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ASSOCIATION OF AEM EQUIPMENT MANUFACTURERS

NFPA National Fluid Power Association 50th Anniversary: 1953-2003

EGSA Electrical Generating Systems Association

■ Arrow natural gas engines such as this VRG330 are popular in small horsepower gas compression applications in New Mexico and other gas patch areas.

ACQUISITIONS AND PRODUCT DEVELOPMENT FUEL ENGINE MANUFACTURER'S GROWTH

Arrow Engines Offers Diversity of Products to Serve Compression and Other Industries

By Norm Shade

Tulsa, Oklahoma, U.S.A., once carried the title of "The Oil Capital of the World." Great companies such as Skelly, Getty, Sinclair and Gulf were started there. While most of this industry has moved elsewhere, Arrow Engine Company still builds its engines and serves its markets from this historic city.

In September 2002, Arrow Engine Company announced the acquisition of Haun Industries, a manufacturer and distributor of natural gas engine aftermarket parts. Len Turner, president and chief executive officer of Arrow Engine, said, "This allowed Arrow to pick up three complete new lines of replacement parts for established engine product lines like Waukesha, Gemini and Caterpillar. For the past 14 years Haun had built up an extensive customer base for engine replacement parts with a special niche in the oil and gas marketplace. With this acquisition, Arrow has gained market share and increased its offerings."

Arrow Engine is certainly no stranger to acquisitions or to product development related to the oil field. Founded in 1955, it developed lines of aftermarket parts for various oil and gas patch engines. In 1973 Arrow purchased the Climax engine line from Waukesha, primarily to get the patterns for its aftermarket parts business. However, during the subsequent "boom days" in the patch, the demand for pumping engines was so great that Arrow reintroduced complete new Climax engines to the market. This trend continued with the purchase of the Lufkin pumping engine line from Lufkin Industries in 1980, the Witte line from National Oilwell in 1990, and the VR engine series from Waukesha in 1993 (*Diesel Progress Engines & Drives*, November 1994).

Today, the company provides a wide variety of replacement parts and engine accessory products, as well as Arrow C Series slow-speed single-cylinder engines, Arrow VR multi-cylinder engines, generator sets and chemical injector pumps for the oil and gas industry and other industrial engine markets. In addition to Arrow engine parts, the company produces its own line of replacement parts for use in Ajax, Fairbanks, Caterpillar, Waukesha, Lufkin, Witte, Gemini, Ford and Hercules engines, and offers a wide assortment of Impco carburetor and Twin Disc clutch components, Arrow chemical injector pumps and parts, packaged generator sets and engine starters.

Arrow's aftermarket product lines include a number of replacement components. One such example is a one-piece all steel exhaust manifold that replaces the original three-piece cast iron design on Waukesha F817 engines. The all steel design resists cracking and simplifies installation and maintenance. Other examples include a series of one-piece large gaskets for Waukesha F3521, L7042, P9390 engines that eliminate the dovetail joints used on the original gaskets, various molded rubber gaskets, and a standard line of upper bore block repair sleeves for Caterpillar 300, 342, 3300, 3400 and 3500 series engines.

The most popular engine family manufactured by the company is the VR Series, which they tag "very reliable." This 3.875 in. (98 mm) bore by 4.665 in. (118 mm) stroke line consists of two naturally

■ **Arrow VR series engines are assembled on this conveyor line, which contains a block washer, rollover fixtures and other special tooling that can efficiently accommodate production runs of 10 or more engines at a time. Many of the engines are built as "long blocks" ready for short lead time completion with various customer preferred options.**

■ **ISO 9002 certified since 1994, Arrow's rigid quality standards back their standard replacement parts warranty of two years or 12,000 running hours.**

aspirated models, the four-cylinder VRG220 rated at 53 hp (40 kW) at 2200 rpm and six-cylinder VRG330 rated at 80 hp (60 kW) at 2200 rpm, and the turbocharged VGR-330TA rated at 100 hp (75 kW) at 1800 rpm. All ratings are for continuous duty on natural gas fuel at 500 ft. (152 m) altitude and 85°F (29°C) ambient temperature. Higher ratings are available for intermittent duty. The VR Series has more than 40 years of experience operating on natural gas and well-head gas. These engines are available in various configurations to suit a wide variety of applications.

Many VR improvements have been developed by Arrow's engineers. These include an improved cylinder block with improved water flow and liner sealing, new camshaft, a rugged PTFE rear oil seal, a 10:1 compression ratio configuration, a new cross-flow cylinder head and numerous new options and accessories. The new rear oil seal includes a Teflon sealing lip, dust excluder and carbon steel wear sleeve. It provides longer life at high and low temperature extremes and is more forgiving of shaft imperfections, excessive crankshaft movement and misalignment. Arrow offers a special tool that simplifies installation of this new seal. The new cross-flow head, which is now entering limited production, provides improved longevity, better valve life (typically 2 years) and better fuel economy.

Kavas Mistry, corporate director — VR engines, said, "The VR is the compressor engine of choice in its horsepower range, with large numbers applied in areas such as Farmington, New Mexico, the Arkoma basin and Canada." The engines are also popular on generator sets and pumps in the oil field, where dependability and long life are primary requirements. Mistry indicated that the engine is "user friendly" and easy to rebuild with replaceable wet liners, regrindable crankshafts and renewable cylinder heads. Most popular ignition systems are available.

Mistry added, "We try to work closely with customers and packagers in specification and delivery of the product, and we provide excellent and personalized after sales support." The company indicated it can normally deliver VR engines within a few days of a customer order.

The other gas engine series manufactured by Arrow is the C Series, which is a descendant of the original Climax four-cycle line. The company offers several single-cylinder models at continuous duty ratings from 11.7 hp (8.7 kW) to 38.7 hp (28.9 kW) and a two-cylinder model rated at 65.7 hp (49 kW). Arrow also manufactures the L Series and the W Series, which are based on the original Lufkin two-cycle gas and Witte four-cycle diesel engine lines. All of these models have rated speeds in the 600 to 800 rpm range and are used to drive pump jacks, liquid pumps and generators. "Engines and parts built by Arrow Engine Company have a long and enviable track record in the field," says Turner. "All of us at Arrow make it our first priority to build a superior product that will keep customers coming back for more."

Here too, product improve-

■ **An impressive collection of company product displays and historical photographs and collectibles from the oil boom days adorn special galleries, conference rooms, hallways and offices throughout Arrow's headquarters building in Tulsa, Oklahoma, U.S.A.**

ARROW ENGINE CO.
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www.arrowengines.com
Engine Range: 10 to 155 hp

Arrow Engine's VR series natural gas engines are available with a wide array of options.

ment has been the key to the series' continued popularity in these niche markets. Bob Fornell, C & L series sales consultant, said, "used engines are our main competition, so we have had to continually improve the Arrow C series in order to retain a market for new engines." Improvements such as a 12-volt ring gear starting system, Starfire 600 ignition and G-tube radiators have been introduced over the last decade. The Starfire capacitive discharge ignition has no moving parts and is much more consistent and reliable than the original magneto system that had 48 in. (1219 mm) leads. The G-tube radiator, which comes with a 2 year warranty, has a welded core with O-ring grommet cushioned header and tube joints, eliminating the original radiator's soldered joints that were susceptible to vibration, high temperature leaching and resultant overheating.

The company's most recent product introduction is an auto-start system for use with all Arrow engine families. This system, developed and tested by Arrow engineers, was first introduced to the field in the spring of this year. The flexible programmable system allows for different cycles for each day of the week as well as continuous monitoring of critical parameters and automatic shutdown when potentially hazardous conditions are detected. It can also provide automatic on/off cycle timing, selectable speed ranges and automatic start-up sequencing. The system is available for retrofit to existing engines and is backed by a one year factory warranty.

Arrow's 100,000 sq.ft. (9291 m^2) plant in Tulsa includes the business' administrative headquarters, engineering, parts manufacturing and procurement, engine assembly and test, parts warehousing and distribution, and customer service. The plant is the main inventory point for both new units and aftermarket parts. Everett Treat, plant manager, said, "We have grown by the acquisition of various product lines from different companies as well as our own new product development over many years, so we must manage 20,000 different part numbers." For this purpose, the company maintains a well organized document center and now produces all new designs on Autocad or a new 3D Unigraphics system that was added in 2002.

"We have been ISO 9002 certified since 1994, so we have a thorough quality system with extensive inspection capabilities including a CMM," explained Treat. All new suppliers, part numbers and revisions are subject to a first article inspection. New suppliers also are subject to 100% inspection for three consecutive orders until completely defect-free. Thereafter, a statistical sampling process is used to ensure consistent conformance.

Chemical injection pumps, engine subassemblies such as gears and carburetors, repair kits and flywheel starters are produced in a subassembly section of the plant. The main assembly bay contains two engine assembly lines, one for the C series and a conveyor assembly line for the VR series. The VR line, which contains a block washer, rollover fixtures and other special tooling, can efficiently accommodate production runs of 10 or more engines at a time. Many of the engines are built as "long blocks" ready for short lead time completion with various customer preferred options. Each engine is tested on a dynamometer after assembly and before painting.

Finished components and subassemblies are warehoused to support aftermarket and new engine production requirements. Customer orders, ranging from a single part to entire engine overhaul kits to a complete new engine, are packaged and shipped directly from the Tulsa plant. Kevin Boucher, manager — parts sales, said, "Our standard parts warranty is two years or 12,000 running hours." The company offers technical support and training on its products, including online parts lists and maintenance instructions via its website. Another feature of this site is the Arrow Utilities Toolbox, a handy set of web applications for selecting the appropriate Arrow Gas Engine for a specific application, calculating fuel consumption, determining sheave size and belt length, comparing gas versus electric engines, and more. The company holds a three day "hands-on" school 3 to 4 times a year on all engine series, including some in Spanish.

Arrow's pride in their oil and gas industry heritage is evident in their headquarters office, where visitors are in for a pleasant surprise. Not only are they greeted by an exceptional array of professional cutaways of the company's current products when they walk into the lobby, but special galleries, conference rooms, hallways and offices throughout the building contain an impressive collective of company product displays, historical photographs and collectibles from the oil boom days.

Arrow is part of the Industrial Specialties group formed by TriMas Corporation, which is headquartered in Bloomfield Hills, Michigan, U.S.A. Consisting of 12 companies with combined 2002 revenues of approximately $740 million, TriMas employs nearly 4000 people at 56 facilities in 10 countries around the world. ■

■ **Each Arrow engine is factory tested on a dynamometer after assembly and before painting.**

ARROW ENGINE COMPANY

Tulsa, Oklahoma

OEM

Arrow C-Series
(Continental Engine Models)

- *C-46
- *C-66
- *C-96
- *C-106
- *C-255

Arrow VR-Series
(Waukesha Engine Models)

- VR-155
- *VR-220
- VR-232
- VR-265
- VR-283
- VR-310
- *VR-330

Lufkin Engines

- L-333
- *L-795
- *L-1770
- *L-2165

Witte Engines
(National Oilwell)

- 98
- B12
- E15
- E20
- F32
- F42
- WD-14

Arrow OEM Chemical Pumps

- 10 Series Beam Operated
- 12 Series Pneumatic
- 13 Series Pneumatic
- 370 Series Pneumatic
- 430 Series Electric
- 500 Series Pneumatic
- 510 Series Pneumatic

* Engine models currently manufactured by Arrow Engine Company and owned as OEM

ARROW REPLACEMENT PARTS

Hercules Engines

- 4800
- 1600

Ford Engines

- 300 Industrial Engine Governor

Caterpillar Engines

- G3304
- G3306
- G379
- G398
- G399

Waukesha Engines

- 145G/F817
- 140G/F554
- WAK/1197
- F2895
- F3521
- L5108
- L5790
- L7042
- P9390

Ajax

- 5 x 6½ WL
- EA-22
  6½ x 8 CMA
- EA-30
  7¼ x 8 CMA
- E-30
  7½ x 8 CMA
- E-42
  8½ x 10 CMA
- DP-60
  9½ x 12 CMA
- DP-70/80/160
  11 x 14 CMA
- DP-115
  DP-230
  13¼ x 16

Piston & Rod Assemblies

- 180
- 360
- 600
- 800

Fairbanks Engines

- ZC-118 (Bell Model K-7)
- ZC-208 (Bell Model D12)
- ZC-346 (Bell Model B-18)
- ZC-503 (Bell Model J-24)
- ZC-739 (Bell Model E-40)

Gemini Engines

- G26
- G40
- Compressor Parts

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