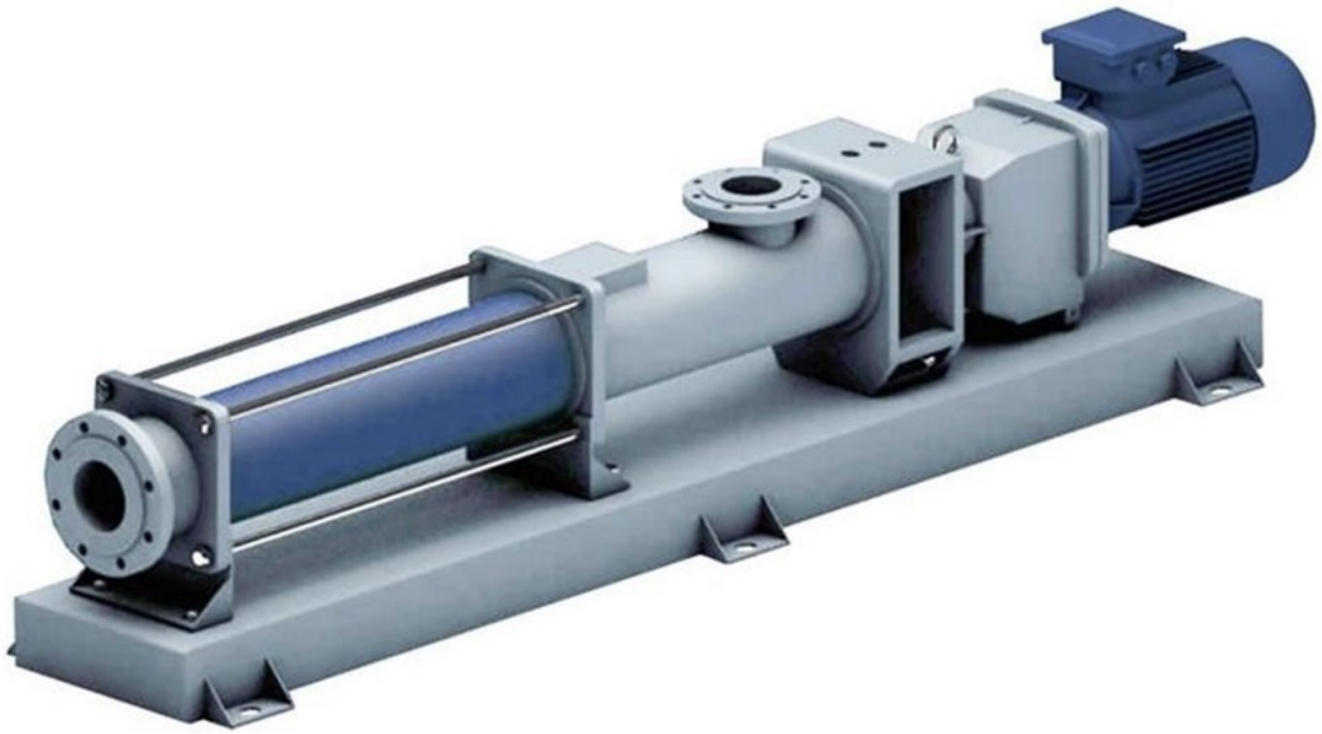
NOVA PETROLEUM
SERVICES

MULTIPHASE SURFACE

Progressive Cavity Pump Systems

Complete design and supply of multiphase PCP systems for onshore and offshore oil and gas production — engineered for high GVF, viscous, and abrasive service.



CATALOGUE OVERVIEW

Surface PCP systems

An application-led guide to multiphase progressive cavity pump packages, equipment options and the information needed for selection.

NOVA Petroleum Services supports the definition and supply of surface pumping packages for oil, water, gas and solids-bearing streams. This catalogue connects the pump with its drive, materials, auxiliary systems and process interfaces, so the enquiry starts with the complete duty.

Explore the catalogue	Pages
Applications and pumping principle	03-04
Package components and duty definition	05-06
Gas fraction and thermal management	07-08
Elastomers, metallurgy and solids	09-10
Seals and drive selection	11-12
Protection, controls and performance review	13-14
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Operations and service planning	17
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How to use this catalogue

Use the illustrations and selection guidance to frame an enquiry. Model ratings, materials, permitted gas fraction, control settings and performance guarantees are established for the specified application. Images show representative equipment; the agreed quotation and project documents define the supplied package.

WHERE SURFACE PCPS FIT

Applications and production context

Start with the process objective, the incoming stream and the facilities that the package must connect.

Wellstream boosting

A surface PCP can be evaluated for moving a low-pressure wellstream into a gathering system. Assess how suction pressure, gas breakout and downstream backpressure change across the production cycle.

Viscous oil and emulsions

Low-speed positive-displacement pumping can suit viscous service. Pump selection must account for inlet filling, starting torque, temperature and changes in viscosity; an emulsion cannot be represented by API gravity alone.

Solids-bearing production

Abrasive solids affect rotor coatings, stator wear and the preferred speed. Specify particle size and loading as well as concentration, including short periods of sand production.

Brownfield integration

For an existing facility, define the pressure limits, utilities, tie-in points, space and shutdown constraints. Package integration and maintainability are part of the equipment selection.

Compare the complete process arrangement

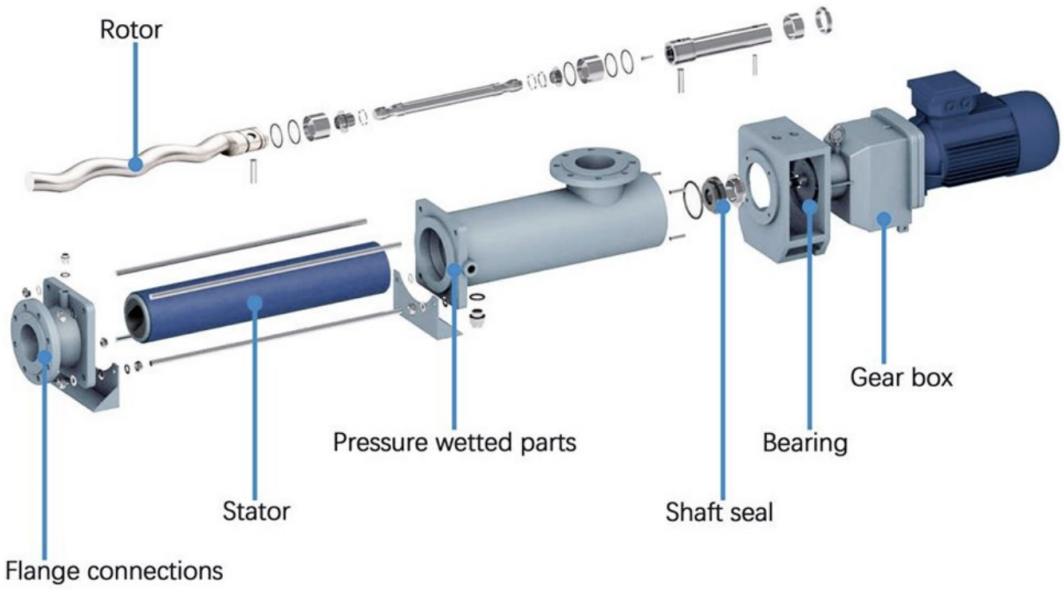
Option	Questions that guide the comparison
Multiphase surface PCP	Can the selected unit handle the complete inlet gas/liquid envelope while maintaining lubrication and thermal control?
Liquid pump after separation	What vessels, gas handling and controls are needed upstream of the liquid pump?
Other multiphase technologies	How do gas fraction, viscosity, solids, turndown and lifecycle cost affect the suitable technology?

Surface PCP packages are distinct from downhole PCP systems. This catalogue covers surface installations.

OPERATING PRINCIPLE

How a PCP moves the stream

A rotor turns eccentrically within a matched stator, creating cavities that progress from suction to discharge.



Representative PCP assembly from NOVA product materials. Geometry and component arrangement vary by model.

Displacement and speed

For a selected geometry, theoretical volumetric flow is proportional to rotational speed. Actual delivered flow also depends on slip, pressure, fluid properties, cavity filling and wear.

Pressure and temperature

Pressure capability depends on geometry, stages, materials and the duty. Gas compression and rotor/stator friction add thermal demands that must be checked alongside hydraulic requirements.

A matched working pair

The rotor and stator are selected together. Interference, elastomer response and rotor finish influence sealing, friction and service life. More interference, more speed or more stages is not automatically the best answer for every stream.

Technical basis: rotor/stator and displacement principles [T1, T2]. References on page 20.

EQUIPMENT AND SCOPE

A coordinated pump package

Define the pump, the drive and the supporting systems as one package with clear supply boundaries.

Element	Role in the package	Selection focus
Pump wet end	Rotor, stator, suction and discharge housings	Total inlet volume, pressure, viscosity, solids and temperature
Drive train	Motor, gearbox, coupling and guard	Starting/running torque, speed range, duty and area classification
Shaft sealing	Seal assembly and supporting auxiliaries	Pressure, temperature, gas, solids and leakage requirements
Base and piping	Skid, connections, valves, drains and supports	Nozzle loads, layout, lifting, access and relief arrangement
Instrumentation	Pressure, temperature and selected flow/load measurements	Monitoring coverage, hazardous-area suitability and maintainability
Electrical and controls	VFD, panel, junction boxes and interfaces	Utilities, protection, local operation and remote integration
Liquid management	Injection or recycle facilities where required	Compatible liquid source, flow assurance, cooling and interlocks

Scope to agree before purchase

Identify which party supplies external piping, power distribution, field cabling, foundations, control-system integration and utilities. State whether the package is skid-mounted, enclosed or containerised, and whether commissioning assistance, operating spares and specialist tools are included.

> **One set of coordinated documents**
>
> Align the equipment list, process flow diagram, P&ID, general arrangement, datasheets and control narrative. The quoted configuration should be traceable through each document.

APPLICATION ENGINEERING

Define the operating envelope

Record minimum, normal, maximum and transient conditions. A single design point is not enough for multiphase service.

Data to provide	Include the basis	Why it matters
Flow rates	Oil, water and free gas; actual or standard conditions	Determines total volume at the pump inlet
Pressures	Suction and discharge; gauge/absolute; transients	Sets differential pressure and gas behaviour
Temperatures	Normal, cold start, maximum and ambient range	Affects viscosity, elastomers and thermal balance
Fluid properties	Viscosity versus temperature, density, water cut and composition	Supports inlet, power and compatibility review
Gas description	Composition, GOR, PVT data and actual inlet GVF	Supports gas-volume and compression assessment
Solids and chemistry	Particle size/loading, H2S, CO2, chlorides and treatment chemicals	Guides wear, corrosion and material selection
Operating pattern	Start/stop, turndown, slugging, cleaning and future decline	Defines controls and credible off-design cases

Capacity limits belong to the selected model

A catalogue-wide maximum cannot be applied simultaneously to flow, pressure, temperature, viscosity, gas fraction and solids. Request the allowable envelope and guaranteed duty points for the offered pump, with the fluid basis and exclusions stated.

Use the structured enquiry sheets on pages 18-19 to gather the required information.

MULTIPHASE FLOW

Gas fraction changes pump sizing

Use gas and liquid volumes at the same pressure and temperature when calculating the gas volume fraction at the pump suction.

Inlet-volume relationships

GVF = Qgas / (Qgas + Qliquid)
Qtotal = Qliquid / (1 - GVF)

All rates in these expressions are actual volumetric rates at the same inlet conditions. Use GVF as a fraction, for example 0.70 for 70%.

Illustration: 20 m3/h of liquid at the inlet

Inlet GVF	Liquid rate	Gas rate	Total inlet rate
30%	20.0 m3/h	8.6 m3/h	28.6 m3/h
50%	20.0 m3/h	20.0 m3/h	40.0 m3/h
70%	20.0 m3/h	46.7 m3/h	66.7 m3/h
90%	20.0 m3/h	180.0 m3/h	200.0 m3/h

The examples show inlet-volume arithmetic only. They are not guaranteed PCP operating points. At the same liquid rate, increasing GVF can substantially increase the volume that must enter the pump, while also changing compression, lubrication and heat generation.

GOR is not the suction GVF

A standard-condition gas-oil ratio cannot be used directly as an inlet gas fraction. Establish free gas after any upstream separation and flashing, then convert it to actual suction conditions using appropriate PVT data. State the standard-condition basis, gas compressibility and absolute pressure used.

Arithmetic illustration, not a performance curve or a claim of continuous operation at 90% GVF.

HIGH GAS FRACTION SERVICE

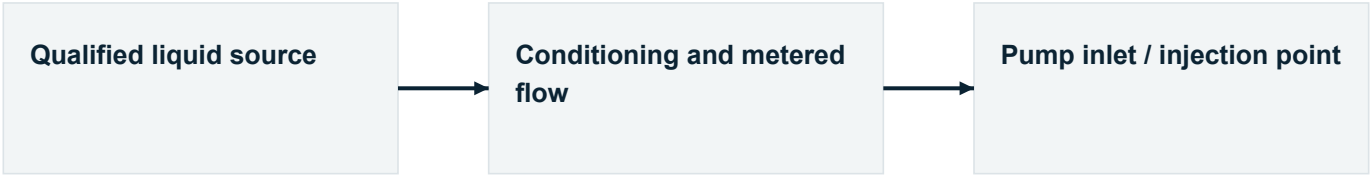
Liquid availability and thermal control

The rotor/stator interface needs a suitable operating environment. Evaluate lubrication and heat removal over the entire duty cycle.

Gas compression, friction and low liquid availability can raise stator temperature. Temperature at a process nozzle alone may not reveal the hottest part of the stator. Define appropriate sensing, allowable exposure and protective responses with the pump supplier.

Design question	Information to establish
Is natural liquid flow sufficient?	Minimum liquid fraction, intermittent gas periods and the duration of credible gas slugs
Is auxiliary liquid required?	Compatible liquid source; required flow, temperature, cleanliness and pressure
Can heat accumulate?	Duty-dependent heat balance, maximum stator temperature and limits on recirculation
What happens on loss of liquid?	Run permissives, low-flow detection, temperature response and trip/reset requirements

Auxiliary-liquid concept



A defined liquid supply can be arranged where the application requires it. Recycle from discharge is one possible concept, but recirculated hot liquid does not automatically provide cooling. Confirm the flow path, heat rejection, chemical compatibility and control logic for the selected package.

Concept illustration only; not a construction or operating schematic. Dry-run protection context [T3].

ELASTOMERS AND COMPATIBILITY

Select the stator compound

Choose an actual qualified compound and interference fit, not simply a generic rubber family.

Candidate family	Typical selection discussion	Confirm for the actual compound
NBR	Oil-service applications where the fluid and temperature are compatible	Aromatic content, additives, swelling, hardness change and abrasion response
HNBR	Oil service requiring consideration of thermal, mechanical or chemical durability	Fluid exposure, gas decompression behaviour, temperature and fit
FKM	Selected aggressive-fluid or elevated-temperature applications	Chemical limitations, low-temperature behaviour and dynamic performance
Other formulations	Specialist duties supported by the pump supplier	Full fluid compatibility and mechanical qualification; do not substitute by family name alone

Fluid testing informs the selection

- Provide representative oil, water, treatment chemicals and cleaning fluids, including anticipated changes in composition.
- Agree test temperature, exposure time and acceptance criteria for swelling, hardness and other relevant changes.
- Include pressure cycling and gas decompression concerns where relevant; confirm that the test represents the intended service.
- Coordinate the compound with rotor dimensions, coating, fit and operating speed.

> **Temperature ratings are compound-specific**
>
> A generic material-family temperature limit is not a pump operating guarantee. Allow for the actual fluid environment, stator heat generation, pressure cycling and the supplier's qualified service limits.

MATERIALS SELECTION

Metallurgy, corrosion and solids

Review chemical attack, cracking, erosion and mechanical loading together. No single fluid concentration determines the full material specification.

H2S and CO2 service

Assess the complete aqueous and gas environment, temperature and operating pressure. For sour service, the applicable ISO 15156 / NACE MR0175 requirements address resistance to specified cracking mechanisms in metallic materials.

Abrasive duty

Specify solids concentration, particle-size distribution, hardness and whether loading is continuous or intermittent. Rotor/stator wear and inlet filling must be reviewed at the proposed speed and pressure.

Component	Material or design review
Pressure-containing parts	Alloy grade, strength, corrosion allowance, environmental limits and pressure-temperature rating
Rotor and shaft	Mechanical strength, corrosion resistance, surface finish, coating adhesion and wear allowance
Elastomers and seals	Compatibility with the whole fluid mixture, temperature and decompression exposure
Piping and fasteners	Compatible metallurgy, corrosion management, joining procedures and external exposure

Avoid shortcuts in sour-service selection

Do not select an alloy from H2S ppm alone. Service assessment can require H2S partial pressure or fugacity, pH, temperature, chlorides and the material condition. Sour-service cracking resistance does not by itself establish resistance to every corrosion mechanism.

Metallic-material scope and environmental assessment: ISO 15156 [T6].

CONTAINMENT AND RELIABILITY

Seals and auxiliary systems

The mechanical seal and its support system are selected for the fluid at the seal, including gas, solids and transient conditions.

Arrangement to evaluate	Selection considerations
Single mechanical seal	Suitability for the process fluid, leakage requirements, lubrication, cooling and contamination
Dual seal arrangement	Barrier or buffer system requirements, pressure control, monitoring and utility availability
Flushing or cooling	Compatible fluid, pressure/temperature balance, consumption, fouling and return/disposal route
Seal support monitoring	Parameters appropriate to the selected arrangement, with alarm/trip actions agreed in the cause-and-effect schedule

Specify the seal environment

- Provide suction and seal-chamber conditions across the duty, together with fluid composition and solids information.
- Define acceptable leakage and emissions performance, maintenance access and the site's operating practices.
- Confirm seal-face and secondary-seal materials, the selected support plan and its operating instructions.
- Include auxiliary instruments and consumables in the package documentation and spares plan.

> **Use API 682 with an agreed scope**
>
> API 682 addresses shaft-sealing systems for centrifugal and rotary pumps. Applicability, seal category, arrangement and auxiliary details must be agreed for the offered equipment. A seal plan number alone is not proof of suitability.

API 682 scope and application responsibility [T5].

POWER AND TORQUE

Drive, gearbox and speed control

The drive must support starting, continuous operation and credible transient loads across the selected pump envelope.

Item	Checks to include
Motor	Supply voltage/frequency, continuous and starting duty, cooling, ambient conditions and area classification
Gearbox	Output speed, running and starting torque, service duty, lubrication and thermal capacity
VFD	Motor compatibility, speed range, current/torque limits, overload duty and control interfaces
Coupling and guard	Torque capacity, alignment allowance, maintenance access and guarding
Power system	Available capacity, protection, cable design and utility limitations

A useful liquid-only power check

> **Hydraulic power for an incompressible liquid**
>
> P_hydraulic (kW) = differential pressure (bar) x flow (m3/h) / 36
>
> For example, 20 m3/h at 10 bar requires approximately 5.6 kW of hydraulic power before losses. This is a calculation example, not a motor selection.

For a multiphase package, absorbed power also depends on gas compression, mechanical and volumetric losses, and the actual inlet conditions. Starting torque, cold-fluid viscosity, liquid slugs and low-speed motor cooling may govern the selected drive. Request the vendor's power and torque assessment for each agreed case.

INSTRUMENTATION AND INTERFACES

Monitoring and protective control

Agree normal control, overrides, trips and reset conditions in a cause-and-effect schedule for the selected package.

Signal or condition	Purpose	Response to define
Suction pressure	Identify inlet starvation or an unsuitable suction condition	Low-pressure alarm and protective action as required
Discharge pressure	Monitor the downstream system and pump pressure duty	Control override and trip logic; engineered overpressure relief remains a separate requirement
Stator temperature	Detect an adverse thermal condition at the selected monitoring locations	Corrective action and shutdown before qualified limits are exceeded
Motor current / torque	Track loading, obstruction and transient demand	Limit or trip settings coordinated with starting and process duty
Auxiliary liquid flow	Confirm the required lubrication/cooling supply	Run permissive and protective action on insufficient flow
Seal / auxiliary status	Monitor the selected support-system conditions	Alarm, interlock and maintenance response
Emergency shutdown	Coordinate package and facility protective actions	Defined hardwired or safety-system interface and restart controls

Control may use flow, suction pressure or another agreed process variable. State the priority of overrides, the handling of bad signals and loss of communications, and whether local or remote commands are permitted. Process control does not replace independently required safeguards.

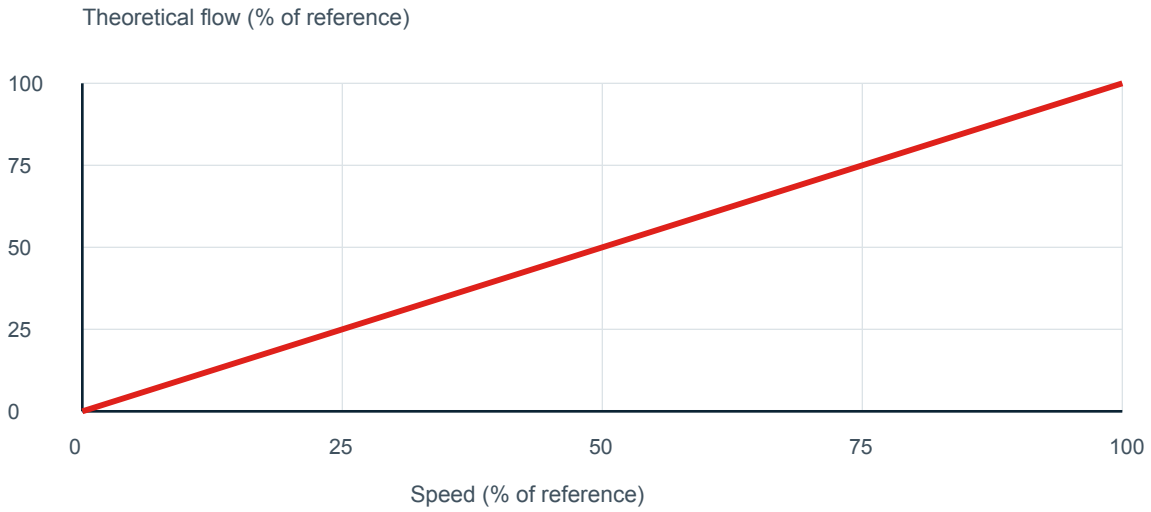
All setpoints, delays and safety functions are established through project engineering and equipment requirements.

SELECTION AND VERIFICATION

Read performance data in context

Ask for performance information at the specified fluid conditions, speed, differential pressure and inlet gas fraction.

Theoretical displacement relationship



For fixed displacement, Q_theoretical = displacement per revolution x speed. The normalised line shows this mathematical relationship only. Actual delivered flow can differ because of slip, fluid compressibility, inlet filling, pressure, temperature and wear.

Request from the supplier	Confirm before selection
Rated performance cases	Minimum, normal, maximum and transient duties with the inlet fluid basis
Speed, power and torque	Permitted speed range; starting and running loads; motor and gearbox checks
Gas and thermal limits	Continuous/transient GVF conditions, minimum liquid and permitted exposure
Test and guarantee basis	Test medium, correction method, acceptance tolerances and agreed exclusions

Illustration only. No measured curve, model capacity or guaranteed operating range is implied.

QUALITY REQUIREMENTS

Standards, testing and documentation

A standards reference becomes meaningful when its scope, edition, deviations and acceptance criteria are agreed for the purchase.

Reference or requirement	How it enters the specification
API 676	Rotary positive-displacement pump requirements where specified. Document the applicable requirements and any exceptions for the offered package.
API 682	Shaft-sealing systems where applicable. Coordinate seal and auxiliary-system details with the intended service.
ISO 15156 / NACE MR0175	Metallic-material selection and qualification for relevant H2S-containing production environments.
Project codes and specifications	Applicable piping, pressure equipment, flanges, electrical/area classification, structural and coating requirements.

Inspection and factory acceptance

- Agree the inspection and test plan before manufacture, including witness and hold points.
- Identify material traceability, pressure testing, mechanical/performance testing and instrument calibration records required by the order.
- Include control I/O checks, alarms, interlocks, permissives and the agreed trip/reset sequence in functional testing.
- Record deviations, corrective actions and acceptance against agreed criteria rather than a generic pass statement.

Handover documentation: approved and as-built drawings, equipment datasheets, certified test records, control narrative, instrument list, operating and maintenance manuals, preservation requirements and recommended spares.

Standard scopes: [T4-T6]. References do not constitute a NOVA certification or blanket compliance statement.

INSTALLATION AND INTEGRATION

Fit the package to the facility

The package boundary must work mechanically, electrically and operationally with the existing site.

Layout and maintenance access

Allow space for stator/rotor removal, seal work, lifting and safe access to instruments. Confirm component weights, removal paths and the access needed around an enclosure or container.

Foundations and piping

Check skid stiffness, supports, alignment and foundation loads. Pipe supports and thermal movement should not impose unacceptable loads on the pump nozzles.

Utilities and environment

Identify the electrical supply, auxiliary-liquid source, drainage and any heating, cooling or ventilation requirements. Record ambient limits, corrosion exposure and site hazardous-area classification.

Facility interfaces

Define upstream and downstream isolation, relief destination, drains/vents, local and remote controls, shutdown interfaces and ownership of connecting systems.

Document	Coordination purpose
General arrangement	Footprint, lifting points, centre of gravity, access and maintenance envelopes
P&ID; and interface list	Process connections, auxiliary services, valve/instrument scope and battery limits
Electrical and I/O schedules	Power, earthing, cabling, signal types and control-system responsibility
Site acceptance plan	Installation checks, loop checks, operating trials and handover responsibilities

Installation and commissioning follow the selected equipment manuals and the approved site procedures.

LIFECYCLE SUPPORT

Operations and service planning

Build a monitoring baseline and a service plan around the actual fluid, operating pattern and selected equipment.

Prepare for a controlled handover

The commissioning plan should cover installation and alignment checks, cleanliness, approved lubrication and priming arrangements, instrument verification, protective-function tests and operator training. Record baseline flow, pressures, speed, load, temperatures and vibration under known conditions.

Observed change	Areas to investigate within the approved procedure
Less flow at the same speed	Inlet conditions, gas fraction, fluid properties, instrument accuracy and rotor/stator wear
Rising temperature	Liquid availability, auxiliary-flow status, pressure duty, speed and material compatibility
Higher current or torque	Cold viscosity, solids, obstruction, mechanical condition, alignment and changed process demand
Leakage or abnormal vibration	Seal support, bearings, drive train, fasteners, piping loads and alignment
Repeated trips	Event trends, process transients, signal health and the cause-and-effect schedule; do not bypass protection to maintain production

Plan for maintainability

Identify wear parts, seal kits, compatible stators, critical instruments and long-lead drive components. Define preservation conditions, inspection intervals and the records needed to track changes in performance. Spares and replacement compounds should remain traceable to the approved equipment specification.

This catalogue is not a maintenance procedure. Isolate and make equipment safe using the site and OEM instructions.

PROVIDE THE OPERATING DATA

Process enquiry sheet

Enter minimum / normal / maximum values where possible. State units and whether rates are at actual or standard conditions.

Project information	Customer entry
Company / project	_____
Site / contact / date	_____

Process parameter	Unit / basis	Min / Normal / Max or description
Oil flow	m3/h or bbl/day	
Water flow / water cut	m3/h / %	
Free-gas flow	State standard or actual basis	
Inlet GVF	% at suction P and T	
Suction pressure	barg or bara; identify basis	
Discharge pressure	barg or bara; identify basis	
Suction temperature	deg C	
Viscosity	cP at stated temperature	
Density / API gravity	State temperature / basis	
PVT / GOR / gas composition	Attach supporting data	
H2S / CO2 / water chemistry	State units; attach analysis	
Solids	Size, hardness, concentration	
Chemical / cleaning exposure	Product and concentration	
Transient conditions	Slugging, start-up, decline	

Attach fluid analysis, PVT information and any operating trends. Unknown values can be identified for follow-up.

DEFINE SCOPE AND INTERFACES

Package enquiry sheet

Use this sheet with the process data on page 18 to establish a coordinated supply scope.

Package requirement	Customer entry
Required quantity and duty / standby philosophy	
Skid, enclosure or container preference	
Available footprint and maintenance constraints	
Power supply: voltage, frequency, phase	
Area classification and applicable certification	
Ambient range and installation environment	
Connection sizes, ratings and material requirements	
Applicable codes, standards and client specifications	
Local / remote operation and control variable	
DCS / SCADA, communications and shutdown interface	
Auxiliary liquid, cooling and drainage availability	
Inspection, tests and documentation required	
Commissioning assistance, training and spares	
Delivery location, required date and project stage	

Useful attachments

Process flow diagram, P&ID, site layout, tie-in and utility information, existing equipment references and the project specifications. Mark provisional information clearly so it can be resolved during selection.

NEXT STEP

Discuss your application with NOVA

Send the process and package information together so the equipment discussion starts from the complete operating requirement.

NOVA Petroleum Services

Email: info@novapservices.com
Website: www.novapservices.com
Enquiries: novapservices.com/contact

Identify your production objective, the expected duty range and the scope you need. NOVA can then clarify the proposed configuration, required supporting data, applicable specifications and quotation basis.

Technical reference notes

T1 NETZSCH - Construction of a progressing cavity pump

T2 SEEPEX - Guide to progressive cavity pumps

T3 NETZSCH - Pump accessories and dry-running protection

T4 API - Publications catalogue; API 676 scope

T5 API - Standard 682 scope, shaft-sealing systems

T6 ISO - ISO 15156-1, general principles for H2S-service materials

These references support general technical context; their product ratings are not NOVA specifications. Use the editions and requirements agreed in the purchase specification. NOVA equipment imagery and offering descriptions are drawn from existing NOVA materials.

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