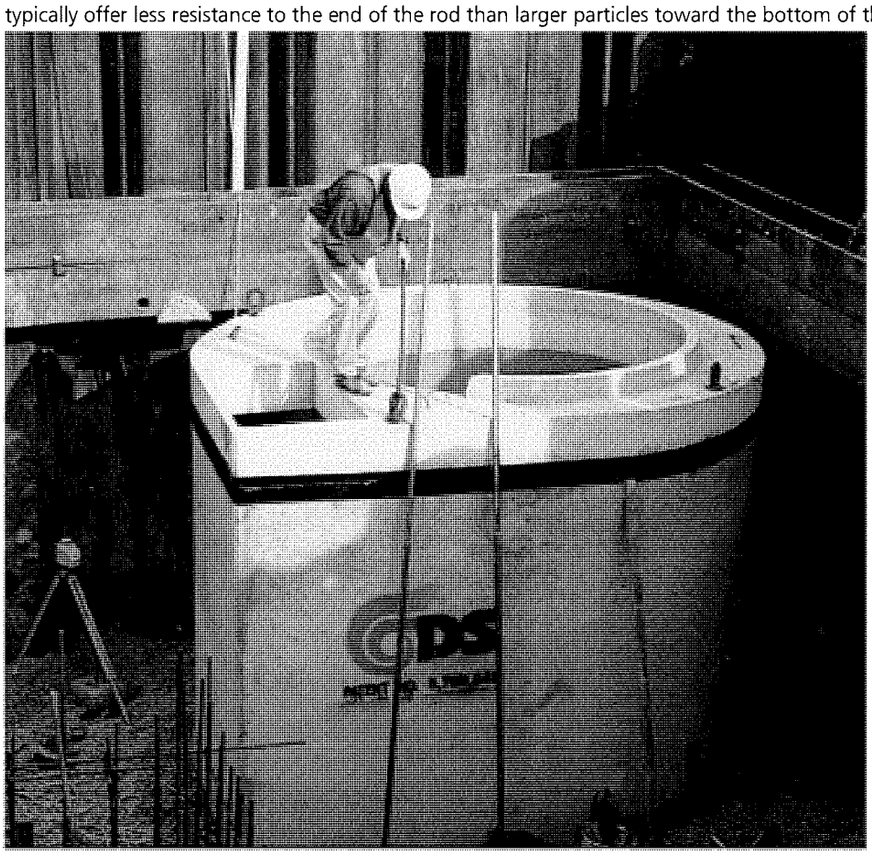
Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

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RECYCLED PAPER

Installation, Operation, and
Maintenance Manual

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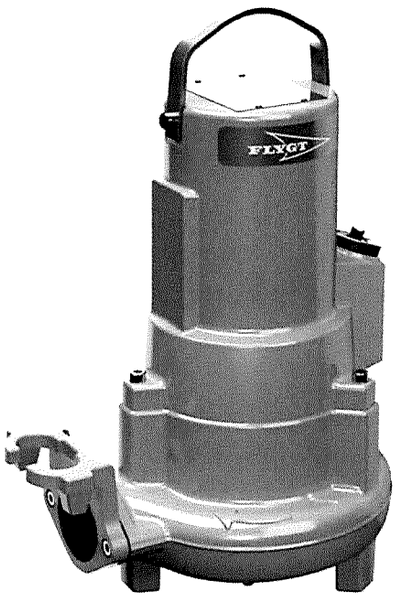

Flygt 3069

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Table of Contents

6 Maintenance

Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 3 have been read and understood.

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

CAUTION: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

Make sure that you follow these requirements:

- Check the explosion risk before you weld or use electrical hand tools.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product and its components have been thoroughly cleaned.
- Make sure that the work area is well-ventilated before you open any vent or drain valves, remove any plugs, or disassemble the unit.
- Do not open any vent or drain valves or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.

Ground continuity verification

A ground (earth) continuity test must always be performed after service.

Maintenance guidelines

During the maintenance and before reassembly, always remember to perform these tasks:

- Clean all parts thoroughly, particularly O-ring grooves.
- Change all O-rings, gaskets, and seal washers.
- Lubricate all springs, screws, O-rings with grease.

During the reassembly, always make sure that existing index markings are in line.

The reassembled drive unit must always be insulation-tested and the reassembled pump must always be test-run before normal operation.

6.1 Torque values

All screws and nuts must be lubricated to achieve correct tightening torque. Screws that are screwed into stainless steel must have the threads coated with suitable lubricants to prevent seizing.

If there is a question regarding the tightening torques, then contact a sales or authorized service representative.

Screws and nuts

Table 1: Stainless steel, A2 and A4, torque Nm (ft-lbs)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
50	1.0 (0.74)	2.0 (1.5)	3.0 (2.2)	8.0 (5.9)	15 (11)	27 (20)	65 (48)	127 (93.7)	220 (162)	434 (320)
70, 80	2.7 (2)	5.4 (4)	9.0 (6.6)	22 (16)	44 (32)	76 (56)	187 (138)	364 (268)	629 (464)	1240 (915)
100	4.1 (3)	8.1 (6)	14 (10)	34 (25)	66 (49)	115 (84.8)	248 (183)	481 (355)	–	–

Table 2: Steel, torque Nm (ft-lbs)

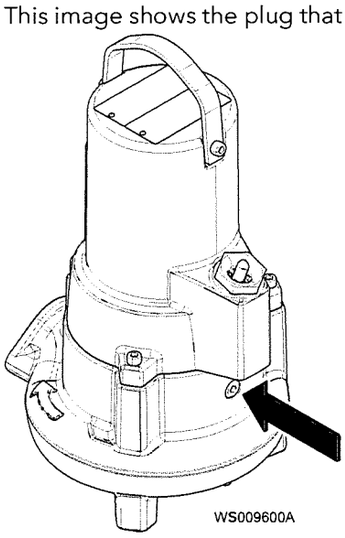
Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
8.8	2.9 (2.1)	5.7 (4.2)	9.8 (7.2)	24 (18)	47 (35)	81(60)	194 (143)	385 (285)	665 (490)	1310 (966.2)
10.9	4.0 (2.9)	8.1 (6)	14 (10)	33 (24)	65 (48)	114 (84)	277 (204)	541 (399)	935 (689)	1840 (1357)
12.9	4.9 (3.6)	9.7 (7.2)	17 (13)	40 (30)	79 (58)	136 (100)	333 (245)	649 (480)	1120 (825.1)	2210 (1630)

Hexagon screws with countersunk heads

For hexagon socket head screws with countersunk head, maximum torque for all property classes must be 80% of the values for property class 8.8 above.

6.2 Change the oil

This image shows the plug that is used to change the oil.

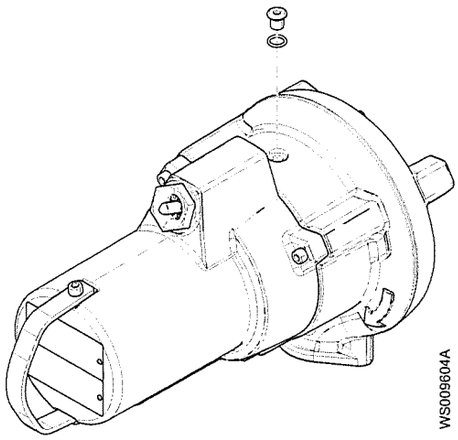


Empty the oil

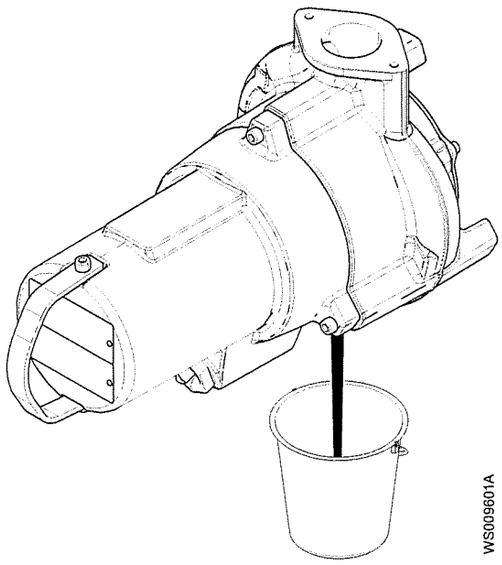
CAUTION: Compressed Gas Hazard

Air inside the chamber may cause parts or liquid to be propelled with force. Be careful when opening. Allow the chamber to de-pressurize before removal of the plug.

1. Put the pump in a horizontal position and unscrew the oil plug.



2. Put a container under the pump and turn the pump.

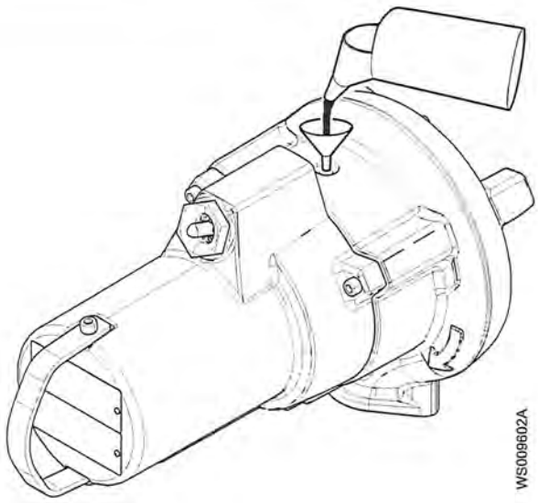


Fill with oil

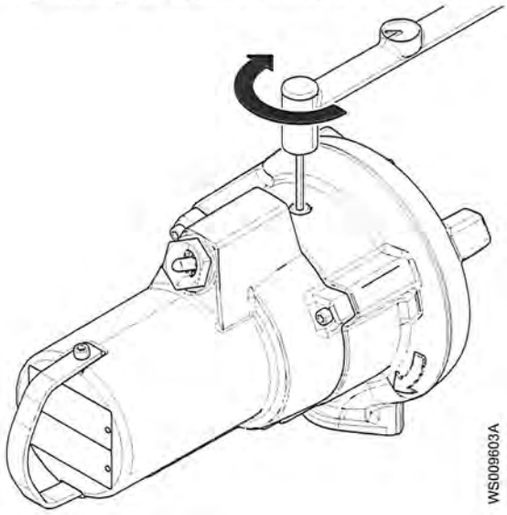
The oil should be a medical white oil of paraffin type that fulfills FDA 172.878 (a) and viscosity close to VG32. Examples of applicable oil types are the following:

- Statoil MedicWay 32™
- BP Enerpar M 004™
- Shell Ondina 927™
- Shell Ondina X430™

1. Replace the O-ring of the oil plug.
2. Fill with oil.
   Quantity: approximately 0.6 L (0.6 quarts).



3. Refit and tighten the oil plug.
   Tightening torque: 10-40 Nm (7.5-29.5 ft-lb).



6.3 Service the pump

Type of maintenance	Purpose	Inspection interval
Initial inspection	A Xylem-authorized personnel checks the pump condition. From the results, the personnel recommends the intervals for the periodical inspection and overhaul for the installation.	Within the first year of operation.
Periodical inspection	The inspection prevents operational interruptions and machine breakdowns. The measures to increase performance and pump efficiency are decided for each application. They can include such things as impeller trimming, wear part control and replacement, control of zinc-anodes and control of the stator.	Up to every year Applies to normal applications and operating conditions at media (liquid) temperatures <40°C (104°F).

Type of maintenance	Purpose	Inspection interval
Overhaul	The overhaul lengthens the operating lifetime of the product. It includes the replacement of key components and the measures that are taken during an inspection.	Up to every three years Applies to normal applications and operating conditions at media (liquid) temperatures <40°C (104°F).

NOTICE:

Shorter intervals may be required when the operating conditions are extreme, for example with very abrasive or corrosive applications or when the liquid temperatures exceed 40°C (104°F).

6.3.1 Inspection

Service item	Action
Cable	1. If the outer jacket is damaged, replace the cable. 2. Check that the cables do not have any sharp bends and are not pinched.
Connection to power	Check that the connections are properly secured.
Electrical cabinets	Check that they are clean and dry.
Impeller	1. Check the clearance. 2. If necessary, adjust.
Stator housing	1. Drain any liquid. 2. Check the resistance of the leakage sensor. Normal value approximately 1500 ohms, alarm approximately 430 ohms.
Insulation	Use a megger maximum 1000 V. 1. Check that the resistance between the ground (earth) and phase lead is more than 5 megohms. 2. Conduct a phase-to-phase resistance check.
Junction box	Check that it is clean and dry.
Lifting device	Check that the local safety regulations are followed.
Lifting handle	1. Check the screws. 2. Check the condition of the lifting handle and the chain. 3. If necessary, replace.
O-rings	1. Replace the O-rings of the oil plugs. 2. Replace the O-rings at the entrance or junction cover. 3. Lubricate the new O-rings.
Overload protection and other protections	Check the correct settings.
Personnel safety devices	Check the guard rails, covers, and other protections.
Rotation direction	Check the impeller rotation.
Oil housing	If necessary, fill with new oil.
Electrical connections	Check that the connections are properly secured.
Thermal contacts	Normally closed circuit; interval 0–1 ohm.
Voltage and amperage	Check the running values.

6.3.2 Overhaul

The basic repair kit includes O-rings, seals, and bearings.

For an overhaul, do the following in addition to the tasks listed under Inspection.

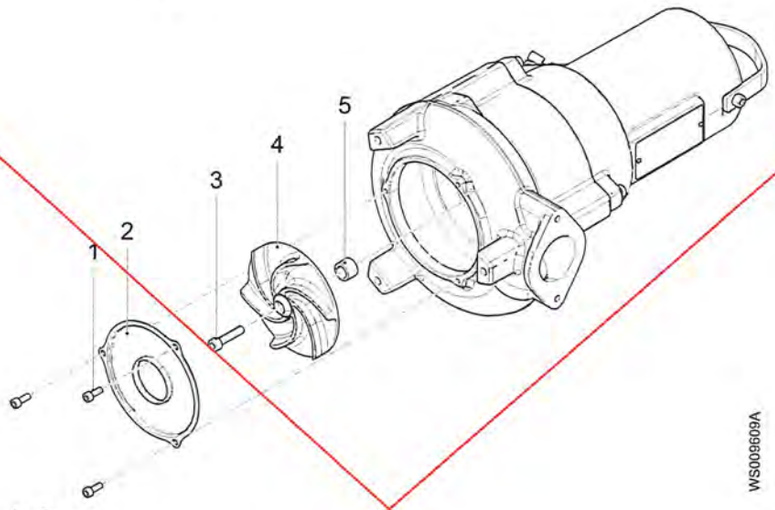
Service item	Action
Support and main bearing	Replace the bearings with new bearings.
Mechanical seal	Replace with new seal units.

6.3.3 Service in case of alarm

For information about indication values for sensors, see *Sensors connection* on page 28 .

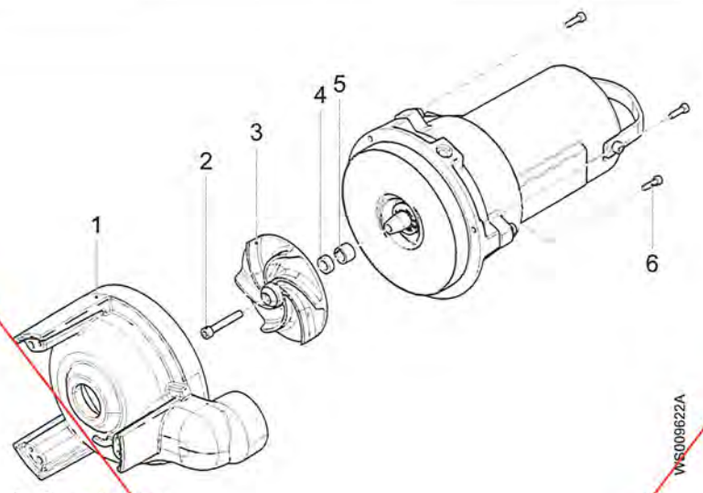
Alarm source	Action
FLS	1. Check for liquid in the stator housing. 2. Drain all liquid, if any. 3. Check the mechanical seal unit, the O-rings, and the cable entry, if liquid was found.
Thermal contact	Check the start and stop levels.
The overload protection	Check that the impeller can rotate freely.

6.4 Replace the D-impeller



1. Screws
2. Suction cover
3. Impeller screw
4. Impeller
5. Sleeve

Figure 4: Standard variant



1. Pump housing
2. Impeller screw
3. Impeller
4. Spacer
5. Sleeve
6. Screws

Figure 5: Abrasive resistant variant

6.4.1 Remove the D-impeller

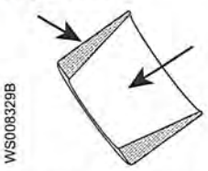
CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

1. Uncover the impeller:
   - For the standard variant, remove the screws and the suction cover.
   - For the abrasive resistant variant, remove the screws and the pump housing.
2. Remove the impeller screw.
   Prevent the impeller from rotating.
3. Remove the impeller:
   - For the standard variant, remove the impeller and the sleeve.
   - For the abrasive resistant variant, remove the impeller, the spacer, and the sleeve.

6.4.2 Install the D-impeller

1. Prepare the shaft:
   a) Polish off any flaws with a fine emery cloth.
   The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic and the outer cylindrical surfaces of the sleeve with a thin layer of grease.

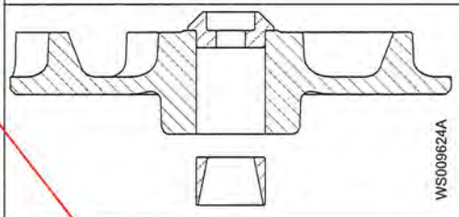
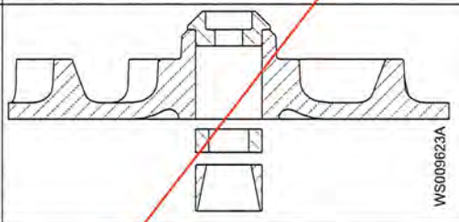


The proper lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

NOTICE:

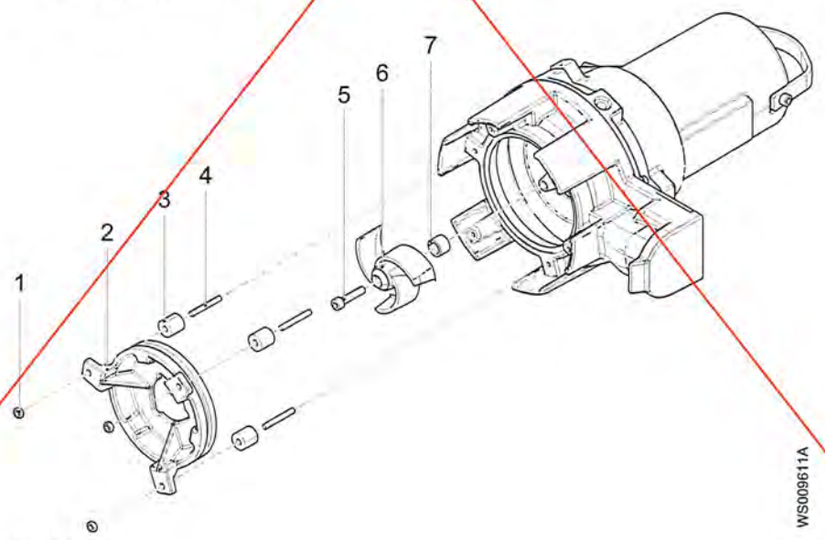
Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.

2. Prepare the impeller:
   - For the standard variant, insert the sleeve into the impeller.
   - For the abrasive resistant variant, insert the spacer and the sleeve into the impeller.

Standard variant	Abrasive resistant variant
	

3. Mount the impeller:
   a) Lubricate the threads of the impeller screw.
      Always use a new screw.
   b) Fit the impeller to the shaft.
   c) Fit the impeller screw to the shaft.
   d) Tighten the impeller screw.
      Prevent the impeller from rotating.
      For tightening torque, see *Torque values* on page 35 .
4. Cover the impeller:
   - For the standard variant, install the suction cover and tighten the screws.
   - For the abrasive resistant variant, install the pump housing. Tighten the screws.

6.5 Replace the F-impeller



1. Nuts
2. Suction cover
3. Seal sleeves
4. Studs
5. Impeller screw
6. Impeller
7. Sleeve

6.5.1 Remove the F-impeller

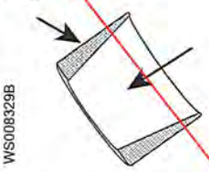
CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

1. Remove the nuts, the suction cover, and the seal sleeves.
2. Remove the impeller screw.
   Prevent the impeller from rotating.
3. Remove the impeller and the sleeve.

6.5.2 Install the F-impeller

1. Prepare the shaft:
   a) Polish off any flaws with a fine emery cloth.
   The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic and the outer cylindrical surfaces of the sleeve with a thin layer of grease.

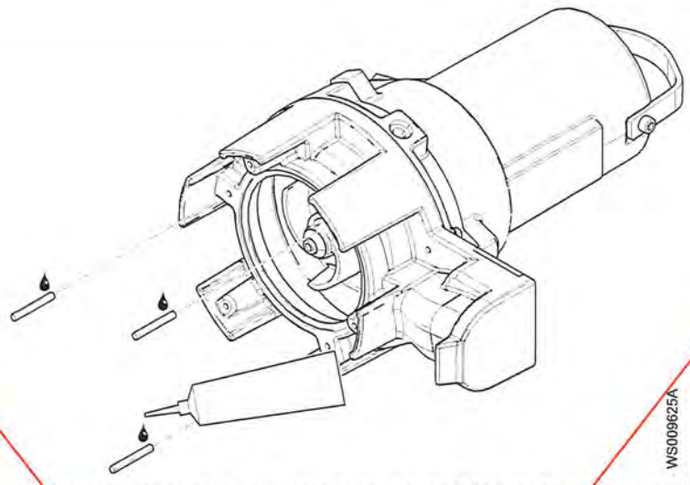


   The proper lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

   NOTICE:

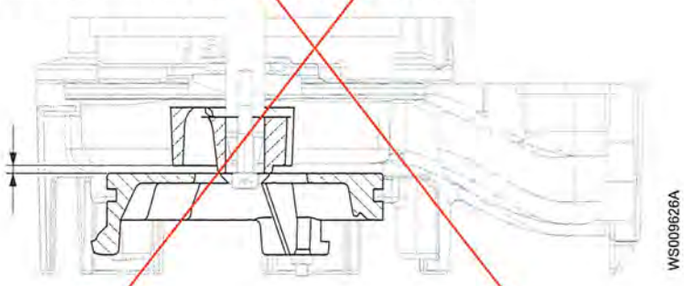
   Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.

2. Mount the impeller:
   a) Insert the sleeve into the impeller.
   b) Lubricate the threads of the impeller screw.
   Always use a new screw.
   c) Fit the impeller to the shaft.
   d) Fit the impeller screw to the shaft.
   e) Tighten the impeller screw.
   Prevent the impeller from rotating.
   For tightening torque, see *Torque values* on page 35 .
3. Install the suction cover:
   a) Fit the studs on the pump housing.
   Use Loctite™ 603 locking liquid to secure the studs.

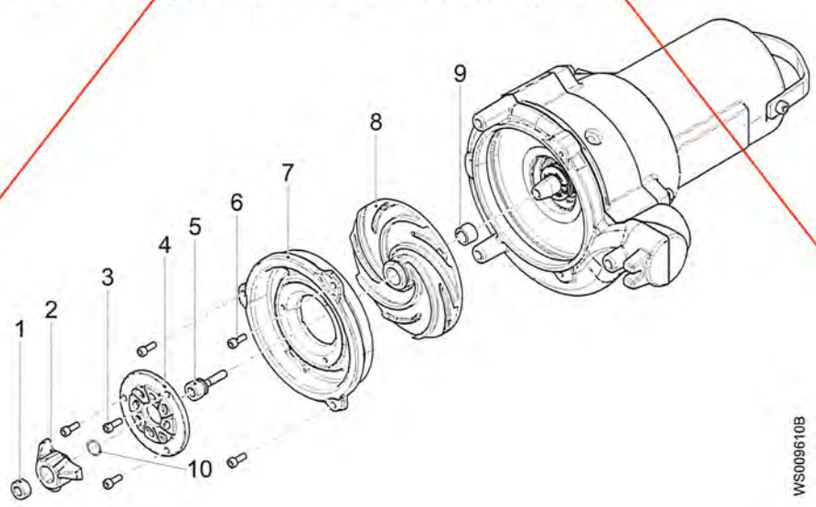


b) Fit the seal sleeves, the suction cover, and the nuts on the studs.
c) Tighten the nuts gradually until the suction cover touches the impeller.
Alternate between the nuts in a circular pattern.

4. Adjust the suction cover:
a) Raise the pump to an upright position.
b) Check that the impeller can rotate freely.
If necessary, then loosen the nuts.
c) Measure the clearance.
Final clearance: 0.2–0.8 mm (0.008–0.03 in)



6.6 Replace the M-impeller and the cutting wheel



1. Set screw
2. Cutting wheel
3. Screws
4. Cutting ring
5. Adjustment screw
6. Screws
7. Suction cover
8. Impeller
9. Sleeve
10. Adjustment washer, plastic shim

6.6.1 Remove the cutting wheel

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

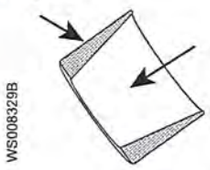
1. Prevent the cutting wheel from rotating, and remove the set screw.
2. Prevent the adjustment screw from rotating, and remove the cutting wheel from the adjustment screw.

6.6.2 Remove the M-impeller

1. Remove the screws and the cutting ring.
2. Remove the screws and the suction cover.
3. Remove the adjustment screw.
4. Remove the impeller and the sleeve.

6.6.3 Install the M-impeller

1. Prepare the shaft:
   a) Polish off any flaws with a fine emery cloth.
      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic and the outer cylindrical surfaces of the sleeve with a thin layer of grease.

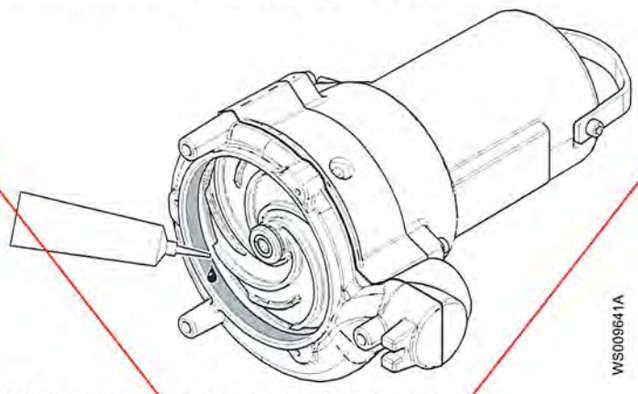


The proper lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

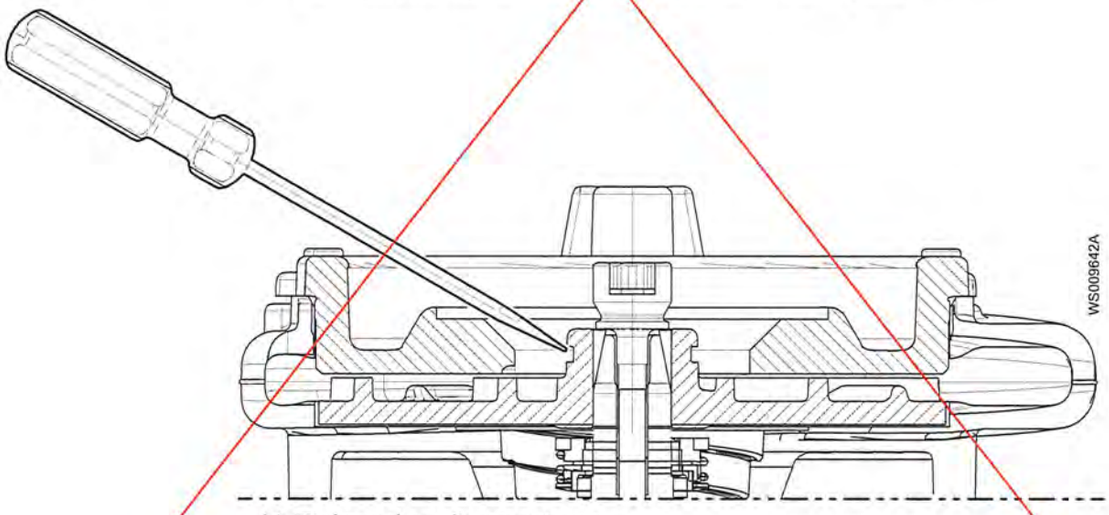
NOTICE:

Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.

2. Mount the impeller:
   a) Insert the sleeve into the impeller.
   b) Fit the impeller to the shaft.
   c) Coat the cylindrical surface of the pump housing with a thin layer of grease.
      The proper lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

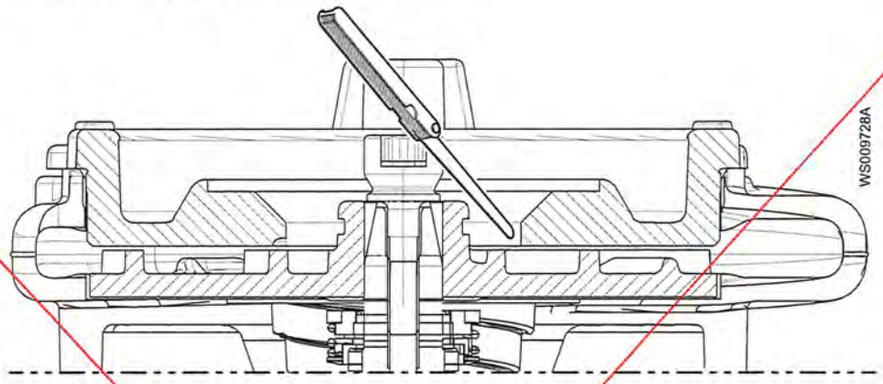


   d) Fit the suction cover and tighten the screws.
   e) Lubricate both threads of the adjustment screw.
      Always use a new screw.
   f) Fit the adjustment screw into the shaft.
      Do not tighten the screw.
   g) Adjust the impeller towards the suction cover until the parts touch.
      Use a screwdriver or similar in the groove of the impeller.



   h) Tighten the adjustment screw.
      Prevent the impeller from rotating.
      Tightening torque: 22 Nm (16 ft-lb)
   i) Tighten the screw a further 1/8 turn (45°).
   j) Check that the impeller can rotate freely.
3. Measure the clearance.

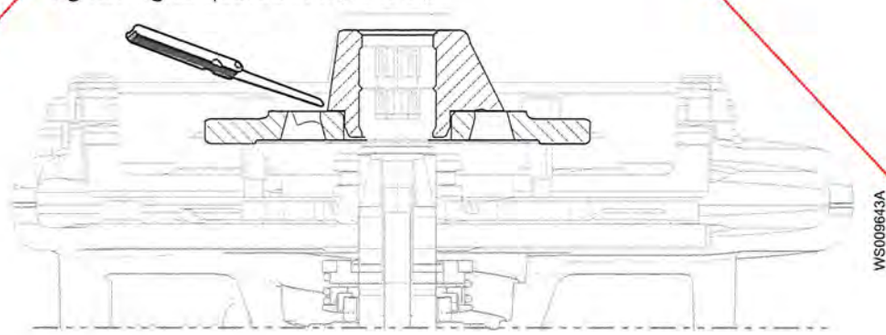
Final clearance: 0.1-0.5 mm (0.004-0.02 in)



4. Fit the cutting ring and tighten the screws.

6.6.4 Install the cutting wheel

1. Fit the plastic shim between the cutting ring and the cutting wheel.
   The 0.19 mm (0.007 in.) thick plastic shim is a spare part: Adjustment washer 811 62 50.
2. Fit the cutting wheel to the adjustment screw until the wheel touches the plastic shim.
3. Fit and tighten the set screw.
   Tightening torque: 55 Nm (41 ft-lb).
4. Make sure that the impeller and cutting wheel can rotate freely.
5. If the cutting wheel does not rotate freely, then adjust it:
   a) Prevent the cutting wheel from rotating, and loosen the set screw.
   b) To increase the clearance, prevent the adjustment screw from rotating and turn the cutting wheel counterclockwise.
   c) Make sure that the impeller and cutting wheel can rotate freely.
   d) Measure the distance between the cutting wheel and the cutting ring.
      Measure for every wing on the cutting wheel. The distance must be less than 0.25 mm (0.010 in) for at least one of the wings.
   e) When the clearance is correct, tighten the set screw.
      Tightening torque: 55 Nm (41 ft-lb).



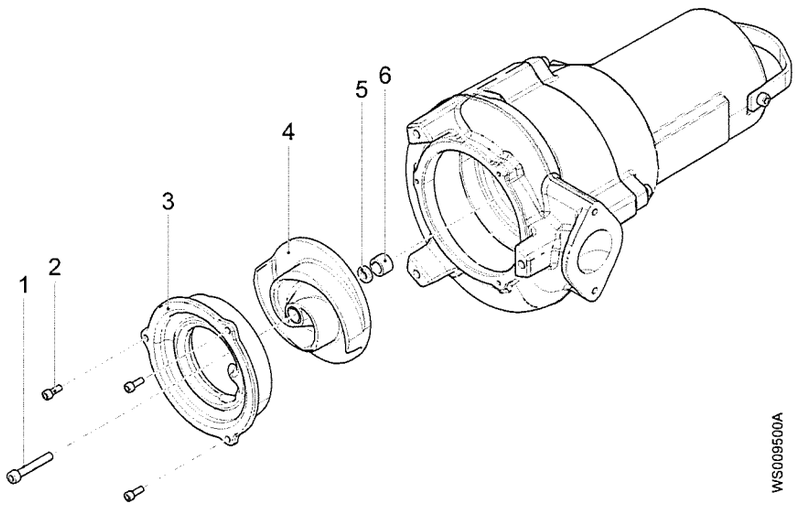
6.7 Replace the N-impeller

CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

NOTICE:

When laying the pump on its side, do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

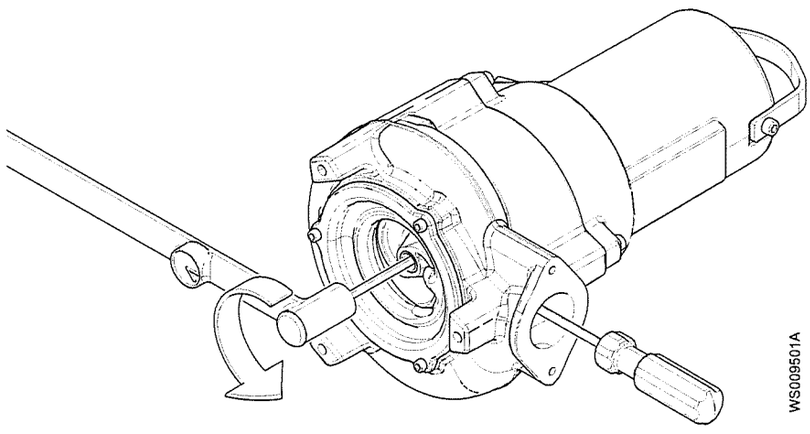


1. Impeller screw
2. Screws
3. Suction cover
4. Impeller
5. Supporting washer
6. Sleeve

6.7.1 Remove the N-impeller

1. Loosen the impeller screw.

   Prevent the impeller from rotating. Insert a screwdriver or similar through the pump housing outlet.



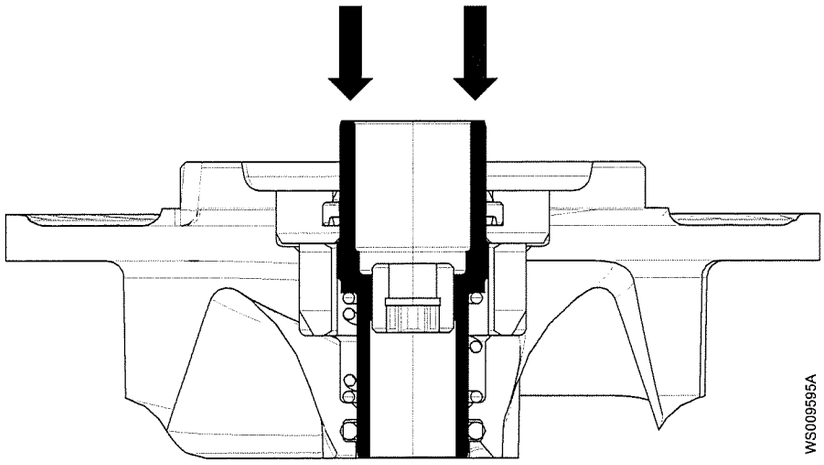
2. Remove and discard the impeller screw.
3. Remove the suction cover.

   If necessary, then pry off the suction cover.
4. Remove the impeller, the supporting washer, and the sleeve.

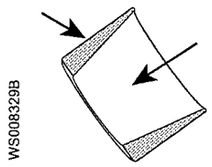
6.7.2 Install the N-impeller

1. Before installation of the impeller, push the sleeve to check that it moves freely up and down.

When the sleeve is released, it must be fully pushed out again. If the sleeve does not move freely, or does not come fully out, then replace the impeller unit.



2. Prepare the shaft:
   a) Polish off any flaws with a fine emery cloth.
      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic and the outer cylindrical surfaces of the sleeve with a thin layer of grease.

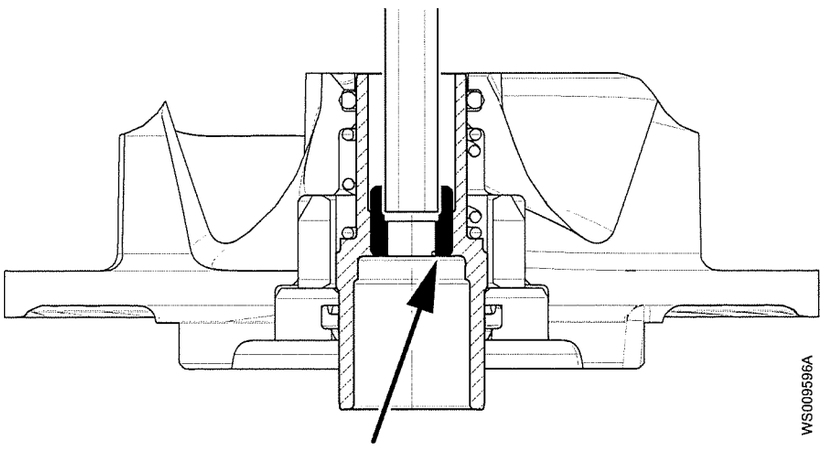


The proper lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

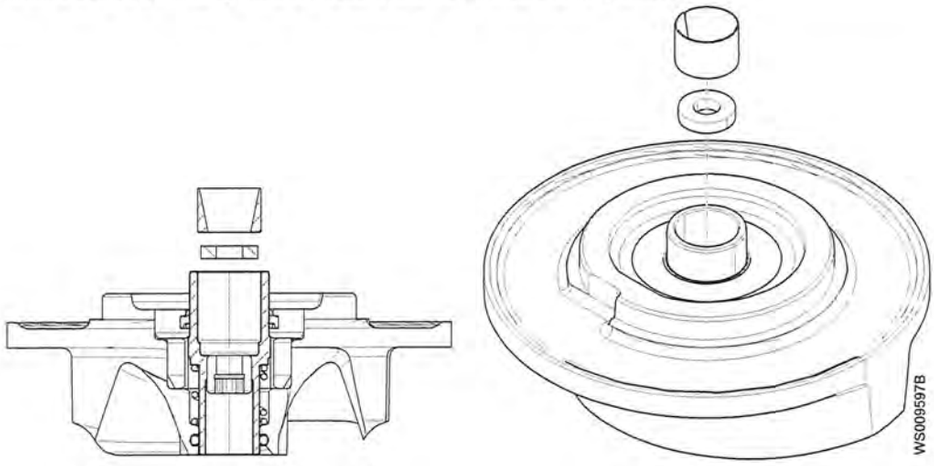
NOTICE:

Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.

3. Mount the impeller:
   a) Lubricate the threads of the impeller screw.
      Always use a new screw.
   b) Adjust the adjustment screw so that it is flush in the sleeve.

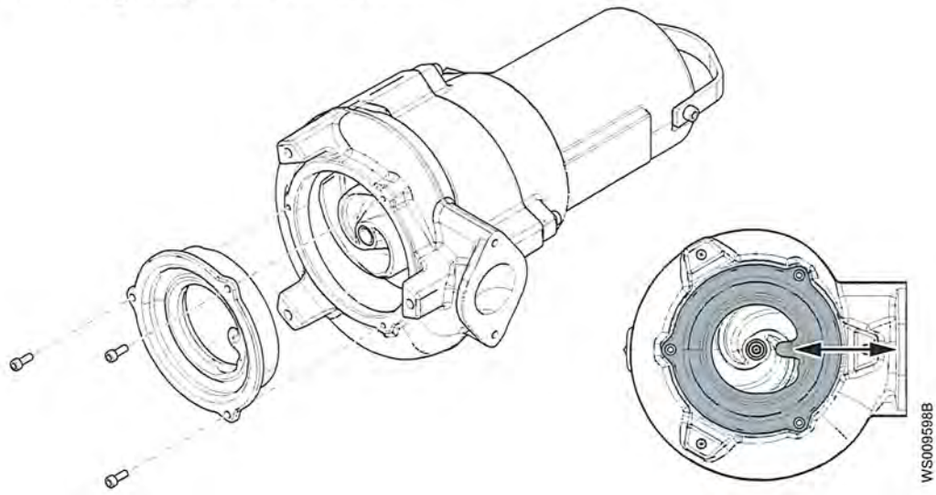


c) Insert the supporting washer and the sleeve into the impeller.



d) Fit the arrangement onto the shaft.

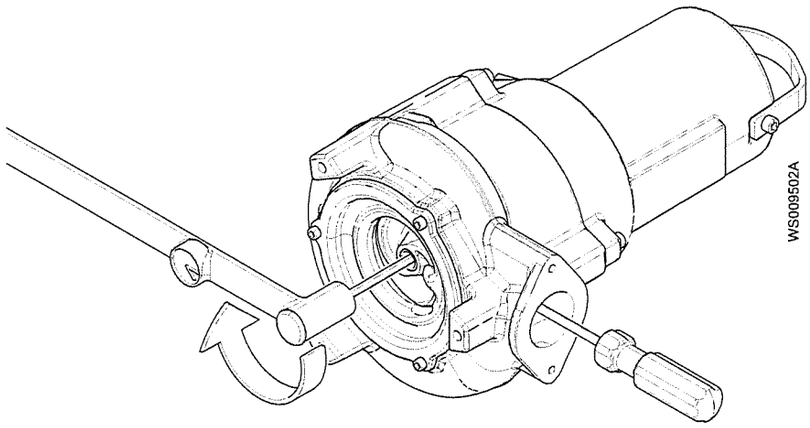
4. Fit the suction cover and tighten the screws.
   Point the guide pin towards the outlet.



5. Check that the impeller can rotate freely.

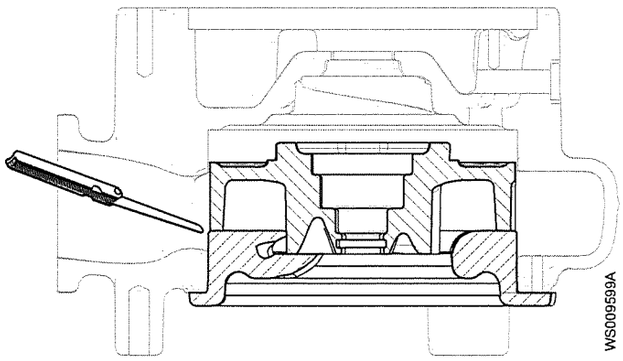
WARNING: Crush Hazard
Beware of the pinch point hazard between the rotating impeller and the guide pin.

6. Adjust the impeller:
   a) Turn the adjustment screw clockwise until the impeller touches the pump housing.
7. Fasten the impeller:
   a) Fit the lubricated impeller screw.
   b) Tighten the impeller screw.
      For tightening torque, see *Torque values* on page 35 .
      Prevent the impeller from rotating. Insert a screwdriver or similar through the pump housing outlet.



c) Tighten the screw a further 1/8 turn (45°).
d) Check that the impeller can rotate freely.
e) Check that the impeller moves freely up and down by pushing on it.
When the sleeve is released, it should be fully pushed out again. If the sleeve does not move freely, or does not come fully out, then replace the impeller unit.

8. Check with a feeler gauge that the impeller clearance is 0.1 - 0.6 mm (0.004-0.02 in).



7 Troubleshooting

Introduction

DANGER: Electrical Hazard

Troubleshooting a live control panel exposes personnel to hazardous voltages. Electrical troubleshooting must be done by a qualified electrician.

Follow these guidelines when troubleshooting:

- Disconnect and lock out the power supply except when conducting checks that require voltage.
- Make sure that no one is near the unit when the power supply is reconnected.
- When troubleshooting electrical equipment, use the following:
  - Universal instrument multimeter
  - Test lamp (continuity tester)
  - Wiring diagram

7.1 The pump does not start

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
An alarm signal has been triggered on the control panel.	Check that: • The impeller rotates freely. • The sensor indicators do not indicate an alarm. • The overload protection is not tripped.
The pump does not start automatically, but can be started manually.	Check that: • The start level regulator is functioning. Clean or replace if necessary. • All connections are intact. • The relay and contactor coils are intact. • The control switch (Man/Auto) makes contact in both positions. Check the control circuit and functions.

Cause	Remedy
The installation is not receiving voltage.	Check that: • The main power switch is on. • There is control voltage to the start equipment. • The fuses are intact. • There is voltage in all phases of the supply line. • All fuses have power and that they are securely fastened to the fuse holders. • The overload protection is not tripped. • The motor cable is not damaged.
The impeller is stuck.	Clean: • The impeller • The sump in order to prevent the impeller from clogging again.

If the problem persists, then contact a sales or authorized service representative.
Always state the serial number of the product, see *Product Description* on page 10 .

7.2 The pump does not stop when a level sensor is used

DANGER: Crush Hazard
Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

Cause	Remedy
The pump is unable to empty the sump to the stop level.	Check that: • There are no leaks from the piping and/or discharge connection. • The impeller is not clogged. • The non-return valve(s) are functioning properly. • The pump has adequate capacity. For information: Contact a sales or authorized service representative.
There is a malfunction in the level-sensing equipment.	• Clean the level regulators. • Check the functioning of the level regulators. • Check the contactor and the control circuit. • Replace all defective items.
The stop level is set too low.	Raise the stop level.

If the problem persists, then contact a sales or authorized service representative.
Always state the serial number of the product, see *Product Description* on page 10 .

7.3 The pump starts-stops-starts in rapid sequence

Cause	Remedy
The pump starts due to back-flow which fills the sump to the start level again.	Check that: • The distance between the start and stop levels is sufficient. • The non-return valve(s) work(s) properly. • The length of the discharge pipe between the pump and the first non-return valve is sufficiently short.
The self-holding function of the contactor malfunctions.	Check: • The contactor connections. • The voltage in the control circuit in relation to the rated voltages on the coil. • The functioning of the stop-level regulator. • Whether the voltage drop in the line at the starting surge causes the contactor's self-holding malfunction.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 10 .

7.4 The pump runs but the motor protection trips

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The motor protection is set too low.	Set the motor protection according to the data plate and if applicable the cable chart.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The drive unit is not receiving full voltage on all three phases.	• Check the fuses. Replace fuses that have tripped. • If the fuses are intact, then notify a certified electrician.
The phase currents vary, or they are too high.	Contact a sales or authorized service representative.

Cause	Remedy
The insulation between the phases and ground in the stator is defective.	1. Use an insulation tester. With a 1000 V DC megger, check that the insulation between the phases and between any phase and ground is > 5 megaohms. 2. If the insulation is less, then do the following: Contact a sales or authorized service representative.
The density of the pumped fluid is too high.	Make sure that the maximum density is 1100 kg/m3 (9.2 lb/US gal) • Change to a more suitable pump • Contact a sales or authorized service representative.
There is a malfunction in the overload protection.	Replace the overload protection.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 10 .

7.5 The pump delivers too little or no water

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The impeller rotates in the wrong direction.	• If it is a 3-phase pump, then transpose two phase leads. • If it is a 1-phase pump, then do the following: Contact a sales or authorized service representative.
One or more of the valves are set in the wrong positions.	• Reset the valves that are set in the wrong position. • Replace the valves, if necessary. • Check that all valves are correctly installed according to media flow. • Check that all valves open correctly.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The pipes are obstructed.	To ensure a free flow, clean out the pipes.
The pipes and joints leak.	Find the leaks and seal them.
There are signs of wear on the impeller, pump, and casing.	Replace the worn parts.

Cause	Remedy
The liquid level is too low.	• Check that the level sensor is set correctly. • Depending on the installation type, add a means for priming the pump, such as a foot valve.

If the problem persists, then contact a sales or authorized service representative.
Always state the serial number of the product, see *Product Description* on page 10 .

8 Technical Reference

8.1 Motor data

Feature	Description
Motor type	Squirrel-cage induction motor
Frequency	50 Hz or 60 Hz
Supply	1-phase or 3-phase
Starting method	• Direct on-line • Star-delta • Soft starter
Maximum starts per hour	15 evenly-spaced starts per hour
Code compliance	IEC 60034-1
Voltage variation without overheating	±10%, if it does not run continuously at full load
Voltage imbalance tolerance	2%
Stator insulation class	F (155°C [311°F])

Motor encapsulation

Motor encapsulation is in accordance with IP68.

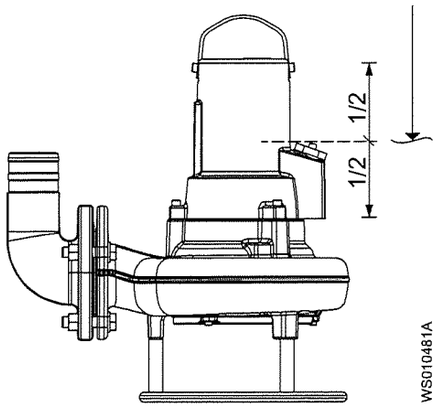
8.2 Application limits

Data	Description
Liquid temperature	Maximum 40°C (104°F) Warm-liquid version: 70°C (158°F) maximum Ex-approved pumps: 40°C (104°F) maximum The pump can be operated at full load only if at least half the stator housing is submerged.
Liquid density	1100 kg/m³ (9.2 lb per US gal) maximum
pH of the pumped media	5.5–14
Depth of immersion	Maximum 20 m (65 ft)
Other	For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump.

8.3 Minimum permitted liquid level

In hazardous areas, this information is critical for the safety of the installation of this product.

This pump can be partly submerged during operation, but it must be submerged to half the drive unit length.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2) a leading global water technology company.

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Visit our Web site for the latest version of this document and more information

The original instruction is in English. All non-English instructions are translations of the original instruction.

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