Fuel Supply Pumps – LNG
ACD offers a wide range of cryogenic fuel supply pumps to accommodate various flow and pressure requirements for LNG fueled gas engine systems, bulk transfer, off-loading, and bunkering.

Each centrifugal and reciprocating pump is specifically designed to meet LNG or CNG applications while providing both efficient operation and extended product life. Cryogenic, hydro, and pneumatic testing during the assembly phase ensure that ACD pumps comply with industry requirements and match product performance guarantees.

### Fueling Applications
- Passenger car (CNG)
- Light or medium duty truck (CNG & LNG)
- Heavy duty truck (LNG)
- Bus (CNG & LNG)
- Maritime (LNG)
- LMT (LNG)
- Rail (LNG)

### Pump Applications
- Fuel gas systems
- LNG high pressure feed to L/CNG station vaporizers
- Vehicle loading and trailer off-loading
- Bulk transfer
- Bunkering

### LNG Properties
- 1 Litre = .64 Nm3 gas
- ± 95% methane (CH4)
- Expansion (liquid to gas): 1 to 620
- Colorless & odorless
- Non toxic, non corrosive
- Specific gravity: Natural gas = .55
  (Air = 1.0, Gasoline = 3.4, Diesel > 4.0)
- Flammability limit: 5-15% (vs. 0.5-4.1% for diesel and 1-7.6% for gasoline) mixed with air
- Ignition temperature: 281-343°C (538-649°F)

### Estimated Greenhouse Gas (GHG) Reduction in Light-Duty Vehicles (LDVs)
- LNG (21-25%, CH4)
- CNG (21-26%, CH4)
- Natural gas vehicles reduce emissions
  (NOx = 87%; CO = 70%)
L/CNG Station Operations

- Fuel is brought in by transport trailers
- LNG is stored in a cryogenic tank
- Vehicles are fueled using a pump and single fill hose from dispenser

CNG Station Operations

- Fuel is supplied via local pipeline
- Gas is compressed and stored in ASME tubes/bottles
- Vehicles are fueled by pressure differential from the storage banks / compressor

L/CNG stations are designed to refuel using low-pressure ("slow-fill") or high-pressure ("fast-fill") systems.
ACD’s TC-34 submerged pump is engineered to meet the world’s most demanding LNG transfer and fueling needs. Able to endure thousands of starts per year without requiring an overhaul, its durable design features an exclusive bearing material composition and vertically-mounted stator and rotor assembly.

Unlike conventional pumps, the TC-34 pump is immersed in fluid, allowing the unit to operate without a mechanical shaft seal. With immediate start-up and minimal heat loss, the TC-34 offers the most dependable and trouble-free operation available for land, sea, and rail applications.

**Performance Map**

**Features & Benefits**
- Gastight design
- Pump and motor are fully submerged in liquid, minimizing heat loss and guaranteeing quick response pumping
- Sealless, submerged design minimizes maintenance requirements
- Vertical pump design provides greater stability and longer life
- Specially-designed VFD motor provides a broad range of operation
- Product-lubricated bearings increase bearing life expectancy

**Applications**
- LNG feed to high pressure (LCNG) pump
- LNG feed to natural gas engines
- LNG storage tank refilling
- LNG circulation
- Storage transfer and pipeline injection for LNG peak shaving plants
ACD’s AC-32 sealless, centrifugal pump offers a safe solution to transferring flammable liquefied gasses such as LNG. Its vertical pump and variable speed motor are hermetically sealed, eliminating the need for a mechanical shaft seal. A helical inducer reduces the NPSH requirement of the pump and assures that suction conditions are stable.

**Features & Benefits**
- Fully submerged pump and motor minimize start-up and downtime for quick, responsive pumping
- Sealless, zero-leakage design minimizes maintenance requirements and is environmentally safe
- Variable frequency motor provides a broad range of operation and power
- Cooling from the cryogen extends electrical motor and bearing life
- Low NPSH inducer and variable speed, soft-start motor eliminate cavitation at pump start-up
- Spring-loaded system allows slight axial movement of the rotor to compensate for temperature

**Applications**
- Bunkering
- LNG feed to natural gas engines
- Storage transfer and pipeline injection for LNG peak shaving plants
- LNG storage tank refilling
- LNG circulation
- LNG feed to LNG vehicle

**Performance Map**

<table>
<thead>
<tr>
<th>Speed Range</th>
<th>Flow Rate (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 x 2 x 4.5</td>
</tr>
<tr>
<td>2</td>
<td>1 x 2 x 6</td>
</tr>
<tr>
<td>3</td>
<td>1.5 x 3 x 6</td>
</tr>
<tr>
<td>4</td>
<td>2 x 4 x 6</td>
</tr>
<tr>
<td>5</td>
<td>2 x 4 x 8.5</td>
</tr>
<tr>
<td>6</td>
<td>3 x 5 x 8.5</td>
</tr>
<tr>
<td>7</td>
<td>4 x 5 x 10.5</td>
</tr>
</tbody>
</table>
ACD’s X9 high pressure reciprocating pump offers reliable LNG service using existing SGV components with proven technology and standardization. The X9 features a modular design with a wide range of flow rates. Multiple cold end sizes allow interchangeability and flexibility at the customer’s specific flow and pressure requirements.

**Features & Benefits**
- Modular design (available in 1, 2, or 3 cylinder configurations) provides a wide range of flow rates
- Splash oil lubrication extends drive end life
- Multiple cold end sizes allow interchangeability and flexibility at the customer’s specific flow and pressure requirements
- Drive end design uses existing SGV components, providing proven technology, reliability, and standardization

**Applications**
- High pressure LNG for L/CNG vehicle fueling

Note: LOX limited to 4,000 psi
ACD’s P2K reciprocating pump features a vertical design that offers less vibration, reduced noise, and a compact system footprint. Its cold end is submerged inside a vacuum-jacketed liquid sump, minimizing heat leak and increasing system efficiency.

**Performance Map**

<table>
<thead>
<tr>
<th>Flow Rate–gpm</th>
<th>Discharge Pressure – psi</th>
<th>Discharge Pressure – bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.55</td>
<td>1.25 x 1.50</td>
<td>1.75 x 1.50</td>
</tr>
<tr>
<td>3.47</td>
<td>1.50 x 1.50</td>
<td>2.00 x 1.50</td>
</tr>
<tr>
<td>4.54</td>
<td>1.75 x 1.50</td>
<td>2.00 x 1.50</td>
</tr>
</tbody>
</table>

Maximum Capacity Rating:
- 2.55 gpm (9.6 lpm) @ 6,000 psi (414 bar)
- 3.47 gpm (13.1 lpm) @ 4,500 psi (310 bar)
- 4.54 gpm (17.2 lpm) @ 3,500 psi (241 bar)

Contact ACD Engineering for recommendations for flow/pressure specifications not listed.

**Features & Benefits**
- Vertical pump design eliminates gravitational loading on the piston, extending sealing ring life and providing smoother suction valve operation
- V-band clamp secures the sump to the intermediate, allowing quick and easy access to the cold end assembly
- External re-lubrication nipples for roller bearings and crosshead assembly provide extended life
- Motor positioned on the backside of the pumping skid eliminates possible fire, explosion, or hazard in the event of a liquid leak
- Replaceable crosshead wearband eliminates crosshead piston wear and reduces maintenance

**Applications**
- Light duty high pressure LNG for L/CNG vehicle fueling
ACD’s SGV reciprocating pump has become the industry’s leader for LNG high pressure and high flow applications. With its new large 50 mm bore (1.97 inch) cold end, the SGV can achieve flows up to 25 gpm (95 lpm) at 6,000 psi (414 bar). SGV models are available in complete skid assemblies with auxiliary piping components included to ensure safe, reliable, and efficient LNG pumping. This compact, modular pump is available in single, double or triple cylinder configurations for a wide range of flow options.

**Features & Benefits**
- Modular, compact displacement pump (available in 1, 2, or 3 cylinder configurations) provides a wide range of flows
- Vacuum-jacketed cold end for minimal cool-down losses and economical operation
- Pressurized, oil-lubricated drive with oil pump and reservoir allows higher bearing loads and prevents internal leakage
- Optimized cold end packing assembly increases seal life

**Applications**
- High pressure LNG for L/CNG vehicle fueling
- ME-GI fuel gas system fueling
- Rail fuel gas system fueling
ACD’s SLS reciprocating high pressure pump is engineered to provide high pressure, variable flow with high efficiency for onboard fueling to LNG ship engines and land-based skidded assemblies for high flow and high pressure applications. The SLS features an improved drive end design which allows cooler temperatures during operation and bronze babbitted journal bearings for longer life. Each integral skid-mounted system is designed for ease of operation and maintenance, with multiple configurations to enable adaptability and conformity to LNG shipboard applications.

Features & Benefits
- Improved drive end design allows cooler temperatures during operation with specialized bearings for longer life
- Multiple configurations enable adaptability and conformity to mobile and stationary applications using a standard base model
- Better than 30 to 1 turndown ratios allows for a wide range of operating parameters

Applications
- ME-GI fuel gas system fueling
- Rail fuel gas system fueling
- Land-based high pressure supply to power stations and pipelines
From its headquarters in Southern California, Cryogenic Industries has assembled a network of companies which offer the manufacturing, sales, and service support for customers in today's industrial gas, petrochemical, and new energy markets.

- Cryogenic pumps
- Fuel gas system support
- Turbo expanders
- Heat exchangers
- Vaporizers
- CO₂ generation and recovery systems
- Air separation plants
- Energy recovery turbines
- Process plant systems

Global Network

**NORTH AMERICA**
1. ACD
2. Cosmodyne
3. CryoAtlanta
4. CryoCanada – Red Deer
5. CryoCanada – Toronto
6. Cryogenic Industries – Houston
7. Cryoquip
8. Emergent
9. Pittsburgh Cryogenic Services

**INTERNATIONAL**
10. ACD – Brasil
11. ACD – Dubai
12. ACD Europe (ACD Cryo)
13. ACD – India
14. ACD – Kolkata
15. CI – Brasil
16. Cryogenic Industries – China
17. Cryogenic Industries – Korea
18. Cryogenic Industries – Malaysia
19. Cryoquip – Australia
20. Cryoquip – China
21. Cryoquip – India
22. Cryoquip – Malaysia
23. Cryoquip – South America
24. Cryoquip – UK
25. Rhine Engineering
Cosmodyne, LLC. specializes in the design and manufacture of air separation plants for the industrial gas, aerospace and military industries. With over 50 years of experience in cryogenic liquefaction process plants and turbo expanders for refrigeration cycles, Cosmodyne is able to provide in-house integration and optimization capabilities for producing liquefiers capable of highly stable and efficient operation.

Cosmodyne’s plants are custom-engineered for LNG production capacities ranging from 10,000 to 200,000 gallons per day (38 to 756 m³). Each plant features environmentally friendly nitrogen gas closed loop refrigeration cycles to liquefy the natural gas.

Modular, skid mounted assemblies offer easy onsite installation suitable for remote locations and can provide anywhere from 10,000 to 30,000 gallons per day (38 to 113 m³).

Nitrogen Refrigeration System
- Inert, nonpolluting, corrosion-free refrigerant
- Reliable and simplified single refrigerant system
- Rapid return to production after cold plant shutdown
- Capable of frequent load change
- Minimizes or eliminates need for vapor recovery systems
- Efficiently recovers energy available from near-isentropic expansion of nitrogen refrigerant
Cryoquip, Inc. is an industry leader in the engineering and manufacturing of a diversified line of LNG vaporizing systems which use natural gas, ambient air, water, or steam as an energy source. The systems are designed for either stationary single site applications or as portable systems to be transported from site to site on available trailer or other mobile methods.

Applications include 'send out' vaporization systems for peak shaving plants, temporary gas pipeline supply in the event of emergency or scheduled shutdowns, vessel pressure building, or other process applications for either continuous or temporary service.

Cryoquip also manufactures modular, skid-mounted nitrogen cycle LNG liquefaction plants as well as expander plants for LNG production using pipeline pressure-let-down, LNG boil-off recovery systems, and nitrogen rejection units.
Energent Corporation was formed at the start of the 21st century to create a new paradigm for energy production. By exploiting waste heat and pressure, Energent is developing efficient and cost effective means to convert lost energy into useful power for liquefaction and air separation plants. When installed in parallel with a two-phase J-T valve, Energent’s Flashing Liquid Expander (FLE) generates electricity, increases liquid production, and reduces the specific power required for refrigeration. The FLE, also known as a Variable Phase Turbine (VPT), combines converging-diverging nozzles with an axial impulse turbine to recover energy from supercritical, flashing liquid, vapor, and liquid expansions. Synchronous speeds eliminate the need for a gearbox and the FLE’s hermetic system requires no shaft seal. Unlike radial inflow designs, Energent’s axial impulse turbine prevents erosion from the two-phase flow, requires only a single stage, and achieves high efficiency with flashing LNG.
ACD’s fuel supply centrifugal and reciprocating pumps provide clean energy solutions for LNG vehicle, shipboard and rail fuel gas systems, bulk transfer, off-loading, and recirculation. Each LNG pumping system is engineered to meet the individual flow and pressure requirements needed to provide our customers with eco-responsible solutions for today’s industries.