

Electric Submersible Pumps

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By bringing together a highly experienced team with state-of-the-art manufacturing and a deep commitment to customer service, Canadian Advanced ESP is able to deliver superior high pressure pump applications and leading Variable Frequency Drive Systems to the global oil and gas industry.

Located in the heart of Canada's energy sector, our focus is on Electric Submersible Pump Systems for Artificial Lift applications, Horizontal Pump Systems for a variety of high pressure applications and innovative Variable Frequency Drive Systems.

Engineered Operating sophisticated production processes in challenging conditions, extreme climates and remote locations requires reliable pumping systems. Canadian Advanced ESP pumping systems are the industry choice, producing more flow, more head, greater efficiency and wider operating ranges than most competitor's offerings.

Canadian Advanced ESP creates high quality, innovative, safe and environmentally sound solutions by applying advanced state-of-the-art technologies, strict quality management and superior engineering capabilities. Our detailed process and application knowledge has allowed us to develop several patented engineering solutions as well as custom design systems when required.

Quality and Safety All Canadian Advanced ESP operations are certified to ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:2007 standards to ensure the highest quality products with the greatest value for customers worldwide. Quality assurance begins with a contract review and continues throughout the entire process. All products are inspected and performance tested in line with relevant API and other specification criteria before leaving the factory.



Customer Support Service

The long-term success of any pumping system depends upon the quality and availability of customer support services. Canadian Advanced ESP prides itself on providing fast and efficient response to any situation, without compromising quality.

Fast Response Our field technicians will install, commission and monitor the pumping system to ensure successful operation. The crews are equipped with state-of-the-art tooling and modern truck mounted spooling units for all cable spooling and banding needs. Canadian Advanced ESP service centres, strategically located across the globe, offer our customers easy access to a full range of repair and maintenance services including unit installation, troubleshooting and preventive maintenance.

Servicing all Markets In addition to supplying parts and services for all of our equipment, Canadian Advanced ESP's in-house re-engineering specialists will design, deliver and fit high integrity components for other manufacturer's machinery - including upgrading and retrofitting existing pump installations. Using root-cause failure analysis, system investigation and material assessment, Canadian Advanced ESP can modify existing installations to meet new duty conditions, improve operating efficiencies and increase MTBF.

Canadian Advanced ESP also provides all the accessories needed during installation and maintenance of Electric Submersible Pumps and Horizontal Pump Systems including bleeder valves, check valves, banding materials, MONEL bolting and couplings, as well as flat cable extensions for most designs used in the industry.

Commitment At Canadian Advanced ESP, we constantly strive to improve our customer service performance and deliver the highest possible life cycle value in the industry.

CAESP Electrical Submersible Pumping System

The CAESP Electric Submersible Pump System consists of several components that are carefully selected to combine into the most economical and efficient solution for each set of well conditions.

Wellhead (1) The wellhead provides structural and pressure containing interface for the drilling and production equipment.

Surface Equipment (2) Above ground a system controller combined with a Variable Frequency Drive and related transformer or the patented CAESP Variable Frequency Generator provide controlled power supply to the ESP.

Power Cable (3) Motor Lead Extension (9) The electrical main cable and the flat cable motor lead extension with pothead connect to the surface equipment with the ESP motor and well monitoring device.

Drain Valve (4) Check Valve (5) Other protective devices are located above the pump discharge. These include the check valve that closes on shut down of the unit and prevents back spinning and the drain valve that allows for pulling the ESP without a wet tubing string.

Pump (6) The pumping unit itself consists of the multi-stage centrifugal pump housed in a pressure sleeve with the capability of producing capacities up to 100,000 BPD (16,000 m3/d) from depths of up to 15,000 ft (4,575 m).

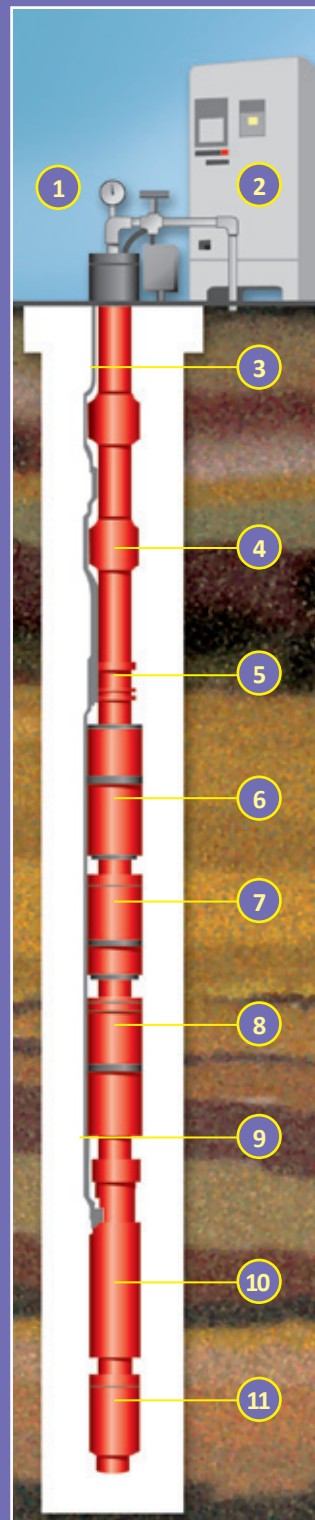
Intake/Gas Separator/Gas Kompressor (7) Immediately below the pump is the intake combined with a gas separator if required. The gas separator allows for trouble free operation in well conditions with free gas contents of more than 10% to 20%. The CAESP Gas Kompressor can handle up to 45% of free gas.

Protector (8) Located between the motor and pump intake is the protector. The protector isolates the motor from the well fluid and contains the high capacity thrust bearing.

Motor (10) The high quality electrical motor for well casings 4-1/2" (114 mm) and larger is a squirrel cage, two pole, three phase induction motor. The motor turns at a speed of approximately 3,500 RPM at 60 HZ and 2,900 RPM at 50 HZ.

Sensor (11) The down hole sensor is located below the motor and transmits important well and system data via the main power cable to the surface.

Expert Advice The correct application of technology is the critical success factor for any down hole pumping solution. You can count on Canadian Advanced ESP's professional engineers to design an Electric Submersible Pumping System that provides optimum performance in each of your well applications.



HEAD

Pump

The pump is a multi-stage centrifugal design. Each stage consists of an impeller (1), and a diffuser (2).



Impeller with
GFR Phenolic
Resin Washer



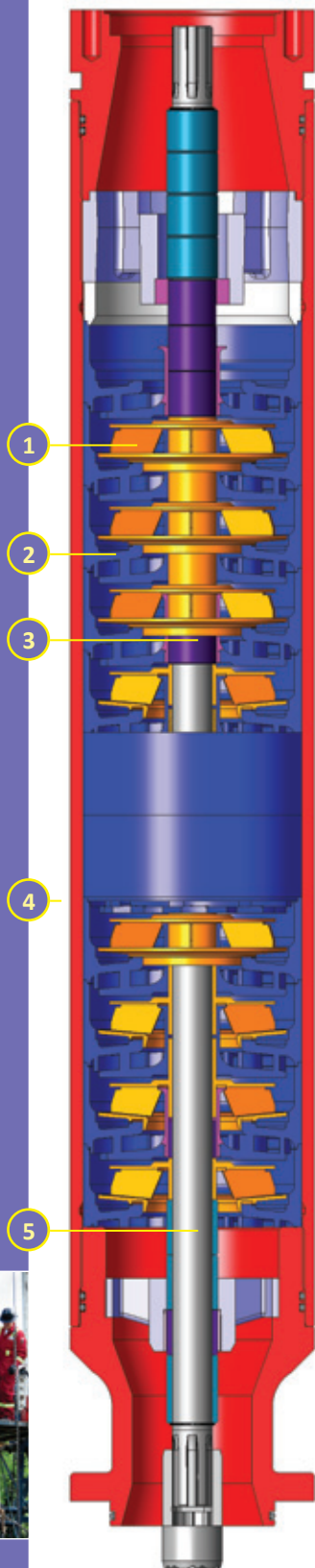
Diffuser

Impeller and Diffuser The impeller is the rotating element and adds velocity to the pump fluid; the stationary diffuser converts this velocity into pressure energy and redirects the pump fluid to the entrance of the next stage impeller.

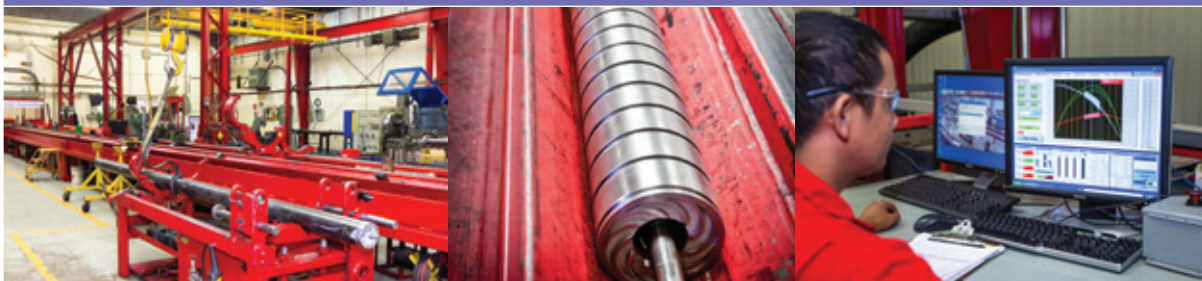
The impeller/diffuser design combinations are available in a variety of Ns (Specific Speed) designs - from axial to mixed flow - to provide optimum efficiencies for any given well condition. The hydraulic designs are such that a positive downward thrust is generated throughout the operating range to assure stable hydraulic operation and to prevent thrust reversal. The standard hydraulics can handle 10% to 20% of free gas. In higher gas content applications, the Gas Kompressor can handle up to 45% of free gas at the pump intake after separation, or without separation if a non-vented packer is deployed.

The CAESP standard material for both impellers and diffusers is a stable austenitic cast material of Ni-Resist which provides sufficient corrosion and erosion resistance in most well applications. Other materials such as Teflon, Tungsten Carbide or Gas Diffusion Hardened Ni-Resist are available to allow for additional protection in extremely corrosive or abrasive environments.

Bearings In each stage of the standard configuration the impeller shroud and the diffuser act as bearing surfaces. In addition, the upper and lower journal bearing of each pump section are supplied in Tungsten Carbide for added protection against abrasion and vibration. Optional stage bearing designs are available to handle well conditions with high content of abrasives.



BASE



COMPRESSION PUMP

- | | | |
|-------------|-------------|------------|
| 1. Impeller | 2. Diffuser | 3. Bearing |
| 4. Housing | 5. Shaft | |

Housing The pump stages are housed in a pressure sleeve (housing) (4) made of high grade alloy steel. The inside diameter of the housing is isolated from the pumped fluid; the outside surface can be treated with a special coating for added protection from hostile fluid in the well casing.

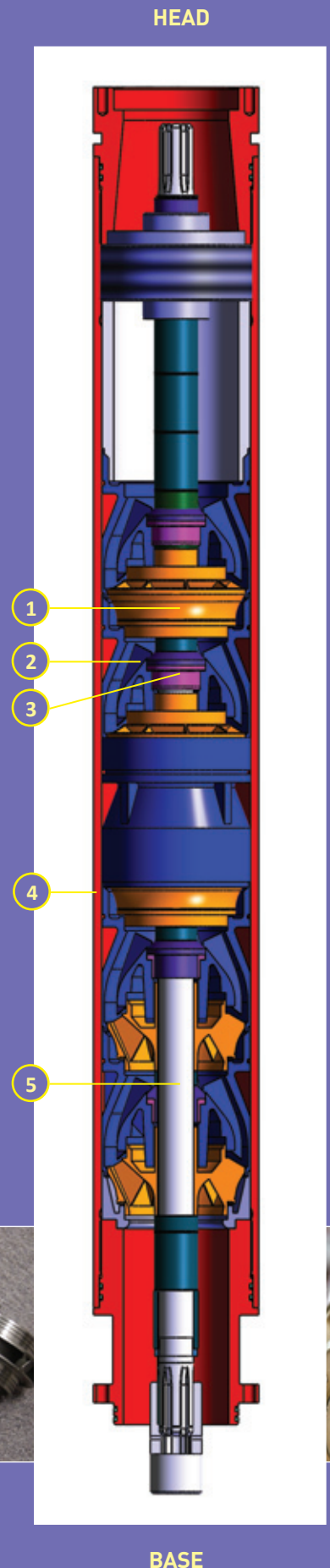
Shaft Standard pump shafts (5) are machined from Monel K-500 material which provides excellent mechanical strength in normal conditions. Special extra high strength shafting material (Inconel) is available for special applications. This modular construction concept provides for the optimal selection of hydraulic flow and head combinations to suit any range of well requirements and can produce fluids from depths of up to 15,000 ft (4,575 m).

CAESP Compression Pump Design

In this design the impellers are fixed to the pump shaft with lock rings. The full hydraulic down thrust of impellers and shaft and the weight of the rotating element is carried by the tilting pad thrust bearings in the protector. This design is commonly used in higher production pumps (675 series and above).

CAESP Floating Impeller Pump Design

This design uses a sliding impeller whereby the impeller, driven by a key, can slide freely in axial direction on the shaft. The hydraulic thrust of each individual stage is carried by three GFR phenolic resin thrust washers, embedded in the impellers, that run against the stationary diffuser. With this design no hydraulic thrust is transmitted from the impellers to the shaft. The weight of the shaft plus the down thrust created at the top end of the shaft are carried by a tilting pad bearing in the protector assembly below the pump. Optional stage bearing designs are available to handle well conditions with high abrasive content.



FLOATING IMPELLER PUMP

- | | | |
|-------------|-------------|------------|
| 1. Impeller | 2. Diffuser | 3. Bearing |
| 4. Housing | 5. Shaft | |

Typical Operating Ranges of Canadian Advanced ESP Electric Submersible Pumps

Canadian Advanced ESP customers have the advantage to choose a pump that fits the well inflow with the best operating efficiency. Our pumps have the widest operating ranges, consuming less power than competitors.

For special flow rate applications, please contact our customer service at sales@cai-esp.com.

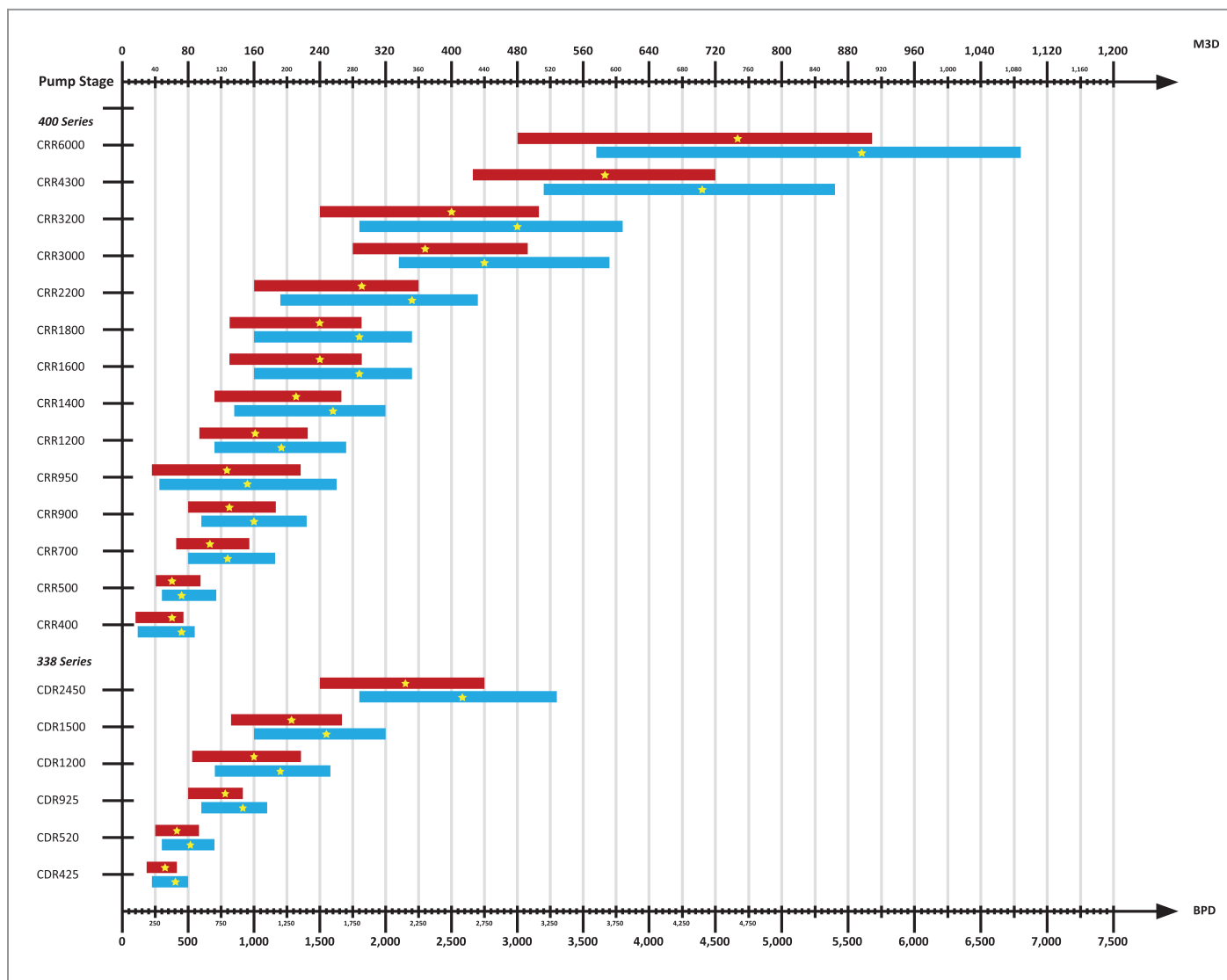


DIAGRAM: 338-400 SERIES

LEGEND

- 60 Hz
- 50 Hz
- ★ Best efficiency point

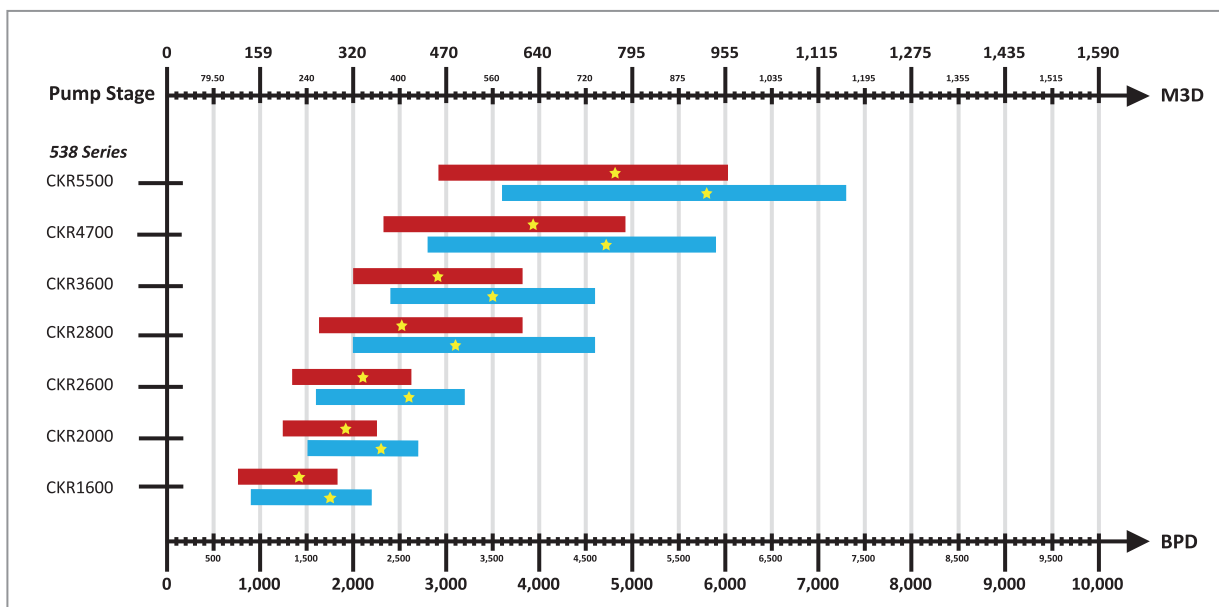


DIAGRAM: 538 SERIES

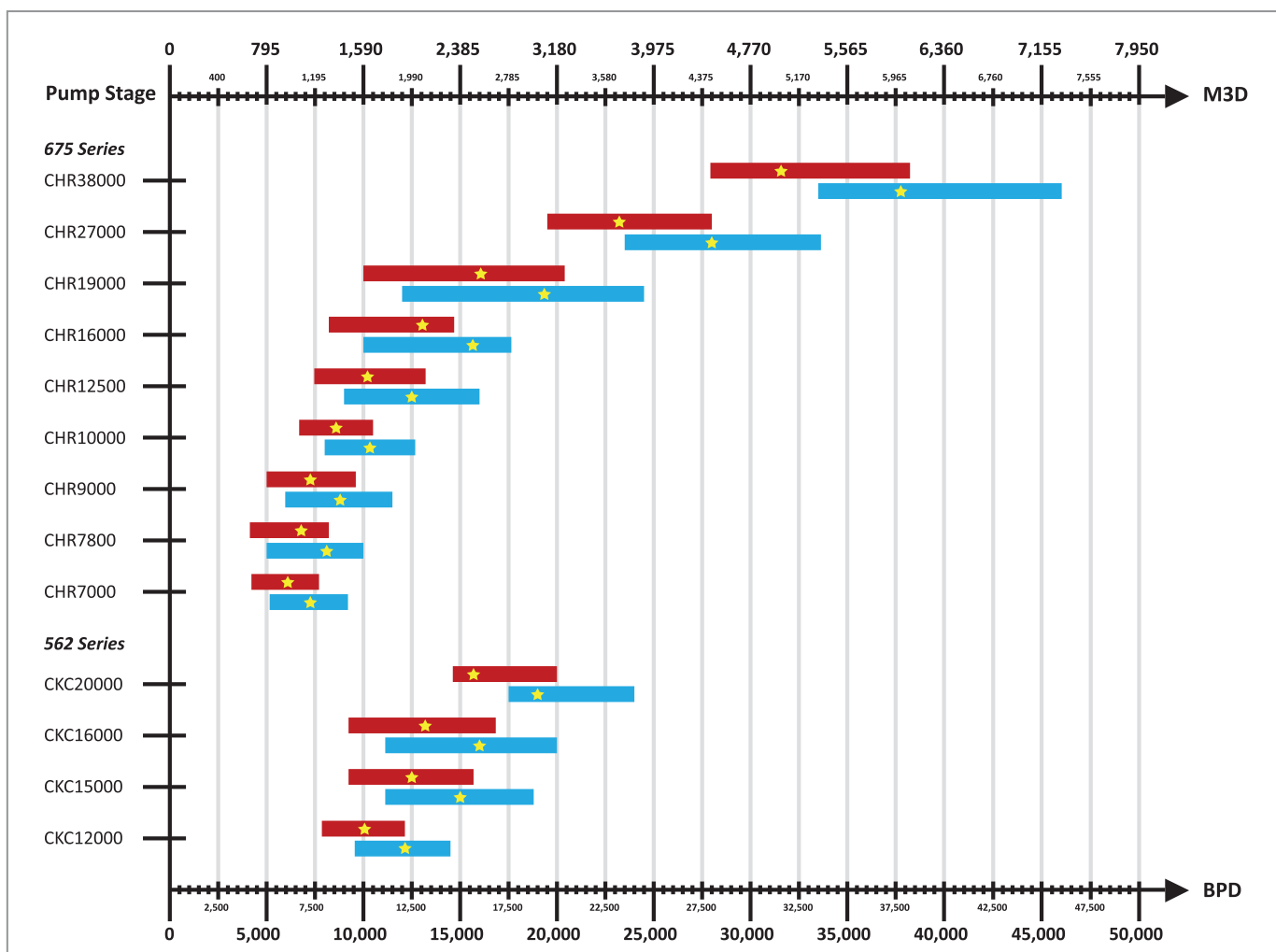


DIAGRAM: 562-675 SERIES

LEGEND

- 60 Hz
- 50 Hz
- ★ Best efficiency point

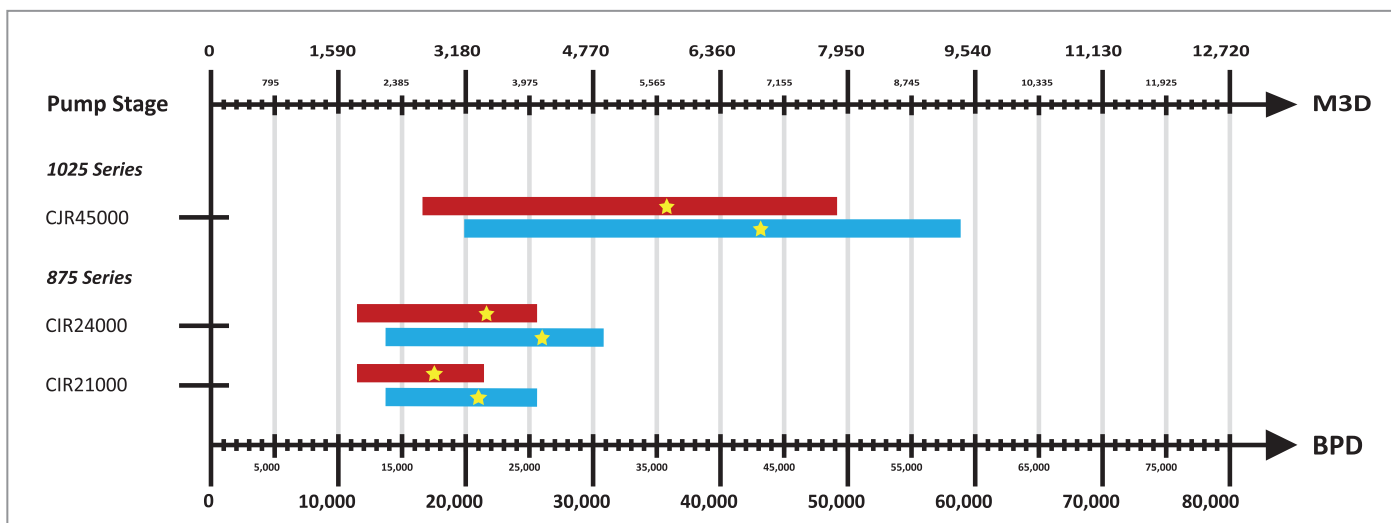


DIAGRAM: 875-1025 SERIES

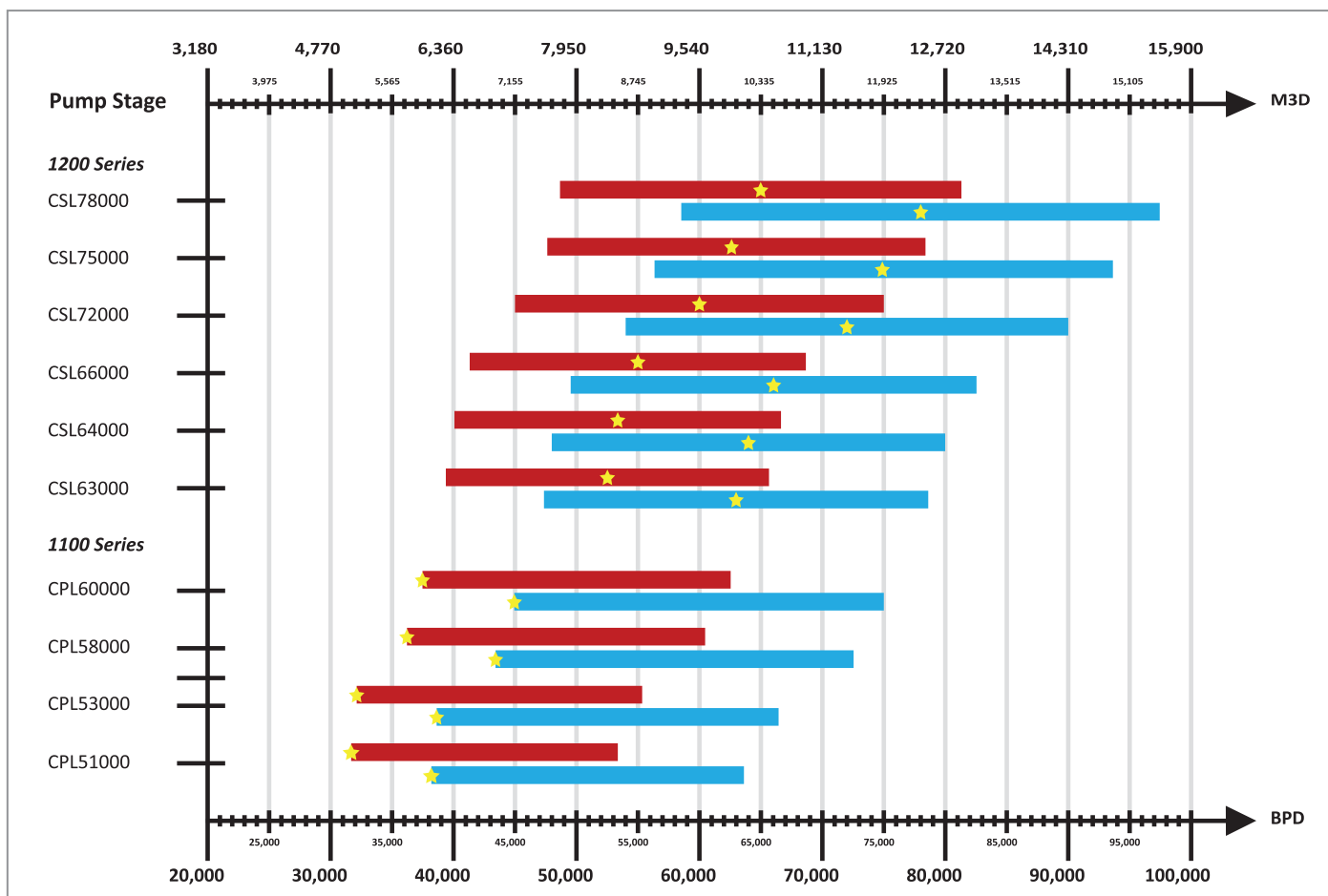


DIAGRAM: 1100-1200 SERIES

LEGEND

- 60 Hz
- 50 Hz
- ★ Best efficiency point

Rotary Gas Separator

The Rotary Gas Separator, commonly called RGS, is an integral component of an ESP System that has been used in oilfield applications for several decades. The RGS accomplishes a very important role in oil wells with gassy applications.

In wells with high Gas to Liquid Ratio, the free gas needs to be separated from the liquid to prevent the ESP system from cycling, cavitation and gas locking, which will reduce the production and the run life of the ESP system.

The gas handling parameters of each well and ESP configuration are affected by a large number of variables, such as specific speed of pump, geometry of pump stage, fluid properties, well geometry and completion details. The combination of these variables will determine if a Single or Tandem RGS is required.

The RGS uses centrifugal force to separate the gas and the liquid streams. The mixture of gas and liquid enters through the intake screen (1) into the inducer section (2). The inducer increases the pressure of the liquid stream and moves the mixture through the guide vanes (3) into the centrifugal rotor chamber (4). The heavier liquid stream is forced to the outer area of the chamber whereas the lighter gas stream concentrates in the centre of the chamber. Through the separation chamber (5), the liquid stream is directed towards the pump intake stage and the gas stream is vented into the annulus. Radial bearings (6) and an oversized shaft provide dynamic stability to the separator.

Application Guidelines

Knowing the amount of free gas that can be handled by a stage is dependent on the geometry of the stage. Point B refers to the maximum rate that can be handled by a typical ESP with no degradation in the performance of the stages. Beyond this point, an RGS should be added to separate a portion of GVF (Gas Void Fraction) and vent it to the annulus. Depending on the RGS efficiency, we can reach point C and D with only 15% GVF at the pump and reach higher production rates. Beyond point D, only gas handling devices such as the Canadian Advanced ESP Gas Kompressor can achieve more draw-down. The Gas Kompressor may be used as an alternative or in conjunction with a Single or Tandem RGS.

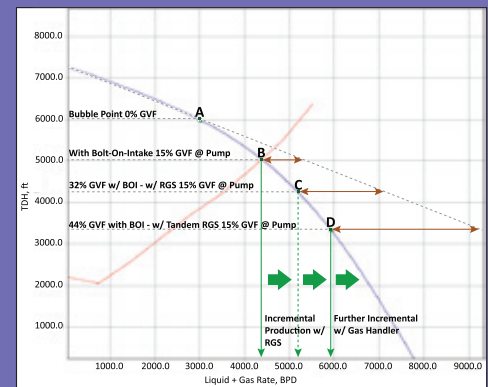


Figure 1.1: Reaching more drawdown with RGS

Technical Specifications

Series	Operating Flow Range (BPD at 60 Hz)	Power Required (HP at 60 Hz)	Separation Efficiency (%)
338	350 - 2,500	2	80 - 95
400	350 - 6,000	3	80 - 95
540	1,000 - 9,000	7	80 - 95

ROTARY GAS SEPARATOR

- 1. Intake Screen
- 2. Inducer
- 3. Guide Vanes
- 4. Rotor
- 5. Divider
- 6. Bearing

Gas Handling Kompressor

The Canadian Advanced ESP Inc. Kompressor is a new generation of Gas Handler – a gas handling device specifically designed for high GLR gassy ESP applications.

The Kompressor increases production in wells previously not considered for ESP – wells having up to 45% gas volume factor (GVF) at low intake pressures. As well, it reduces degradation of pump performance by conditioning gas liquid mixture and extends equipment life by eliminating or reducing pump cycling because of gas lock. The Kompressor also eliminates surging and gas lock in wells with up to 45% GVF and low bottom hole pressure.

The Kompressor is a short lower-tandem pump with high capacity stages. The stages contain impellers with special veins and diffusers providing a smooth axial flow. These special stages ensure an almost homogeneous distribution of gas particles in the fluid due to:

- Radial flow velocities responsible for gas segregation in the impellers are practically eliminated due to the low centrifugal force developed by the pseudo-axial flow impeller
- The stage effectively mixes the two phases
- It compresses the gas into solution

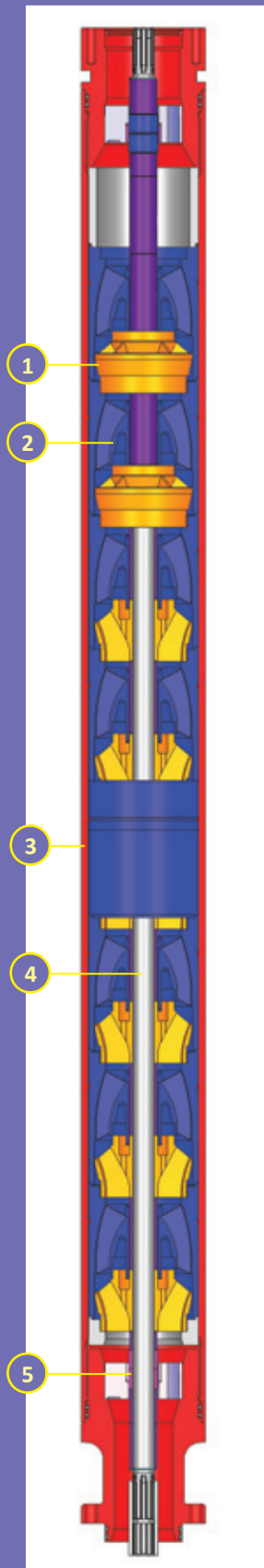
The Kompressor is connected between the pump intake and the ESP main pump and acts as a charge or booster pump. Gassy fluids entering the pump intake get compressed to make it easier for the ESP pump to lift the fluids. The mixture of liquid and gas leaving the gas handler provides ideal conditions for the ESP main pump to lift the fluid to the surface. The unit can handle well streams with up to 45% of free gas content at the pump intake, effectively preventing gas locking of the ESP pump. Available models work in flow ranges between 250 BPD and 11,000 BPD (40 m³/d – 1,750 m³/d).

Applications

- High GVF application even after Gas Separator usage
- Gassy wells with packers above the pump
- Gas well dewatering
- Gas lift to ESP conversion wells
- Low intake pressure wells
- The Kompressor can also be used in combination with Rotary Gas Separators (RGS) to handle extremely gassy environments

Options available

- Abrasion resistant construction
- Ultra high strength shafts
- Polymer coated or Gas Diffuser hardened stages



**GAS HANDLING
KOMPRESSOR**

1. Impeller
4. Shaft

2. Diffuser
5. Bearing

3. Housing

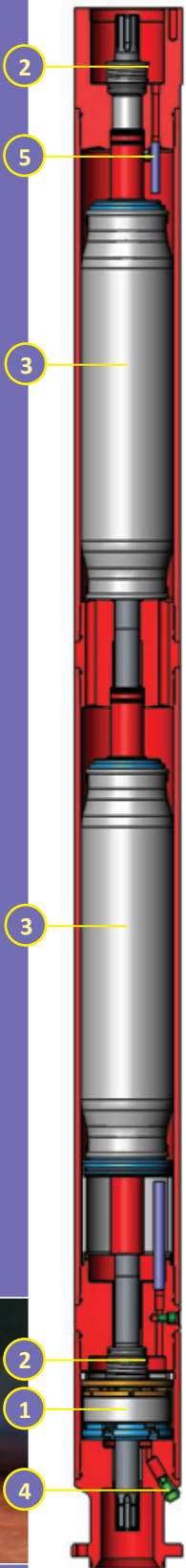
Protector

The Protector is located between the intake and the motor. The Protector is a key element in providing efficient trouble free operation and extended longevity to the entire ESP system.

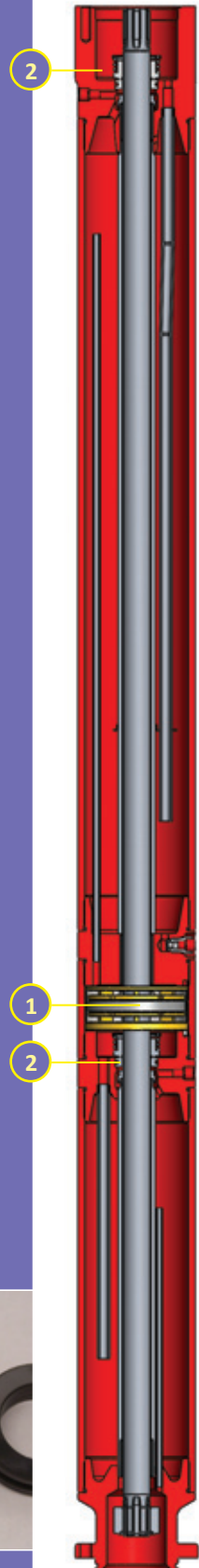
The primary functions of the Protector are:

- To act as a physical barrier between the well fluid and the motor oil under all conditions
- To carry the (residual) hydraulic downthrust generated by the centrifugal pumping action as well as the weight and thrust generated by the rotating elements of the ESP
- To equalize the pressure inside the motor to the pressure conditions in the well bore
- To maintain a minimum pressure differential across the seals. Specially designed mechanical seals prevent well bore fluid from entering the motor.
- To provide a flexible chamber (Viton bags standard) that allows the motor oil to expand and contract as a function of changing well and motor temperatures during installation, motor start-up and shut-down. The specially designed labyrinth and a check valve allows movement of the expanding motor oil into the well bore and blocks the entry of well bore fluid during the contraction of the motor oil.

The CAESP standard protector configuration consists of a labyrinth section and a bladder section. This configuration combines ample volume to allow for sufficient thermal expansion with extensive protection against well fluid entering the motor and thrust bearing cavities.



DOUBLE BAG SECTION



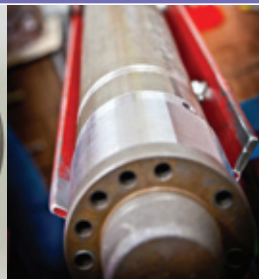
DOUBLE LABYRINTH SECTION



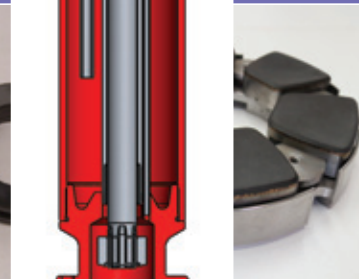
1. Thrust Bearing
4. Fill Plug



2. Mechanical Seal
5. Check Valve



3. Elastomer Expansion Ring



Submersible Motor

The design of the CAESP Electric Submersible Motor is guided by the harsh environmental conditions found in most oil well applications.

The motors are AC two pole, three phase squirrel cage induction type designs. All motors are filled with highly refined mineral or synthetic oil. The oil is specifically selected to provide optimum dielectric strength, sufficient thermal conductivity to secure proper motor cooling and ample lubrication for the thrust (1) and journal bearings (7) in the motor and protector assembly. An internal thrust bearing carries the thrust load generated by the rotor element.

Depending on motor size and cable length, the operating voltage of the motor can range between 380 and 5,000 volts. The horse power ranges from 8 to over 1,500 HP in single, tandem and TUT configurations (tandem-upper-tandem, creates 1,000 HP and larger motor systems with standard motor sections coupled mechanically but not electrically). Standard design operating temperatures can be as high as 375°F (190°C).

The motor shaft (8) is rifle drilled to allow for sufficient oil circulation for all journal bearings and the motor thrust bearing. Shafts are available in high strength materials for high torque / high horsepower applications.

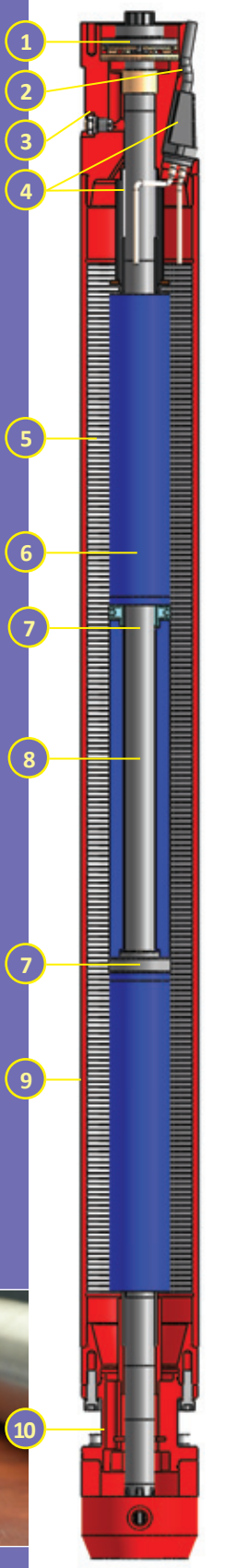
The rotor (6) and stator (5) designs are optimized to provide high electric efficiency and uncompromising performance under all operating conditions.

The flat Motor Lead Extension (2) is connected to the motor by means of a taped-in pothead connector (4).

A downhole sensor can be attached to the motor base (10) to transmit critical information such as intake and discharge pressure, intake temperature, motor temperature and motor vibrations via the main power cable to the surface controls.



Shown: Motor Head Part #12593



SUBMERSIBLE
MOTOR

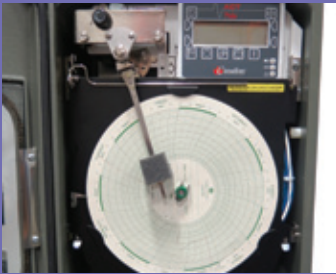
1. Thrust Bearing
5. Wound Stator
9. Motor Casing

2. Motor Lead Extension
6. Squirrel Cage Rotor
10. Motor Base

3. Drain and Fill Plug
7. Journal Bearings

4. Pothead Connection
8. Rifle Drilled Shaft





Surface Equipment & Power Cable

The Electrical Surface Equipment and Power Cable are an essential part of a complete Electric Submersible Pumping System. Canadian Advanced ESP uses leading brand quality components engineered to offer optimum efficiency and maximum run life. Approvals from different Certification Authorities are available.

Switchboards are used for fixed speed ESP applications. A large variety of options exist to meet the specific requirements of each application. Both low voltage and medium voltage models are available.

Motor Controller CAESP's new ACT Pulse Motor Controller comes with a small footprint design. It provides information such as motor load, power supply, and downhole sensor data. The controller also protects the motor against unsafe operations and start-ups. Using an externally installed reverse rotation ground fault shunt, it is able to detect motor backspin and has overload, underload and ground fault protection.

SCADA and PLC connectivity allow the operation and control from remote control centers. The internal log memory has space for 3000 to 7000 events, with an option for additional log memory for up to 1 million events.

Variable Frequency Drives (VFD) are used for variable speed ESP applications. State-of-the-art technology is utilized to reduce the damaging effect of system inherent harmonics on insulation and mechanical components. Harmonic input and output filters are commonly used to reduce this effect.

Variable Frequency Generator (VFG) is an innovative and patented Genset technology engineered by Canadian Advanced ESP. The VFG generates a pure sine wave output with no harmonics across its full variable speed and power range.

Transformers Specialized three phase transformers are required in various system configurations in the step-down and step-up function. Our transformers are designed to work in the rugged oil field environment and feature a wide range of tap selections to allow for optimum voltage supply to the ESP motor.

Power Cable Canadian Advanced ESP features power cable in a wide range of sizes and construction types from reputable manufacturers to provide its customers with the most economical and efficient solution.



Advanced Monitoring Technology

Advanced Monitoring Technology (AMT) is a remote surveillance system specifically developed for the needs of the Artificial Lift Industry by Canadian Advanced ESP Inc.

Optimize production through secure remote access

AMT provides just in time information about equipment and production data for viewing, trending and alarming. Operators can manage their field remotely and prioritize intervention proactively, reducing downtime, production costs and equipment failure. Production can be analyzed and optimized, resulting in higher production rates and higher availability of the production system.

AMT supports the secure on-demand viewing of remote site data through a standard web browser. The gathered data is sent to a highly secured central server, then consolidated and sent to the producer, allowing for surveillance of wells – anywhere, anytime.

Features

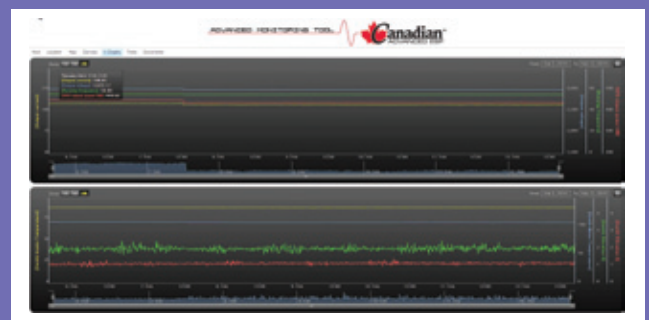
Multiple reports can be generated for monitored wells and machinery, including information such as mean time to pump pull and run time hours. All information gathered is archived, providing detailed well history reports, which can be readily accessed by the operating company and their service providers.

Warnings and notifications can be sent automatically by email for events such as shutdowns and alarm thresholds, and can be customized as required. All Events and operator interventions are captured in the event journaling file system.

With the Data Logger device installed, continuous data samples from multiple enabled devices can be captured and stored. The Data Logger can also convert raw data to .csa file format, allowing data to be read by most spreadsheet applications. The Graphing features allow engineers and operators to analyze data points against time and provide customized solutions for well intervention.

Benefits of AMT include:

- Fast, efficient well data analysis and evaluation
- Unlimited access to data 24/7
- Continuous monitoring service
- Current or historical information can be accessed via a central server for long term trends and analysis
- Proactive intervention based on well site information allows for customized solutions
- Downtime can be reduced significantly with quick reaction to problems and issues as they occur
- There are no extra costs for licenses, and additional software is not required





1200 Series Pump Stage

Geothermal

Geothermal Energy is potentially the largest – and presently the most misunderstood – source of energy in the U.S. and the world today.

- Al Gore in “Our Choice – A plan to solve the climate crisis.”

Holding the energy left over from our planet’s birth, Inner Earth is the inexhaustible source of energy known as Geothermal Energy. Fed and maintained by radioactive decay and gravitational forces from the moon, our planet remains as hot inside as the surface of the sun.

To use Geothermal Energy means to tap this immense resource. Historically, the use of this reliable, sustainable and environmentally friendly energy has been limited to areas near tectonic plate boundaries.

With the development of new artificial lift solutions and deep drilling technology, Geothermal Energy can now be theoretically accessed anywhere. It can be used for heating and cooling purposes, for single households and businesses, or whole districts, including producing electrical energy with Geothermal power plants.

Canadian Advanced ESP has been providing artificial lift solutions to the Geothermal Industry since 2008. In that time, we have continuously developed innovative technologies to steadily improve performance and efficiency.

Canadian Advanced ESP Applications for Geothermal Energy Use

Our powerful ESP product line can move hot fluid (geothermal water) from deep aquifers to wherever its geothermal properties are needed. When the water has cooled down and is ready to be re-injected, our HPS product line comes into play.

ESP applications are available in the market for small flow with high temperature, and high flow with low temperatures. At Canadian Advanced ESP, we lead the development of applications that provide solutions for Geothermal projects combining high flow and high temperatures, and a demand for high horsepower.

By using our Tandem upper Tandem (TuT) configuration our motors are able to provide up to 1,800 HP at up to 150°C fluid temperature. Using our CPL or CSL pump series flow rates up to 170 l/s can be achieved with an efficiency that is unique in the market.

To deliver the high power demands of the ESP or HPS system, Canadian Advanced ESP provides a Medium Voltage Frequency Drive solution – therefore they do not require the step-up transformers usually needed on ESP applications.

Canadian Advanced ESP provides additional services to support your Geothermal project. Please ask your Canadian Advanced ESP representative for further details.

Canadian Advanced ESP provides a broad range of pumping systems.

Electric Submersible Pumps (ESP)

Canadian Advanced ESP manufactures a wide range of ESP for artificial lift and other specialized applications. Many specially engineered and often patented solutions provide equipment that is tailored to your specific operating conditions - like our Super Duty Sand Pump that can master the toughest abrasion conditions in the industry.

Horizontal Pumping System (HPS)

Canadian Advanced ESP manufactures a wide range of HPS for low flow/high head applications like crude oil transfer, pipeline booster, water injection and reverse osmosis. The HPS technology distinguishes itself as a cost effective alternative to other designs like multi-stage barrel, split case and segmental pumps and is based on proven multi-stage centrifugal pump designs that are used in our ESP product range.

Variable Frequency Generators (VFG)

Canadian Advanced ESP has designed and manufactures a unique power supply system that eliminates the need for Variable Frequency Drives, harmonic power filters and step-up transformers. It provides pure sine wave and significantly extends your MTBF and production rates. Combined with an improved electrical efficiency the VFG reduces both, capital and operating costs.

Variable Frequency Drive (VFD)

Canadian Advanced ESP is proud to introduce a new VFD product line to the ESP market, the ACT (Advanced Control Technology) VFD control panel. ACT is supplied with the latest, high performance and full vector drive technology. With superior starting torque and precise speed control, ACT will rival all other VFD technology in the ESP industry today.

Advanced Monitoring Technology (AMT)

Canadian Advanced ESP provides the AMT and can help producers implement the Monitoring System. It is a flexible, easily installed system supporting secure on-demand viewing of remote site data. Producers are able to view their wells from anywhere with an internet connection and a web browser. The implementation of this system enables producers to reduce costly down-time and equipment failures.

Specialty Engineering & Testing

In addition to our standard products, Canadian Advanced ESP specializes in Custom Product Engineering. Our modern and extensive testing facilities guarantee thorough testing of each engineered solution before the product is shipped to the field. As well, Canadian Advanced ESP has the ability to offer all materials and accessories needed for the installation and maintenance of ESP and HPS applications.

ISO 9001:2008
ISO 14001:2004
OHSAS 18001:2007
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Please visit our website at www.cai-esp.com for further information on our products and services.

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Contact sales@cai-esp.com to find a CAESP distributor near your location.



Innovative Solutions for Moving Fluids
to Power the World