Arrow Overview
ARROW ENGINE COMPANY • TULSA, OK

OVERVIEW-ML-S-FEB15
In 1955 Arrow Engine Company opened for business, beginning the tradition of providing premium service and exceptional products to the oil & gas industry, as well as the industrial engine market, throughout the world.

Arrow is a part of the Engineered Components segment formed by TriMas Corporation. Headquartered in Bloomfield Hills, Michigan, TriMas Corporation (NASDAQ-TRS) provides engineered and applied products for growing markets worldwide.

With a consistent focus on our customers’ needs, striving to help them grow their business, and producing the most reliable equipment and parts in the industry, Arrow has forged a tradition of excellence since 1955.
### ARROW ADVANTAGES

- Designed for continuous duty, 24/7
- Run on a variety of low BTU gases (Natural Gas, Methane, Butane, Propane, Diesel)
- Utilizes heavy flywheels to provide high inertia running at low RPM (C-Series)
- Less wear, less maintenance, and less repair compared to higher RPM engines (C-Series)
- Naturally Aspirated and Turbocharged Aftercooled (A-Series)
- Lowers operating costs as much as half the cost of electric motors
- Solid State ignition systems are standard.
- All Arrow engines are EPA certified or certifiable for emissions standards

### ENGINE COMPARISON CHART

<table>
<thead>
<tr>
<th>ENGINE</th>
<th>CYL RATIO*</th>
<th>BHP</th>
<th>RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR 220 (Parts Only)</td>
<td>4</td>
<td>17.24</td>
<td>1,000-1,200**</td>
</tr>
<tr>
<td>A-32</td>
<td>3</td>
<td>9.0:1</td>
<td>17-24.5</td>
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<tr>
<td>A-42 (VR 260)</td>
<td>4</td>
<td>9.0:1</td>
<td>17-47</td>
</tr>
<tr>
<td>A-54 (VR 320)</td>
<td>6</td>
<td>8.0:1</td>
<td>26-48</td>
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<tr>
<td>A-54 Crossflow</td>
<td>6</td>
<td>8.0:1</td>
<td>35-70</td>
</tr>
<tr>
<td>A-62 (VR380)</td>
<td>6</td>
<td>9.0:1</td>
<td>40-80</td>
</tr>
<tr>
<td>A-62TA (VR380TA)</td>
<td>6</td>
<td>9.0:1</td>
<td>64-115</td>
</tr>
<tr>
<td>A-90</td>
<td>6</td>
<td>9.0:1</td>
<td>57-109</td>
</tr>
<tr>
<td>A-90TA</td>
<td>6</td>
<td>9.0:1</td>
<td>82-167</td>
</tr>
<tr>
<td>C-46</td>
<td>1</td>
<td>4.8:1</td>
<td>5-9</td>
</tr>
<tr>
<td>C-66</td>
<td>1</td>
<td>5.2:1</td>
<td>7-13</td>
</tr>
<tr>
<td>C-96</td>
<td>1</td>
<td>4.8:1</td>
<td>16-18</td>
</tr>
<tr>
<td>C-101</td>
<td>1</td>
<td>6.2:1</td>
<td>19-24.5</td>
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<tr>
<td>C-106</td>
<td>1</td>
<td>6.2:1</td>
<td>17-32</td>
</tr>
<tr>
<td>C-255</td>
<td>2</td>
<td>7.0:1</td>
<td>32-55</td>
</tr>
<tr>
<td>L-795</td>
<td>2</td>
<td>5.3:1</td>
<td>35-66</td>
</tr>
<tr>
<td>K-6</td>
<td>1</td>
<td>8:1</td>
<td>2-7.4</td>
</tr>
<tr>
<td>A-90</td>
<td>6</td>
<td>9.0:1</td>
<td>82-167</td>
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<td>A-90TA</td>
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<td>9.0:1</td>
<td>70-140</td>
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<tr>
<td>C-46</td>
<td>1</td>
<td>4.8:1</td>
<td>5-11</td>
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<tr>
<td>C-66</td>
<td>1</td>
<td>5.2:1</td>
<td>7-13</td>
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<tr>
<td>K-6</td>
<td>1</td>
<td>8:1</td>
<td>2-7.4</td>
</tr>
</tbody>
</table>

*Compression Ratio
**Steady state operation only

### C-SERIES ENGINE FOR PUMP JACK

- Aluminum Guard
  - The Arrow aluminum guard is now a standard feature of all C-Series engines.
- AutoStart NS-2
  - Our new AutoStart NS-2 control panel is a simple, programmable system that is compatible with all Arrow Engines.
- Clutch Actuator
  - Arrow has introduced its new patented Clutch Actuator for C-Series and A-Series Arrow Engines.
**GENSETS**

Any Arrow Engine Enclosure Options Available
Natural Gas Fueled

A-42 GENSET  A-54 GENSET  A-62 GENSET  A-90 GENSET

**APPLICATIONS**
- Prime power for facilities
- Backup power
- Emergency power
- Electricity for remote locations
- Compressor power
- Irrigation power
- Hydraulics power

**C-SERIES GENSET POWER RATINGS**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CYLINDERS</th>
<th>kW RATING</th>
<th>ENGINE RPM</th>
<th>ALTERNATOR RPM</th>
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<tr>
<td>C-46 AC</td>
<td>1</td>
<td>5</td>
<td>700</td>
<td>1,800</td>
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<tr>
<td>C-46 DC</td>
<td>1</td>
<td>5</td>
<td>700</td>
<td>1,800</td>
</tr>
<tr>
<td>C-66 AC</td>
<td>1</td>
<td>7.5</td>
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<tr>
<td>C-96 AC</td>
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<tr>
<td>C-106 AC</td>
<td>1</td>
<td>25</td>
<td>700</td>
<td>1,800</td>
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**A-SERIES GENSET POWER RATINGS**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>PRIME POWER RATINGS</th>
<th>STANDBY POWER RATINGS</th>
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<tbody>
<tr>
<td></td>
<td>1800 RPM kW RATING</td>
<td>1500 RPM kW RATING</td>
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<tr>
<td></td>
<td>1800 RPM kW RATING</td>
<td>1500 RPM kW RATING</td>
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<td>A-42</td>
<td>28</td>
<td>23</td>
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<td>A-54</td>
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<td>36</td>
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<tr>
<td>A-62</td>
<td>50</td>
<td>42</td>
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<tr>
<td>A-62 TA</td>
<td>75</td>
<td>63</td>
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<td>A-90</td>
<td>75</td>
<td>68</td>
</tr>
<tr>
<td>A-90 TA</td>
<td>100</td>
<td>95</td>
</tr>
</tbody>
</table>

**APPLICATIONS**

- Prime power for facilities
- Backup power
- Emergency power
- Electricity for remote locations
- Compressor power
- Irrigation power
- Hydraulics power

**GENSET ENCLOSURE**

**BACKUP GENERATOR FOR CNG STATION**
### A-SERIES POWER RATINGS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>PEAK INTERMITTENT TORQUE @ RPM</th>
<th>BRAKE HORSEPOWER AT SPEEDS INDICATED (S.A.E.)</th>
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<tbody>
<tr>
<td></td>
<td>FT LB</td>
<td>N'M</td>
</tr>
<tr>
<td>A-32 Natural Gas</td>
<td>105@900</td>
<td>90</td>
</tr>
<tr>
<td>A-42 Natural Gas (VR260)</td>
<td>165@1200</td>
<td>224@1200</td>
</tr>
<tr>
<td>A-54 Natural Gas (VR330)</td>
<td>220@1600</td>
<td>296@1600</td>
</tr>
<tr>
<td>A-54 HD-5 Propane (VR330)</td>
<td>285@1400</td>
<td>386@1400</td>
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<td>A-62 Natural Gas (VR380)</td>
<td>269@1400</td>
<td>365@1400</td>
</tr>
<tr>
<td>A-62 Turbo Natural Gas</td>
<td>392@1400</td>
<td>55</td>
</tr>
<tr>
<td>A-90 Natural Gas</td>
<td>376@1200</td>
<td>510@1600</td>
</tr>
<tr>
<td>A-90 Turbo Natural Gas</td>
<td>527@1600</td>
<td>116</td>
</tr>
</tbody>
</table>

### A-SERIES FEATURES

- A tradition of excellence since 1955 operating on natural and well-head gas
- Capable of operating on most spark-ignited fuels
- Most popular ignition systems available
- Lifting eyes (front & rear)
- Forged steel crankshaft and connecting rods
- Crankshaft dynamically balanced with hardened journals
- Heavy-duty, deep-skirted crankcases
- Exhaust manifold with top or rear outlets
- Replaceable precision main and rod bearings
- Full pressure lube oil system with full flow oil filter
- Flywheel - SAE No 3 with ring gear and SAE No 3 housing
- Overhead valve cylinder heads with replaceable guides and seats
- Five main bearings on A-42 and seven main bearings on A-54 and A-62
- 10% regulated speed by mechanical governor (other options available)
- 4-groove crankshaft pulley, 2-groove fan, 1-groove water pump, 4th-groove auxiliary
- Single- or double-plate clutch available
- Wet Liners
**VRC-2**
- Two-throw separable reciprocating gas compressor
- Horizontally opposed cylinders accurately balanced for smooth running
- Long lasting durability at 1800 RPM
- Unique three-throw crankshaft configuration eliminates opposing cylinder offset and the vibration associated with traditional designs
- Combined rod-load capability of 14,000 lbs
- Pressurized lubrication system, Hoerbiger valves, and industry proven accessories standard on all Arrow compressors

**VRC-CNG**
- Two-throw compressed natural gas compressor
- Rated at 150 Horsepower
- 3" stroke
- Motor or engine driven
- Combined rod-load capacity of 16,000 lbs
- Maximum Speed 1800 RPM
- Forged steel connecting rods
- First stage 8.5" cylinder rated 250 PSIG MAWP
- Second stage 4.25" cylinder rated 750 PSIG MAWP
- Third stage 2.25" cylinder rated 2500 PSIG MAWP
- Final stage 1.125" cylinder rated 6,000 PSIG MAWP

**VRS-2**
- 275 hp at 1800 rpm
- 3" Stroke
- Combined rod-load capability of 20,000 lbs
- Separable distance pieces
- Babbitted crossheads
- Double-acting and steeple cylinders from 2.25" to 10" diameter
- Variable volume clearance pockets
- Hoerbiger’s latest valve design
- Carbon-filled Teflon® rings and packing

**VRU-1**
- Natural gas fueled Vapor Recovery Unit
- Natural gas booster compressor
- Combined rod-load of 10,000 lbs
- 150-600 RPM Speed Range
- 5 or 8 inch double acting cylinders
- 2 1/4" Stroke
- 158 HP
- Low Operating Speed

**VRU-2**
- 275 hp at 1800 rpm
- 3" Stroke
- Combined rod-load capability of 20,000 lbs
- Separable distance pieces
- Babbitted crossheads
- Double-acting and steeple cylinders from 2.25" to 10" diameter
- Variable volume clearance pockets
- Hoerbiger’s latest valve design
- Carbon-filled Teflon® rings and packing

**VRC-POWERED BY A-SERIES ENGINE**
VRC-2 Packages Powered by A-62 Engines with Arrow Gas Products Vessels

**PACKAGE OPTIONS**

- Engine Drive or Electric Motor Drive
- Low BTU Carburetion
- Standard or Critical Grade Silencers and Catalytic Converters
- Class I, Div. 2, Group D Capable
- Automatic Bypass System/Suction Makeup
- Air/Gas/Electrical Starter System
- 12V/24V Electrical System
- Automatic Cooler Louvers
- Suction & Discharge Companion Flanges
- Trailer Mounting Available
- ASME Coalescing Fuel Scrubbers
- ASME Coded Scrubbers
- Piping design to meet B-33.3 standards
- Pressure Relief Valves
- Gas Cooler with Manual Louvers
- Spare Parts
- Packages available with A-42, A-54, A-54CF, or A-62 Arrow Engines, or 3306NA, 3406NA
- Other manufacturers’ engines up to +/- 275 HP
- Easy to Operate
- Ergonomically Easy to Maintain
- Standard or Custom Paint
- Bent utility pipes
- 2-hole strap clamp bracing
- Ship-board cable in fiberglass tray
- Metal flex hose on oil make-up
- Concrete-filled skids
GAS PRODUCTS

PRODUCTS
- Meter Runs (housing optional)
- Volume Tanks
- ASME Code Vessels
- Vertical & Horizontal Separators
- Suction Scrubbers
- Coalescers
- Skids

WELDING CAPABILITIES
- All types of pressure containing vessels
- Carbon steel
- Stainless steel
- Exotic alloys
- From 1/2” up to 108” diameter

ARROW ADVANTAGES
Arrow Gas Products strives to maintain the highest customer satisfaction by providing quality standards above and beyond the industry norm.
- On-site CWI monitors weld quality continuously
- State-of-the-art blast and paint facility
- Superior American made parts
- Meter Runs meet and exceed AGA standards
  - Fabrication of meter tubes meets or exceeds API standards
  - All vessels are built to ASME code standards
  - Arrow ASME code stamp registered with NBIC ensures vessels have been inspected and conform to standards
  - Authorized U and R stamps for ASME Section VIII as well as repairs and alterations
  - 30,000 square foot of fabrication facilities
ARROW ELECTRONICS
Cost effective and proven controls for engines and engine-driven equipment.

AUTOSTART NS-2
A simple, programmable system that is compatible with all Arrow Engines. Programs can be set for different cycles each day of the week as well as continuous monitoring of critical engine operating parameters and automatic shutdown. Easily automate and monitor your oil field operations.

ELECTRONIC CONTROL PANELS
Arrow's electronic control panels can be combined with Arrow Compressor Packaging to monitor functions, pressures, temperatures, vibrations, and liquid level controls. Arrow panels include a Compressed Natural Gas (CNG) panel for complex fueling stations, as well as a Field Gas Enunciator panel which is built to exceed our customer's requirements.

A-62 Engine with CD-1 Ignition System
**CHEMICAL PUMPS**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OPERATION</th>
<th>PRESSURE (PSI)*</th>
<th>QUARTS**</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERIES 10</td>
<td>Beam</td>
<td>1,500-3,000</td>
<td>12-184</td>
</tr>
<tr>
<td>SERIES 12</td>
<td>Pneumatic</td>
<td>1,500-5,500</td>
<td>50-240</td>
</tr>
<tr>
<td>SERIES 430</td>
<td>Electric</td>
<td>600-3,000</td>
<td>1-64</td>
</tr>
<tr>
<td>SERIES 500</td>
<td>Pneumatic</td>
<td>2,000-12,000</td>
<td>64-2,400</td>
</tr>
<tr>
<td>SERIES 510</td>
<td>Pneumatic</td>
<td>100-6,000</td>
<td>9-128</td>
</tr>
<tr>
<td>SERIES 1200</td>
<td>Solar</td>
<td>1,200</td>
<td>20-40</td>
</tr>
</tbody>
</table>

* Maximum Discharge Pressure (PSI)
** Maximum Discharge Per Day (Quarts)

**SERIES 510 MICROVALVE**

Arrow’s Series 510 pump is equipped with a Microvalve pump that operates slowly, one stroke every two minutes to twenty strokes per minute. Eliminates pilot valve problems.

**ARROW CHEMICAL INJECTOR PUMPS**

Beam, gas, electric, solar, or air powered positive displacement Arrow Chemical Injector Pumps are precision engineered and designed for the injection of de-emulsifiers, solvents, corrosion inhibitors, lubricants, or methanol into gas systems, as well as desalting agents into wellheads and pipelines.
**REPAIR KITS**

Arrow repair kits make engine repairs quick and easy by assuring all parts are present right from the start. Arrow carries more than 500 repair kits for everything from governor rebuilds to engine overhauls. All our parts meet or exceed OEM standards.

**ARROW OEM PARTS**

Arrow Engine stocks a vast array of replacement parts for a wide variety of engines. Arrow knows that your products performance depends on quality parts. As the OEM for C-Series, K-Series, L-Series, and A-Series gas engine product lines, as well as chemical pumps, compressors, and associated products, we carry the very best parts and the most complete selection available anywhere. We have what you need to keep your Arrow product running at peak performance.

**OTHER REPLACEMENT PARTS**

<table>
<thead>
<tr>
<th>Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ajax®</td>
<td>Parts for over a dozen engine models</td>
</tr>
<tr>
<td>Caterpillar® 3300 Series</td>
<td>Complete engine rebuild kits, water pump kits, gasket sets,</td>
</tr>
<tr>
<td></td>
<td>and much more</td>
</tr>
<tr>
<td>Fairbanks Morse®</td>
<td>A vast array of engine replacement parts in stock</td>
</tr>
<tr>
<td>Waukesha® Intermediate</td>
<td>Waukesha® Intermediate (140G/F554, 145G/F817, WAK/F1197)</td>
</tr>
<tr>
<td>Waukesha® VHP®</td>
<td>Waukesha® VHP® (F2895, F3521, L5108, L5790, L7042, P9390)</td>
</tr>
<tr>
<td>Waukesha® VGF®</td>
<td>Waukesha® VGF® (F18/H24)</td>
</tr>
</tbody>
</table>

**ARROW MANUFACTURED REPLACEMENT PARTS**

**ARKA ENGINE COMPANY**

Arrow Engine Company
2301 East Independence, Tulsa, Oklahoma 74110
Toll free (800) 331-3662  Local (918) 583-5711
Fax (918) 699-2202

www.ArrowEngine.com

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A Tradition of Excellence

Quality Products Engineered to Last

Since 1955