



Heavy Duty Submersible & Amphibious Pumps specially designed for Hydro Electric Power Stations



Aqua is India's pioneering manufacturer of hermetically sealed (*air filled*) submersible motor pumps & has successfully substituted (& in some case, *bettered the performances of*) many imported pumps. The "HE" (*Hydro Electric*) series of submersible & amphibious pumps are specially designed (*using proven Aqua models as basis*) to perform reliably under the arduous conditions prevalent at Indian Hydro Electric Power Stations (*HEP's*); they :

- Can tolerate higher silt levels
- Can remove settled silt (*ADS HE models*)
- Are portable & compact
- Are flood proof & cavitation resistant
- Can be commissioned quickly & simply
- Require no routine maintenance
- Operate silently & smoothly
- Require no special pump house/civil structures

They are typically used for *drainage, dewatering, cooling water, fire fighting, lubricating & feed water, raw water intake, water harvesting, etc.*



ARS HE

Submersible / Amphibious Raw water pumps

For clear to mildly silty water

Design features

(of ARS HE)

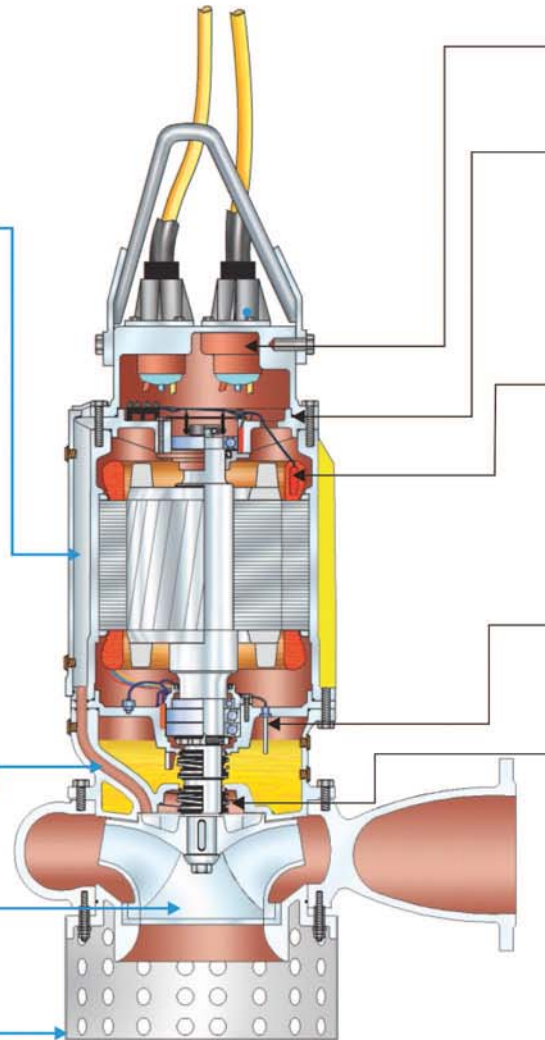
Standard motor cooling is by liquid submergence. However in case of dry pit installations (amphibious) or in case of wet pit installation where the dead water level is desired to be kept low; the ARS HE pumps are equipped with an in built jacket cooling system. Part of the pumped liquid is circulated around the motor (through the jacket shell) thereby cooling it.

Since this system does not use any external pump/coolant or auxillary impeller/coolant; this system is reliable & energy efficient

Integrally cast cooling ducts for cooling water circulation

Multi bladed, enclosed impeller is ideal for raw to mildly turbid water as it has high efficiency

Larger solids (which may foul the impeller), are screened by the strainer



The illustrated ARS HE pump is meant for flooded free suction & hence has a strainer at bell mouth. For dry pit installations (amphibious) it is offered with a flanged suction bell

Design features

(Common to all pumps)

Multi stage cable gland is non wicking - it prevents water seepage (through capillary action) even in case of protective sheath puncture

Spigot joints have long leakage paths & use high quality temperature resistant elastomers to ensure hermetic sealing

Motors are class "H" insulated (max temp 185°C) & have high service factors to withstand upto 20 starts per hour (depending on model & rating)

Bimetallic temperature sensors are embedded in each phase of winding to switch off the motor in case of winding overheating

Super premium, high temperature synthetic grease lasts as long as the oversized bearings thereby delivering a long maintenance free life

Moisture ingress into the motor occurs typically through the pump shaft - this is detected by the inbuilt moisture sensor

Stuffing box design has specially engineered groove which centrifugally expels silt away from the mechanical seal faces thereby reducing erosive wear

Shaft is sealed from the pump by two separate mechanical seals. The primary seal has Silicon Carbide faces for enhance wear resistance to silt. Being bidirectional they can withstand reverse rotation without leakage

Impeller securing is fool-proofed against vibration & reverse rotation

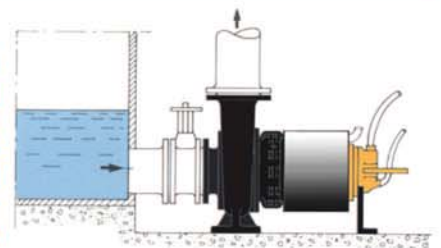
No support bush/ring in contact with the pumped liquid; hence erosive wear (due to silt in water) does not jeopardize the pump reliability

Dry pit installation of ARS HE



High efficiency ARS HE pumps installed in dry pit (amphibious mode) are an ideal replacement for centrifugal pumps using existing pipelines. Flooding (due to gland/valve leakage or seepage) does not jeopardize their operation since the motor is flood proof & operates equally well in wet to dry conditions.

As compared to centrifugal pumps, ARS HE require no routine maintenance (no gland tightening, no oiling / greasing). In case of breakdown maintenance; the back pull out design enables impeller (along with motor shaft) to be pulled out without disturbing the pipeline



ASS HE

Non Clog Submersible Slurry pumps

For pumping of heavily silt laden water

ADS HE

Non Clog Submersible Dredging pumps

For removal of settled silt & prevention of silt sedimentation

- Can start up under severe silt sedimentation thanks to high torque motors
- Withstands high silt levels without undue erosive wear & drop of discharge pressure

Design features

(Common to ASS HE & ADS HE)

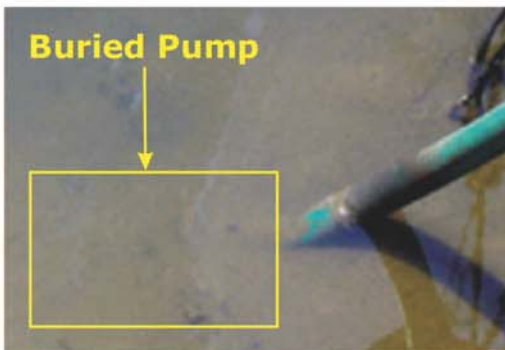
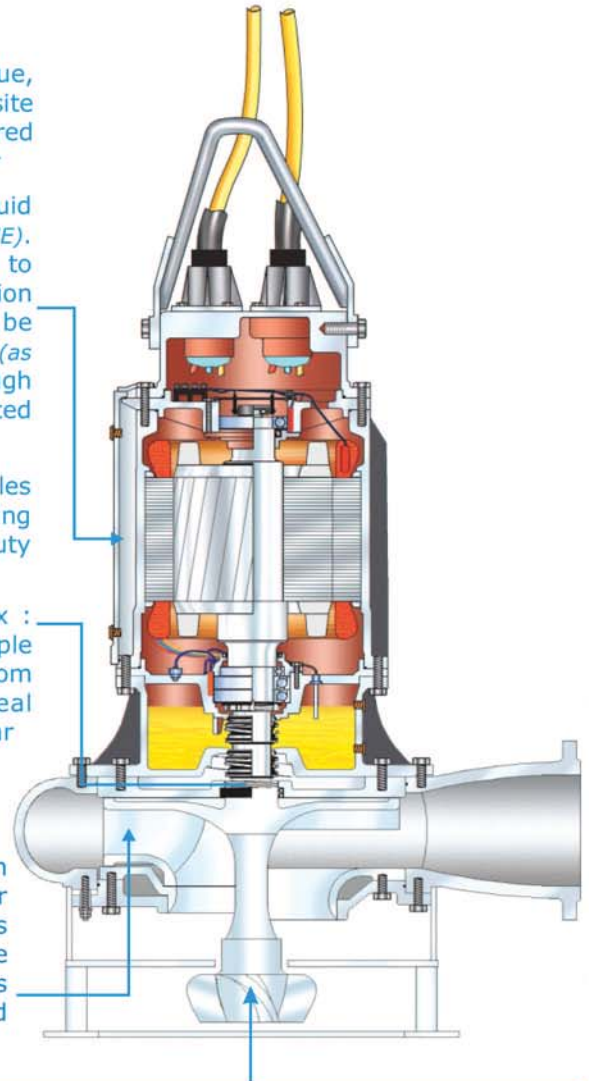
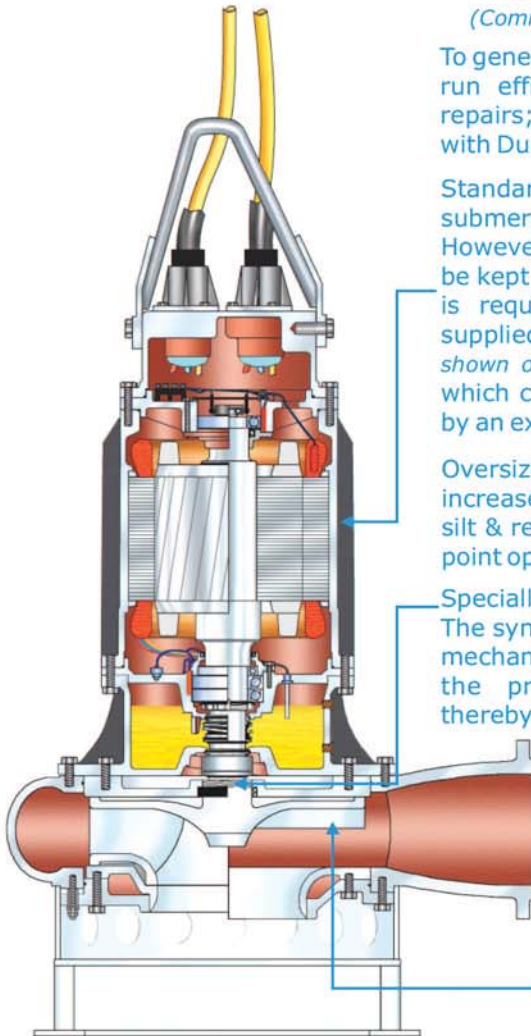
To generate higher starting torque, run efficiently & enable on site repairs; larger motors are offered with Dual Cage Copper Bar rotor

Standard motor cooling is by liquid submergence (as shown on ASS HE). However, if dead water level is to be kept low or a dry pit installation is required; the motor can be supplied with a cooling jacket (as shown on ADS HE - right) through which cooling water is circulated by an external pump

Oversized shaft safely handles increased torque when handling silt & resists deflection at off duty point operation

Specially designed stuffing box : The synergistic actions of multiple mechanisms keep silt away from the primary mechanical seal thereby reducing its erosive wear

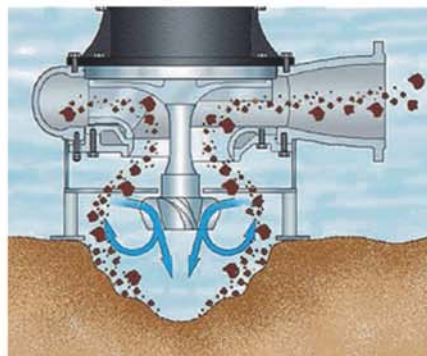
Wear resistant & non clogging impeller handles silt/solids without undue erosive wear/clogging. Options of Vortex or Enclosed designs.



Buried Pump

A drainage pump (installed at leakage sump bottom) is buried under silt after long period of inactivity - only the delivery hose & supply cables remain visible. ASS HE & ADS HE pumps have high torque motors to allow start up under such adverse conditions

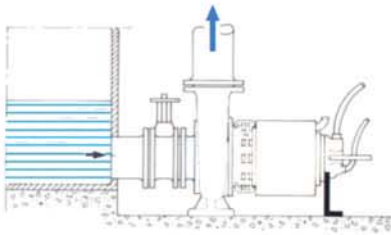
Operational principle of ADS HE pumps



Close up view of agitator

ADS HE pumps have an inbuilt agitator (at the bottom of the pump's suction). It force fully churns up sedimented silt; which is then sucked up by the impeller & finally pumped away

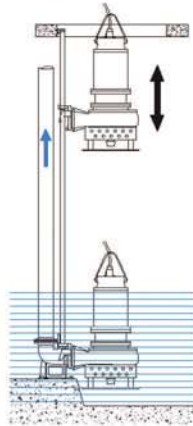
Installation modes



Dry Pit installation
(for ARS HE pumps only)

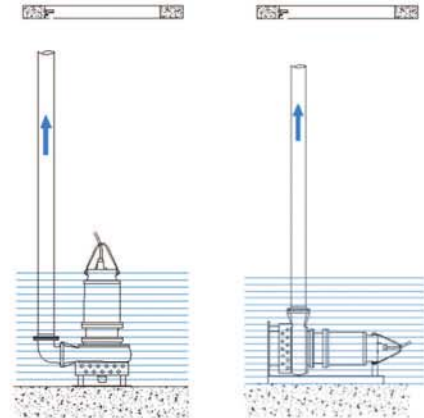
ARS HE pumps are equipped with an *amphibious* motor - i.e. it can operate equally satisfactorily either in dry or submerged conditions. These pumps are a *flood proof* option to replace centrifugal pumps using existing pipelines in dry pits

(refer page 2)



Permanent Installation in Sumps

Aqua's Auto Coupling System enables coupling / decoupling the pump from the piping system by simply lowering/pulling the pump ! Ideal for wet pit arrangement as there is no need to enter into the sump at all!



Temporary Installation in Sumps

Pump is bolted to delivery piping & simply lowered into the wet pit. It can be run either vertically or horizontally! Ideal for flooded pits / emergencies

Typical applications

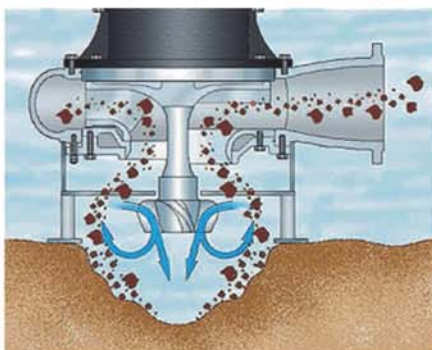
Drainage & Dewatering

Seepage, turbine gland leakage, etc are leakage sources into machine rooms / galleries which must be continuously & reliably drained by drainage pumps. Dewatering pumps are used for planned maintenance works / inspection or in emergency flooding situations. They have to perform with utmost reliability under arduous conditions , they :

- experience long periods of inactivity which may cause galling/seizure or in worst case burial under silt
- operate against wide water level variations corresponding to wide pump discharge head variation – this leads to increased vibrations & thrusts



Water sample from bottom of Shaft gallery drainage sump



ADS HE pumps actually remove settled silt thereby restoring sump's volumetric capacity

(refer page 3)

These pumps are typically located at the bottom of leakage sumps where they may be buried under settled silt, which :

- severely erodes pumps reducing their discharge pressure to a point where they may shut off against static gravitational head
- may lead to breakdown of pump bearings (if they are water lubricated)
- may hamper the ability of motor to start up the pump (as it is buried under silt & not water)

Aqua's pumps have steep natured performance curves which enable them to be used with wide head variations, have reinforced shaft, bearings & anti vibration fastening methods. As the bearings are located deep inside the hermetically sealed motor the pump is essentially non galling / non seizing.

ASS HE pumps are ideal for drainage & dewatering applications. They are portable & compact & of great use in narrow spaces – e.g. galleries. They can be commissioned quickly & are of excellent use in emergency dewatering duties.

ADS HE pumps are the ideal solution for drainage if silt content is high. They have an inbuilt agitator which pumps out settled silt thereby restoring the sump's volumetric capacity. Used regularly they obviate the need for secondary manual silt removal (refer page 3)

The use of Aqua's auto coupling system (refer top) permits quick & simple replacement of any pump thereby ensuring minimal pumping downtime

Typical applications

Cooling water

Turbine & generator bearings are generally cooled & lubricated by oil which in turn is cooled by water through heat exchanger. Shaft seals, generator windings, brakes, HVAC condensers, etc are also cooled by water. This can be either through open or closed loop cooling system wherein either raw or cleaned water is utilized. Cooling water pumps work round the clock & hence should be of high efficiency & require minimum maintenance.

ASS HE pumps are ideal for silt laden water as they sustain their efficiency over a longer period of time (*due to wider internal clearances & improved abrasion resistance*).

ARS HE are perfect for clear water, they can be installed either in wet pit (*replacing vertical turbines*) or into the dry pit (*amphibious installation-replacing centrifugal pumps - refer pages 2 & 4*). They require zero routine maintenance & lesser spares (*no gland leakages to drain, no line shafts to maintain*).



Fire fighting

Water is pumped upto an overhead tank from where it gravity feeds the fire fighting system. These pumps are left idle for extended periods yet should start up at a moment's notice & hence should be of non galling / non seizing type. Aqua's submersible pumps require no civil superstructure & start up immediately even after extended idle periods

Feed & Lubricating water

Clean water can be used to lubricate & cool the turbine shaft seals or pressure feed the labyrinth type shaft seals. ARS HE pumps do the job efficiently & require no routine maintenance.

Raw water intake & Water harvesting

Aqua's submersible pumps are ideal for raw water intakes as they require no special civil structures, are flood proof & are cavitation free (*being located below the minimum water level*). They are silt resistant, non clogging (*ASS HE & ADS HE*) & require no routine operational maintenance. HEP's on non perennial rivers (*especially those with many surrounding yet non - linked water bodies*) can benefit from water harvesting - water from these reservoirs (*which do not feed the turbine*) is pumped to the main reservoir from where it shall feed the turbine thereby resulting in power generation. Aqua's submersible pumps are quick & easy to install & hence can be shifted between multiple sites thereby increasing the returns on their capital cost.



Aqua's pumps (270hp) harvest 6000 m³/hr of rain water for a pumped storage scheme

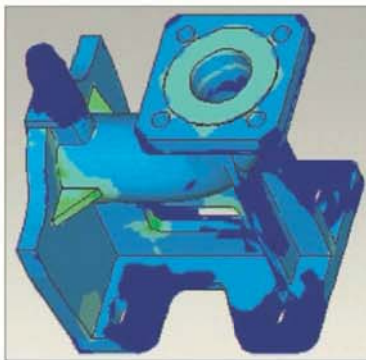
Construction

During construction stages ASS HE & ADS HE pumps are useful for dewatering & ballast removal (*from caissons, etc.*)

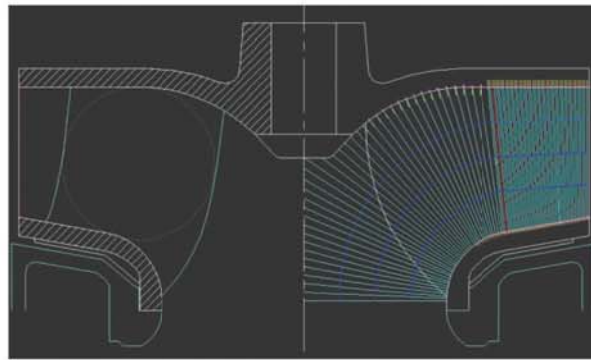
Standard Production Range			
	ARS HE (for clear to mildly silty water)	ASS HE (for silty water)	ADS HE (for desilting)
Pump Discharge Size	DN 65 to 500 mm	DN 100 to 350 mm	DN 65 to 250 mm
Flow rates	upto 4000 m3/hr	upto 2200 m3/hr	upto 1200 m3/hr
Heads	upto 125 m	upto 100 m	upto 95 m
Motor ratings	upto 373 kW	upto 335 kW	upto 315 kW
Typical (MoC) Materials of Construction			
Pump casing	Ductile Cast Iron or Cast Steel	Cast Steel or Chrome Alloyed White Iron	
Impeller	Stainless Steel or Bronze	Hardened Stainless Steel or Chrome Alloyed White Iron	
Seal isolation & suction plate	-		
Agitator			
Motor casing	Cast Iron		
Shaft	Stainless Steel or Chrome Plated Carbon Steel		
Mechanical Seal (primary)	Silicon Carbide v/s Silicon Carbide faces		

R&D

Aqua has comprehensive R&D facilities enabling it to develop pumps as per customer's exact requirements within a short time - we have designed (*from scratch*), manufactured & successfully commissioned submersible pumps for water intake (*270hp x 6nos*) for a leading power generating company in a record time of 6weeks. Our computer aided impeller design software considerably shortens design times while inhouse pattern shop ensures timely transition of designs to patterns. We also make extensive use of Finite Element Analysis (*FEA*) to improve product robustness.



FEA of pump auto coupling system - stress analysis



Computer Aided Design of an impeller



Pattern development of an impeller

Quality to the core

Pumps in HEP applications are required to perform above the industrial standards (*high reliability & low maintenance*) - hence instead of using industrial standard (*off the shelf*) motors, Aqua makes its own motors. We use dual coated winding wires, class "H" insulating materials & design them for higher starting torques & ample reserve margins. They are epoxy resin impregnated under vacuum to eliminate any residual air pockets.

All motors are tested on sophisticated oscillographic tester for winding insulation integrity (*fig A*). Making our own motors makes it possible for us to fine tune their output characteristics to the pump's exact input requirements thereby ensuring smooth performance at site. Hermetic sealing of motors is a critical aspect of our QA & each motor has to pass through multiple tests to



Fig A

Due to constant R&D we reserve the right to change any specifications without prior notice