BLACKHAWK TECHNOLOGY COMPANY®

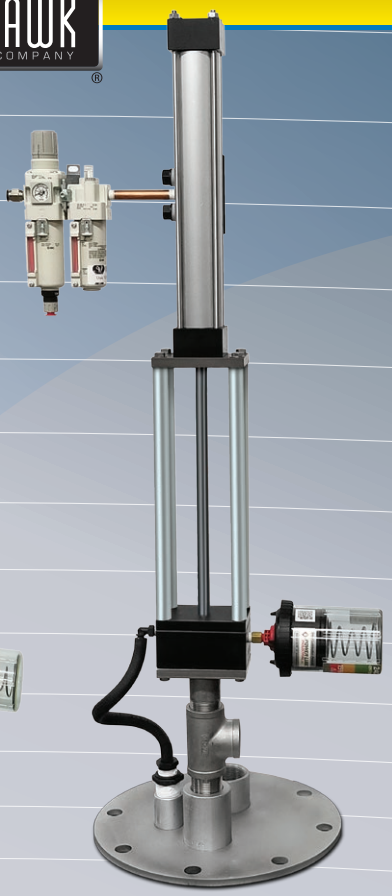
Top-Head-Drive Piston Pumps

Pump Any Fluid

- Remediation
- Leachate
- Landfill Gas
- Elevated Temperature
- Biomass / Biogas Condensate
- Compliance
- Chem Aggressive
- Pipeline Condensate
- Offshore
- Oilfield

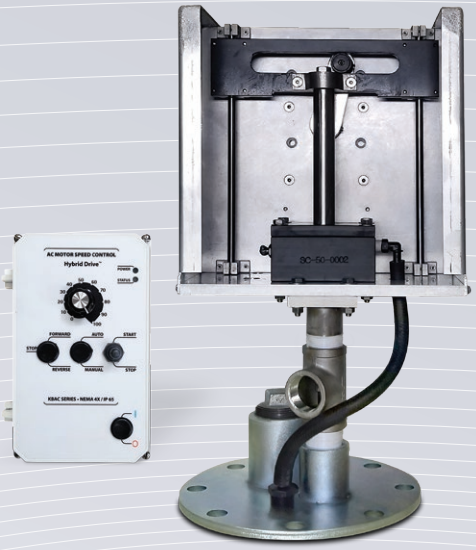
Apollo Solar

Edge Pneumatic



V-2 Pneumatic

Anchor Electric



Apollo-AC Electric

Neptune Offshore Pneumatic

V-2 Elevated-Temp Pneumatic to 300°F

New Technologies in Fluid Management

BLACKHAWK TECHNOLOGY COMPANY®

630.469.4916

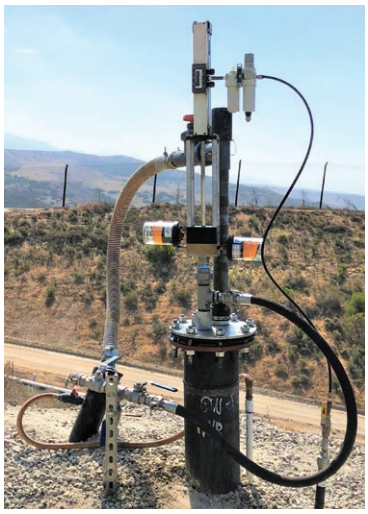
blackhawkco.com

What Is a Piston Pump?

Like reliable oilfield pump jacks, piston pumps achieve positive-displacement flow generation through simple reciprocating-piston technologies. Blackhawk has miniaturized and updated the traditional pump jack for a broad range of applications.

Apollo Solar

Anchor Electric



V-2 Pneumatic

Edge Pneumatic

Piston Pump Advantages

- Pumps any fluid, many semi-solids
- Pumps at any angle, even horizontal
- Pumps to bottom of tank, well, caisson
- Unaffected by + or - changes in pressure
- Can run dry without harm
- Motor outside well or sump
- No air or power contacts fluids
- Can pump viscous, hot, foamy
- Does not shear fluids
- Controlled, metered flow
- Operates in extreme environments
- Safer for workers

All power & maintenance cleanly outside the well, sump or pipe.

General Applications and Common Power Options

Application	Power
Chemical remediation	Electric, pneumatic
Sinking-product remediation	Electric, pneumatic
Landfill methane dewatering	Solar, pneumatic
Condensate sump	Apollo Solar or AC
Landfill leachate	Pneumatic, electric, solar
Elevated temp., viscous fluids to 300°	Heavy-duty pneumatic, electric
Remote sites	Solar
Offshore rig sump	Special-duty pneumatic
Oilfield stripper wells, gas	Explosion-proof electric, solar, pneumatic
Compliance	Pneumatic, solar, electric
Other low-flow applications	All drivers customizable to special needs

Positive Displacement

Because a positive-displacement pump produces virtually the same flow at a given speed regardless of differential/discharge pressure, it is known as a constant-volume pump.

There are several styles of positive-displacement pumps, but the suction-discharge principle remains the same. Fluid flows into the pump as the suction volume increases and then flows out as the discharge volume decreases. The fluid in motion is positively displaced by an equal amount on the next stroke.

Reciprocating Piston

Reciprocating pumps are positive-displacement pumps that employ a constant back-forth motion within a cylinder to move fluid. They are highly efficient, require less power, and are well suited to high-pressure, low-flow applications.

Piston pumps utilize a piston within the cylinder to create an alternating increase and decrease in flow between the suction side and discharge side. As the piston move backward (up), the available volume in the intake portion of the cylinder increases. A one-way suction valve opens to allow fluid to enter.

Blackhawk piston pumps are built with a unique hollow piston and internal check valve. On the forward stroke (down), the fluid is compressed and flows through the piston into the discharge side of the cylinder, trapped from returning by the check valve. On the next backward (up) stroke, the fluid is forced out through the discharge tee.

See blackhawkco.com

Piston Pump Technology

Above, outside the well or sump

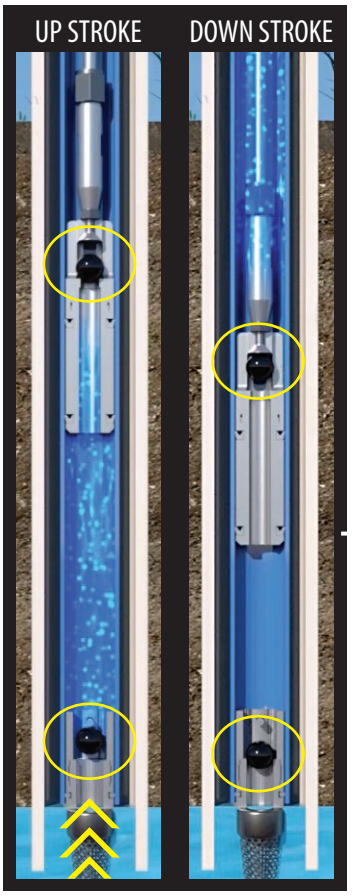
Blackhawk positive-displacement reciprocating-piston pumps are powered by electricity, pneumatic air or solar panels.

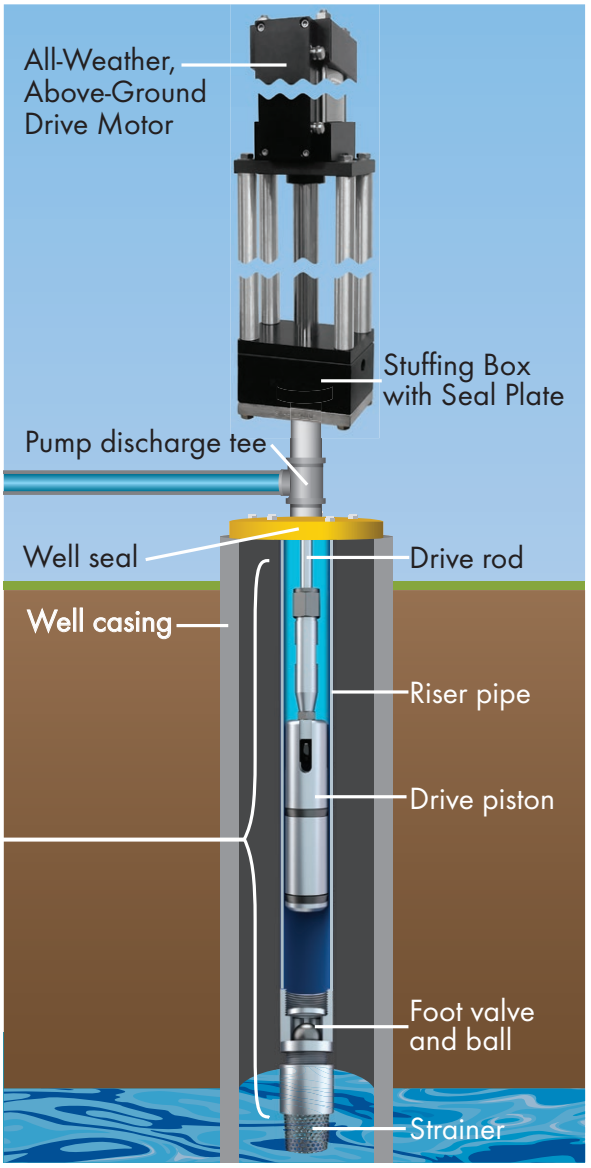
The all-weather drive motors and stuffing boxes are cleanly and safely outside the well or sump. Because motors and mechanicals can be roughly two-thirds of a pump's cost, the principal investment is secure from downhole loss.

Inside the pump

Low-flow action pulls fluid into the pump without disturbing the formation.

- The durable, flexible drive rod, enclosed in a riser-pipe cylinder, connects outside motor to reciprocating piston in pump barrel.
- As the motor pulls up rod, piston creates suction at intake.
- Fluid is pulled through strainer into the foot valve.
- Stainless-steel balls in piston and foot valve open naturally to allow fluid to flow through the piston, and then close to prevent fluid return.
- Reciprocating pumping lifts/pushes fluid up the riser pipe with each stroke.
- Fluid exits discharge tee beyond the wellhead as new fluid is pulled through strainer.





See blackhawkco.com/how-pneumatic-piston-pumps-work for animation.

V-2 Pneumatic

Blackhawk Pump Ranges

Model	Power	Gal./ liters per min.	Gal./ liters per day	Lift weight in feet/ meters	Min pipe size: in/cm
Anchor	Electric	6.7 / 25.3	9,648 / 36,432	800 / 240	2 / 4.8
Apollo	Solar	2.7 / 10.2	3,888 / 14,172	400 / 122	2 / 4.8
Apollo-AC	Electric	2.7 / 10.2	3,888 / 14,172	400 / 122	2 / 4.8
Edge	Pneumatic	5.0 / 18.9	7,200 / 27,250	281 / 86	2 / 4.8
V-2	Pneumatic	11 / 41.6	15,800 / 59,900	555 / 169	2 / 4.8
Neptune	Pneumatic	11.0 / 41.6	15,800 / 59,900	100 / 30	8 / 20
Rhino Oil	Electric	—	15 bbl /day	1,500 ft	2-3/8; 2-7/8 in

Performances vary by model size.

Why Blackhawk?

Blackhawk is the originator and No.1 producer of top-head-drive, positive-displacement piston pumps for low-flow applications. Electric, solar and pneumatic models are in service worldwide.

Ruggedness & Reliability

- All-weather drivers
- Toughest downhole components
- Depths to 800 feet / 240 meters
- Operator-set controls & meters

Cost Effectiveness

- Low maintenance, longer intervals
- Quick servicing
- Simple installation
- Refurbishment, seal replacement, lease programs

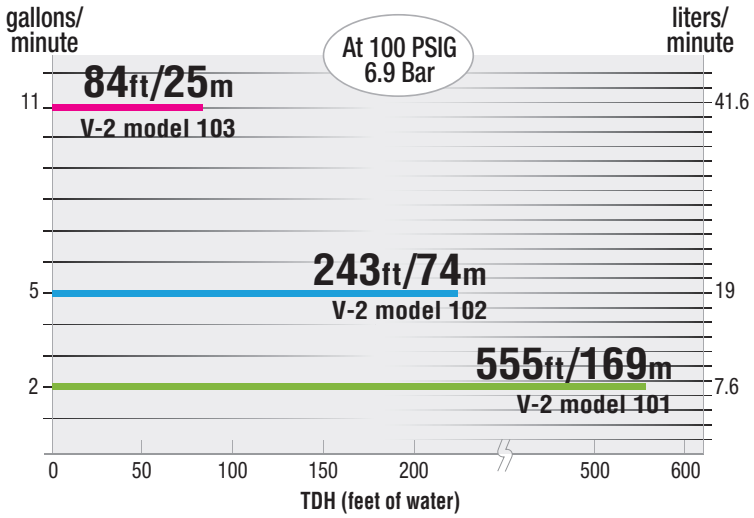
Adaptability

- Pump at any angle to horizontal
- Choose materials of construction
- Customize component configurations
- Fits any well casing

Safety

- All service outside well, sump or pipe
- No worker contact with liquid
- No power in well
- No pneumatic air in well or discharge
- Explosion-proof option

Steady Flows to Submergence Depth



Easy to install; onsite assistance (Shown: Apollo Solar)

Electric pump control (Shown: Apollo-AC Electric)

Accessories for general or special service (Shown: Edge Pneumatic)

Three Pump-Driver Technologies

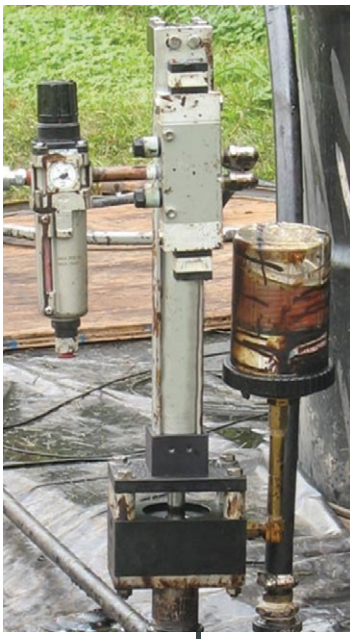
Pneumatic

Blackhawk's standard models of land-based pneumatics offer many choices for force and application requirements using closed-system, above-grade drivers — no compressed air enters the well or discharge.

Designed for depths 800 ft/240 m and flows to 11 gpm/41.6 lpm depending upon models, applications include:

- Chemically aggressive
- Elevated temperatures
- Sinking-product recovery / coal tar
- Landfill leachate and methane
- Deep, angled wells
- Crusty, bio-reactive, foamy
- Condensate sump
- Everyday pumping

V-2 Pneumatic



Edge Pneumatic

Land-Based

Offshore

Neptune Pneumatic

The Neptune Offshore Pneumatic Caisson Sump Piston Pump™ is a high-performance pump jack designed to remove hot, viscous, oily liquids from aggressive saltwater environments.

The lightweight Neptune driver is mounted over the caisson and built of high-grade stainless steel for greater efficiency and superior wear resistance. It draws product from operator-set depth at adjustable flow rates.

Designed for depths to 800 ft/240 m and flows to 11.5 gpm/43.5 lpm, advantages include:

- Unaffected by chemical composition
- Fits into enclosed vault
- All weather
- No pneumatic air in sump
- Safe, easy access above sump
- Reduced bio buildup, encrustation
- Shutdown does not damage driver
- Clean air discharge

Electric

Anchor Electric

Blackhawk's Anchor Electric Piston Pump® is a broad-duty model driven by a ball-screw actuator utilizing incoming single or 3-phase 120v, 240v or 480v AC current with an explosion-proof option.

Designed for depths to 800 ft/240 m and flows to 6.7 gpm/25.3 lpm depending on size, applications include:

- Hydrocarbon remediation
- NAPL recovery
- Chemical
- Landfill leachate
- Condensate sump
- Oilfield -- Rhino MiniJack

Anchor Electric

Apollo-AC Electric

Apollo-AC Electric

The Apollo-AC combines the reliable simplicity of Apollo's linear-rod design with the availability of 24/7 grid power.

Powered by 115v – 230v single-phase AC, the efficient 3/8 HP driver maintains steady flows to 3.5 gpm (13.25 lpm) at 100 ft (30.5 m).

Solar

Apollo Solar

The economical Apollo Solar Piston Pump™ is driven by a linear-rod motor powered by one or more solar panels, successfully operating in latitudes as northerly as Toronto, even in winter.

Designed for depths to 400 ft/122 m and flows to 2.7 gpm/10.2 lpm depending on size, applications include:

- Landfill gas dewatering
- Remote, closed sites
- Biomass / biogas condensate
- Refinery recovery
- Groundwater remediation
- Landfill leachate
- Pipeline condensate

An Elegantly Simple Biomass Sump Pump

Developed for tough landfill and remediation/recovery sites, Blackhawk Technology's Apollo solar and electric piston pumps have emerged as a key component in renewable energy.

Reliable, non-polluting, affordable Apollos pump anything that flows, regardless of viscosity or chemical composition.

The Scotch-yoke, above-grade driver has few moving parts and requires less maintenance. The in-sump piston pump resist biofouling and encrustation.

Flows range to 3,800 gallons per day for solar models, 4,300 gpd for AC Electric.

Solar-powered Apollo, pumping methane biogas condensate sump at large Midwest bioenergy operation.

Rhino MiniJack™ Oilfield Piston Pump

Blackhawk's innovative Rhino MiniJack™ Piston Oil Pump miniaturizes the century-old oilfield pump jack to recover oil economically from low-flow stripper wells, bringing up more oil and less water through micropumping.

At less than half the price of a pump jack and only 125 pounds, the Rhino MiniJack features a top-head-drive motor mounted at surface grade on a standard wellhead.

Power is direct from grade through the sucker-rod assembly. The quiet, low-profile MiniJack reliably recovers up to 15 bbl/day at 1,500 feet. Operating costs and maintenance requirements are low, and the pump operates in extreme environments.

The MiniJack can be tuned to the yield of formation, not overpumping, to reduce water intake, gas lock and emulsification. It can be made explosion proof, meeting Class 2, Div. 1 requirements.

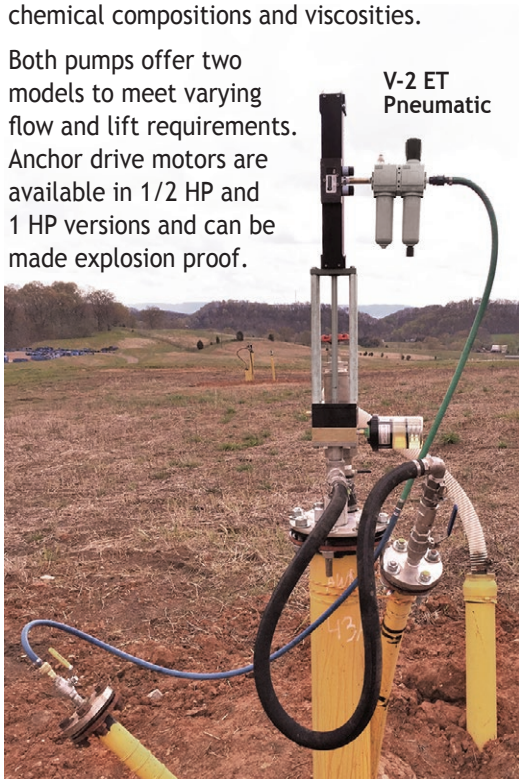
Rhino MiniJack, pumping stripper oil well

Elevated-Temp Pumps - 150°F to 300°F

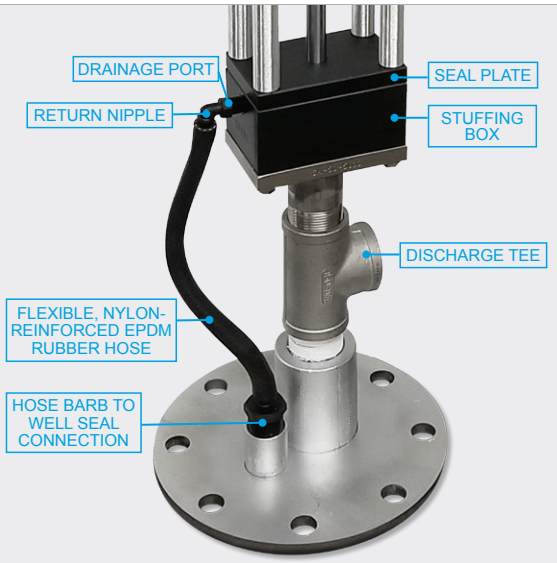
Pneumatic & Electric

Built for Elevated Temperature Landfills and other ET wells, Blackhawk's V-2 Elevated Temp Pneumatic and Anchor ET Electric manage virtually anything flowable, regardless of chemical compositions and viscosities.

Both pumps offer two models to meet varying flow and lift requirements. Anchor drive motors are available in 1/2 HP and 1 HP versions and can be made explosion proof.



Elevated-Temp Downhole



CleanHead System Keeps Seals, Stuffing Boxes Clean & Dry

All Blackhawk pneumatic, electric and solar pumps include the CleanHead Contained-Pump System™ to ensure that no below-ground fluid is present at or above the wellhead.

A CLEANHEAD PORT IS INCLUDED ON ALL NEW BLACKHAWK WELL SEALS.

The closed CleanHead system provides an exit drain to return any potential surface fluids back into the well.

Together with Blackhawk's airtight-seal seal plate and high-clearance driver extensions, the system is designed to keep stuffing-box cartridge seals and wellheads clean and dry if seals begin to wear.

Accessories

Air-Supply Kit

Cylinder oiler/ filter regulator conditions, cleans & regulates incoming air

Apollo-AC Control

Converts incoming grid AC to Apollo-motor DC, sets operator-directed speed

Conductivity Liquid-Level Control

Uses conductivity probes to turn pump on and off

Cycle Counter

Counts each full stroke; mounted on driver

Discharge Kit

Includes hose and connectors

External Foot Valve

Includes check valve & SS ball

Flexible Fiberglass Rod

Choose elevated-temp (green) or standard drive rod. Cut to any length.

Flow Meter

Counts gallons of liquid flowing from discharge tee

HDPE to SS Fittings

Threaded for heat butt fuse connections

Rod Lubricator

Injects tiny, pre-set amounts of oil into stuffing box to lubricate rod

Rod-to-Rod Coupling

Connects fiberglass rods to extend length

Solar DC Controller

Modulates solar panel variances to feed steady 24v DC current

SS Coupling w Drain Port

1.25 in. NPT female threaded connection from discharge tee

Stuffing Box Seal Kit

Seals in Buna & Viton; quick pop-out cartridges

Vanstone Flange & Well Seals

Zinc-coated steel seals 4 to 12 in., gas head 6 to 12 in.; with drain port

Pneumatic On/Off Timer

Turns pump on and off at operator-set schedule

Pressure Gauge

Measures pressure in pump discharge

Pressure Relief Valve

Controls/limits built-up pressure from clogs, failures

Rod Extractor

Rescue tool if drive rod slips below discharge tee

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