



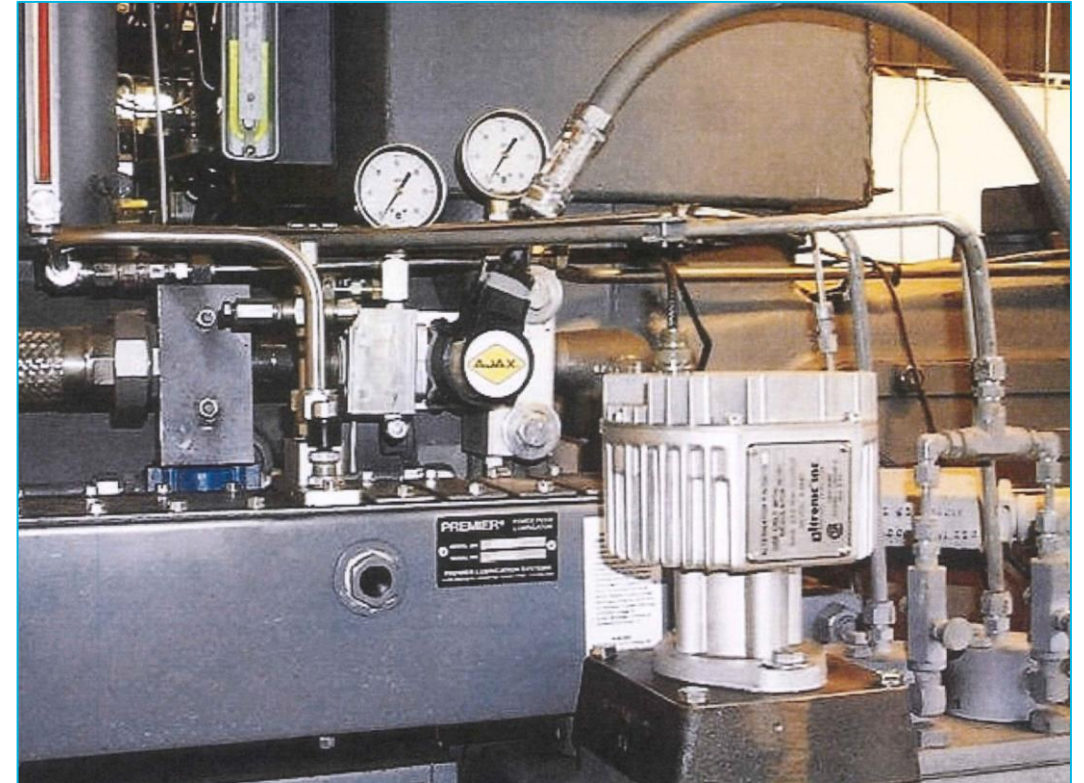
Ajax™ Performance Enhancements & Upgrade Offerings

April 3, 2018

Performance Enhancement & Upgrades

Introduction timeline

- 1963: Gas Injection Fuel Systems
- 1977: Flywheel Ring Gear Start Systems
- 1988: Compressor Poppet Valves
- 1991: LE (Low Emissions) Engines
- 1991: Dry Type Air Intake Systems
- 1995: 440 RPM
- 1998: Rebecca Gas Injection Valve Cartridge
- 2001: High Compression/Elevation Power Pistons
- 2002: Exhaust Expansion Chamber Systems
- 2003: IGTB Electronic Governor
- 2003: Catalyst Mufflers
- 2005: Flexible Fuel Header
- 2008: Screw in Pre Chambers (SIP)
- 2014: Auto Pre-Lube Systems
- 2014: Poppet Intake Valves

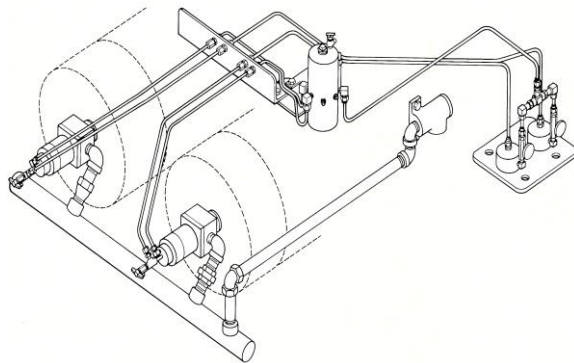


“Economizer” Gas Injection System



Description

- Fuel is injected directly into the power cylinder instead of being drawn into the engine through the scavenging chamber utilized on the Ajax two cycle engine.
- In addition to saving on fuel, this design provides precise balancing of the load on Ajax multi-cylinder engines



Benefits

- Reduces fuel consumption by up to 33%.
- From 11-14 scf/bhp-hr
- To 8.5-9 scf/bhp-hr

Model	Annual Fuel Savings (Mscf)	Annual Savings	
		\$1.50/Mscf	\$2.00/Mscf
E-42/C-42	1,343	\$2,015	\$2,686
DP-60/DPC-60	2,368	\$3,552	\$4,736
DP-80/DPC-80	3,146	\$4,719	\$6,292
DP-115/DPC-115	4,034	\$6,051	\$8,068
DP-160/DPC-160	5,624	\$8,436	\$11,248
DP-230/DPC-230	8,072	\$12,108	\$16,144
DP-300/DPC-300	10,512	\$15,768	\$21,024



Ring Gear Starting



PERFORMANCE



MAINTENANCE

Description

- Many end users are faced with declining site gas pressures. Air-in-head start systems require 200-250 psig pressure. With ring gear start, pressures as low as 30 psig.
- Legacy Ajax engines & engine-compressors originally built with air-in-head start systems can now be retrofitted with ring gear start systems.

Benefits

- Eliminates the need for air/gas receivers
- Eliminates the need for auxiliary air compressors
- Lower pressure supply required – as low as 30 psig
- Components readily available



Ring
Gear
Start



Compressor Poppet Valves



PERFORMANCE



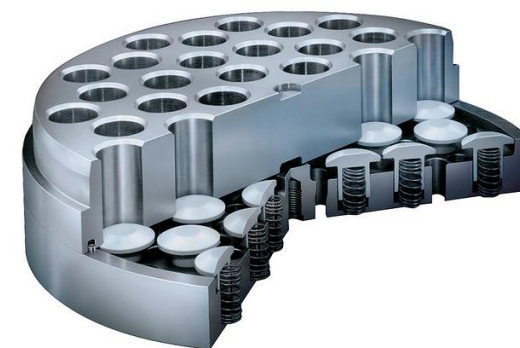
MAINTENANCE

Description

- Poppet valves deliver the highest efficiency of any valve design. Compared to conventional plate, channel or strip valves, poppet valves offer significant fuel or horsepower savings through more efficient and reliable operation.

Benefits

- More efficient performance
- Longer service life
- Reduced losses to 4-12%
- Fuel savings up to 12%
- Retrofitting payback in 6-18 months



Compressor Poppet Valves

Poppet vs. Plate valves performance - example

GE Oil & Gas, Ajax Division
DATE : Thursday, September 15, 2016
TIME : 11:24:26 AM
QUOTE: DPC-2804LE CONVERSION to POPPET VALVES PERFORMANCE
MODEL: DPC-2804LE 3-Throws

eAjax Performance Software
Version = 04.01.03

CYLINDER ON THROW #1: YK1F [12] (HE equipped with a manual VVP.) (Poppet Valves)
CYLINDER ON THROW #2: YK1F [12] (HE equipped with a manual VVP.) (Poppet Valves)
CYLINDER ON THROW #3: YKDC [8] (HE equipped with a manual VVP.) (Poppet Valves)

ARRANGEMENT: Two Double Acting Cylinders Stage-1, One Double Cylinder Acting Stage-2.

Elevation: 0.0 ft
Ambient Temperature: 100.0 °F
Gas Gravity: 0.6500
Gas Compress. Used: Redlich-Kwong
Load Available for Compression: 766.4 BHP

Barometric Pressure: 14.696 psiA
Gas to be Compressed: Natural Gas
Ratio of Specific Heats: 1.2600
Rated Speed (RPM): 440
Non-lube Factor: 1.00

Standard Conditions: Base Pressure of 14.6500 psiA and Base Temperature of 60.00 °F
Suction and Discharge Pressures are considered measured at the skid edge.

Run ID#-->>	PLATE VALVES	POPPET VALVES
Stage : Throw:	1 : 1 2 : 3	1 : 1 2 : 3
Speed (RPM):	440 440	440 440
Active HES : CEs:	2 : 2 1 : 1	2 : 2 1 : 1
* Cyl. Bore Diameter (in):	12.000 8.000	12.000 8.000
Stroke (in):	11.00 11.00	11.00 11.00
Max Gas RL-Compress (lbs):	37111 19022	37575 18907
Max Gas RL-Tension (lbs):	34924 14810	35751 14659
Max Net RL-Compress (lbs):	26326 20237	27242 18655
Max Net RL-Tension (lbs):	25425 14982	25648 13168
Min Rod Reversal:	Passed Passed	Passed Passed
Rod Diameter (in):	2.50 2.50	2.50 2.50
* HE Fixed Clr (%) :	12.30 12.20	14.60 14.10
* HE Set Clr (%) :	20.45 18.70	15.67 14.97
VVP Setting (<< Inches >>):	1.29 1.27	0.17 0.17
* CE Fixed Clr (%) :	11.20 13.00	13.60 15.10
* Average Clr (%) :	15.93 16.00	14.66 15.03
Z-Suction:	0.9902 0.9750	0.9902 0.9746
Z-Discharge:	0.9882 0.9742	0.9882 0.9737
Min HE VE-Suction (%) :	48.8 80.0	58.9 83.7
Min CE VE-Suction (%) :	69.9 85.2	63.7 83.6
Suction Pressure (psiG):	60.0 252.1	60.0 257.2
Discharge Pressure (psiG):	318.8 570.0	325.2 570.0
Suction Temperature (°F):	80.0 130.0	80.0 130.0
Dischrg Temperature (°F):	275.2 238.0	278.1 235.5
Cooler Temperature (°F):	130.0 120.0	130.0 120.0
Compression Ratio:	4.47 2.26	4.55 2.22
Load Per Stage (BHP):	481.3 284.1	496.7 266.2
Load Per Unit (BHP):	765.4 765.4	765.9 765.9
Per Unit Flow (BHP/MMscfd):	147.55 147.58	142.63 142.66
Flow Rate (MMscfd):	5.19 5.19	5.37 5.37
User Notes:	Run#1 17.97=3% 67.98=20% 19.12=3%	
Cooler (psi):66.70=20%		
VVP Throw#1 (<< Inches >>):	1.29	0.17
VVP Throw#2 (<< Inches >>):	1.29	0.17
VVP Throw#3 (<< Inches >>):	1.27	0.17
Ambient Temperature (°F):	100.00	100.00
Max Allowed Load (BHP):	766.4	766.4

PERFORMANCE PREDICTIONS ASSUME STEADY-STATE PRESSURES FREE OF THE EFFECTS OF PULSATION.
<<Flagged Items Indicate Corresponding Run ID# Details a Non-valid Operating Condition!
Flow tolerances measured at Ps flanges (psiG): ±3%(Ps>50 & r>2.5) ±6%(Ps<20) else ±4%.

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Economics of converting to poppet valves

- DPC-2804LE operating with plate valves, moving 5.19 MMscfd at current conditions
- Convert to Poppet valve, now moves 5.37 MMscfd
- Additional gas volumes of 0.18 MMscfd @ \$3.00 per Mscf:
- +\$540/day; +\$16,200/mo; +\$194,400/yr**

$P_s = 60$
 $P_D = 570$

bhp/MMscfd/stage Plate = 147.55
bhp/MMscfd/stage Poppet = 142.66

Q w/Plate = 5.19 MMscfd
Q w/Poppet = 5.17 MMscfd

Low Emissions (LE) Conversion Kit



Description

- Ajax LE technology is based on combustion modification in order to achieve NO_x emission control.
- The main component of the system is the ignitor assembly that creates a high energy ignition source, igniting a leaner mixture of fuel, resulting in lower NO_x formation and cleaner exhaust.

Benefits

- Lower NO_x
- Low maintenance
- Reduced fuel consumption
- Enhanced fuel tolerance
- Field installations of one day per power cylinder
- Available for all the large bore 13.25" and 15" Ajax engines.



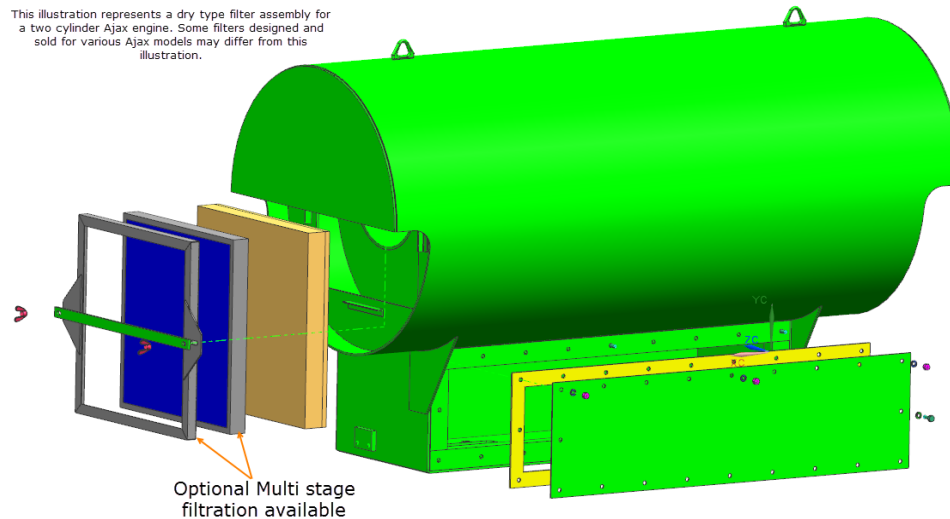
Dry Type Air Filter Conversion



Description

- Since the mid 1980's Ajax integral engine-compressors have been packaged with "Dry Type" engine air filters instead of the "Oil Bath" systems.
- Now Ajax owners with the older oil bath type air cleaner can benefit from this product improvement.

This illustration represents a dry type filter assembly for a two cylinder Ajax engine. Some filters designed and sold for various Ajax models may differ from this illustration.



Benefits

- Air filter housing designed with simple bolt-on flange matched to each individual integral model for easy installation.
- Air filter housing designed for maximum aerodynamic efficiency.
- Dry type air filters are enclosed in sturdy frame for effective sealing.
- Filters rated at 97% - 99% efficiency.
- Simple design provides easy access for filter removal.
- Dry type air filter improves air flow by providing a clearer air path thus reducing air restriction.
- Engines run cleaner extending the service life of the unit.
- Maintenance costs associated with air filtration system are drastically reduced

440 rpm Upgrade



Description

- Increases the speed of the large bore Ajax units from 360 & 400 rpm to 440 rpm, increasing horsepower ratings while maintaining emissions ratings.
- Eliminates the wedged flywheel design to use an external Ringfeder® design, which allows for the higher inertial forces at the increased operating speeds.

Economics of 440 rpm's

- DPC-360 operating at 400 rpm, moving 3 MMscfd at current conditions.
- Upgraded to 440 rpm, now moves 3.3 MMscfd
- Additional gas volumes of 0.3 MMscfd @ \$3.00/Mscf:
- **+\$900/day; +\$27,000/mo; +\$324,000/yr**



Rebecca Fuel Cartridge



Description

- The two-part system consists of a permanent valve body and replaceable cartridge assembly. The cartridge contains the complete valve mechanism and seat.
- For inspection, maintenance or replacement, simply remove the valve cartridge — the cage and all fuel gas piping remain in place
- New Rebecca valve can be supplied as original equipment or can be easily retrofitted to existing installations.

Benefits

- Low-friction operation and reduced stem leakage thanks to spring-loaded, non-metallic, self-adjusting packing
- Eliminated the need for lube maintenance due to low-friction, pre-lubricated bushings at both ends of the Rebecca valve stem
- Simplified maintenance - valve replacement without removing cage or piping
- Reduced replacement time, from hours to minutes
- No heavy lifting or special tools

Rebecca Fuel Cartridge



High Compression Ratio (HCR) Power Pistons

Description

- Compression ratios at 5,000-6,500 FASL: mechanical = 9.25:1
- Compression ratios at 6,500 FASL: mechanical = 9.45:1
- vs. standard compression ratio of 8:1



Benefits

- Improves Combustion Stability at Higher Elevations
- Greater Rich Fuel Tolerance
- Sustains Emissions Compliance
- Can typically be installed in the field in less than one day

Exhaust Expansion Chambers

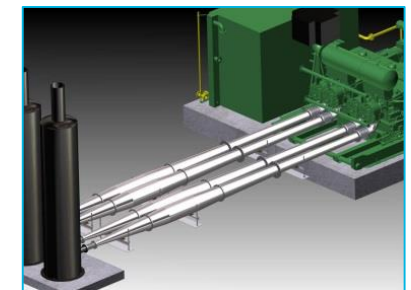


Description

- Substantially increases the mass of fresh air that is trapped inside the power cylinders
- This configuration results in added hp, cooler combustion, and/or reduced NO_x levels.
- This method of exhaust emissions reduction does not rely on any moving mechanical devices nor does it require system adjustments and maintenance to achieve the emissions reduction

Benefits

- Increased hp with more efficient performance
- Reduced NO_x with improved combustion
- Increased MMscfd/bhp
- Fuel savings with reduced loads at same MMscfd
- Payback in weeks not months
- Low Maintenance with virtually no moving parts



Integrated Governor Throttle Body (IGTB)



PERFORMANCE



MAINTENANCE

Description

- The IGTB is a combined throttle valve and electronic governor. Its purpose is to maintain a fixed speed set-point throughout the engine's load range.
- The governor measures engine speed with a magnetic pickup and compares it to the set-point speed provided by the transducer.
- When engine speed changes from the desired level, the IGTB automatically adjusts fuel gas header pressure as required to maintain the desired speed.

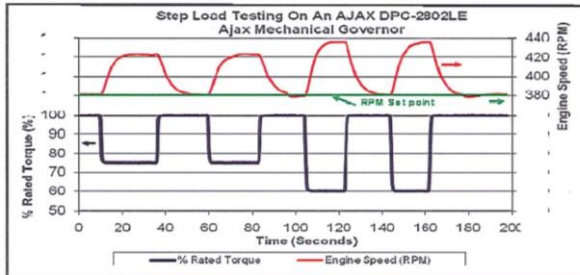
Benefits

- Fast response to compressor load change
- Improved stability of compressor
- Easy installation
- If needed, no electrical power required
- Ideal for usage with fuel gas containing H₂S
- Vibration resistant



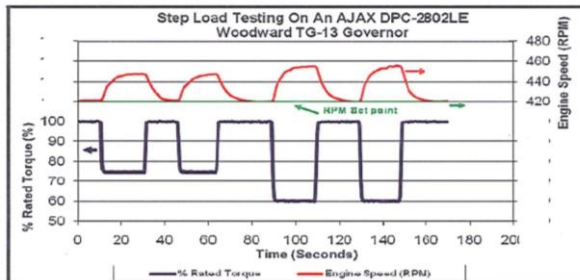
Integrated Governor Throttle Body (IGTB)

Three governors' response to load change



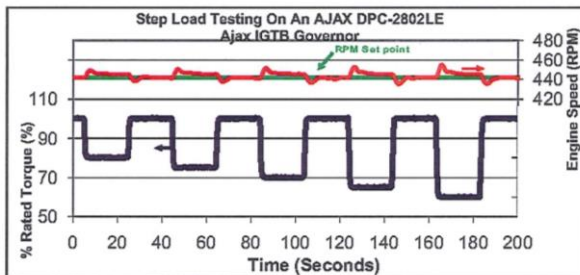
Ajax Flyweight Governor

- Rpm set point at 380 w/100% torque load
- Decrease load to 75% and rpm increases to 420 rpm
- Reestablish 100% torque load, and rpm returns to 380



Woodward TG-13 Governor

- Rpm set point at 420 w/100% torque load
- Decrease load to 75% and rpm increases to 448 rpm
- Reestablish 100% torque load, and rpm returns to 420



IGTB Governor

- Rpm set point at 440 w/100% torque load
- Decrease load to 75% and rpm increases briefly to 454 rpm and returns to the 440 rpm set point
- Reestablish 100% torque load, and rpm decreases briefly to 438 rpm and returns to 440 rpm set point

Noise Control



PERFORMANCE



MAINTENANCE

Major noise sources

- Exhaust
Silencer
Exhaust lines
- Air intake
- Process and engine heat exchangers
- Mechanical noise of the engine and compressor

Ajax
insulation



Benefits

- Exhaust silencers – hospital 89 dBA; critical 83 dBA; super critical 76 dBA @10ft
- Insulation – 9 dBA reduction
- Air intake filtered silencers - standard intake 88 dBA; residential grade 80 dBA; critical grade 67 dBA @10ft
- Process & engine heat exchangers – fan tip speed 12,000 fpm 83 dBA; 10,600 fpm 79 dBA; 9,100 fpm 77 dBA @10ft

Oxidizing Catalytic Converter



Description

- The Ajax oxidizing catalytic converter is designed to meet the new environmental guidelines for 2-stroke, lean-burn (2SLB) gas engines., with impressive removal efficiencies of CO, VOC, & H₂CO.
- As a result of an exhaustive research and development program, the converter is now available for new units as well as retrofit applications.

Benefits

- Lower emission available with good, better, best element selection.
- Available on any Ajax fuel injected engine
- Internal baffles and pipes designed to silence exhaust and protect the catalyst element
- Catalyst elements in retainer rack
- One identical element per power cylinder

Flexible Fuel Header System



Description

- Expedite fuel gas valve accessibility
- Eliminates header misalignment by utilizing single piece fuel header system. This also eliminates cumbersome couplings with multi-piece fuel header systems.
- Eliminates stress & distortion on gas valve body. Rigid systems can put undue stress on gas valve bodies when trying to align & tighten header connections that can distort valve body preventing proper valve operation causing leakage and/or premature wear/failure.

Benefits

- Low cost 100% Retrofit able on Ajax legacy single, twin, trip & quad engines
- Reduces scheduled / unscheduled downtime for servicing gas injection valves ultimately saving money.
- Relocates fuel header allowing easy access to power end without removing header



Screw In Pre-chamber

Description

- New device can be installed on all Ajax products with easily installed conversion kit available in one part number. Kit includes pre-chamber, piping, regulators, cooling water pump (if required).



Benefits

- Reduced emission and fuel consumption
- Screw-in design to existing spark plug hole eliminates requirements for new cylinder heads
- Easy maintenance due to water jacket cooling and less engine misfires
- Standard Spark Plug utilized to ignite gas in pre-chamber
- Corrosion resistance utilizing high quality alloy steel.
- Easy conversion kit available for single and twin cylinder engines

Auto Pre-Lube Systems



MAINTENANCE



EMISSIONS

Description

- Pre-Lube systems are standard equipment on current production Ajax units, offered with manual, electric or pneumatic configurations.
- Available in retrofit kits for all Ajax units.
- Various controls logic is also offered to accommodate permissive / custom start-up sequencing

Benefits

- Increases unit dependability & product life
- Reduces start-up and idle time
- Reduces maintenance costs associated with cold weather starts
- Allows for start – up sequencing to comply with various emissions regulations



Scavenging Intake Poppet Valve



PERFORMANCE



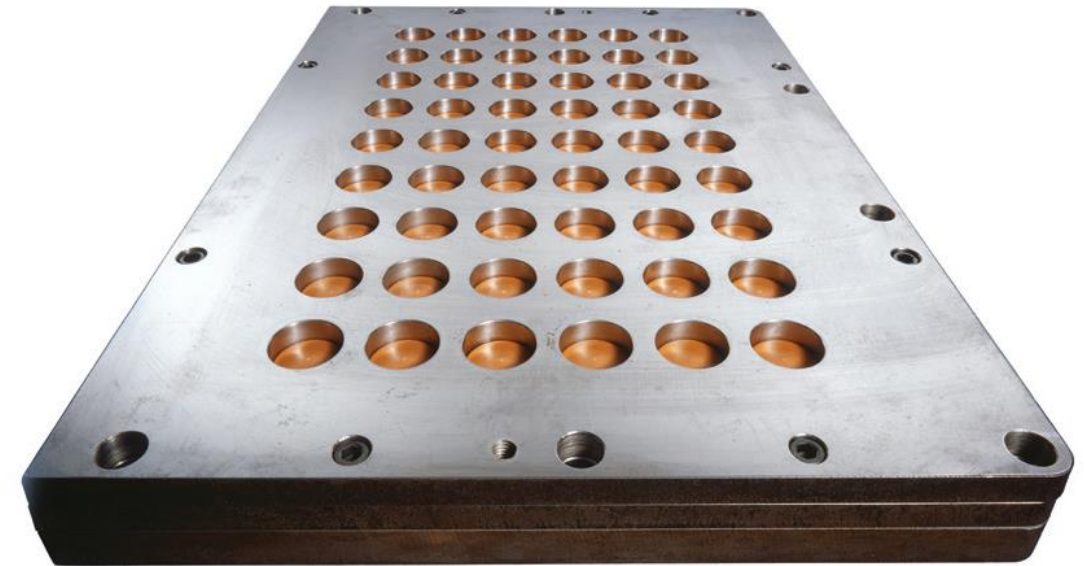
MAINTENANCE

Description

- Air Flow Improvement: Available for DPC-2800 Series Engines
- The Scavenging Intake Poppet Valve is a bolt on retrofit able by just replacing the reed strip valve plate.
- Allows more scavenging air to the combustion chamber that subsequently increases combustion efficiency.

Benefits

- Fuel consumption/costs reduced
- Emissions reduction
- Lower operating/maintenance costs



Integral Engine-Compressor Reconfiguration



Description

- Compression requirements change as a result of:
Natural gas demands in the market
Changes in site conditions
Relocation of equipment
Changes in compression applications
- Our Applications Engineering team can take your new application conditions and determine what is required to get the optimum utilization of your existing equipment.

Benefits

- Lower initial cost vs. new equipment
- Quicker return on investment
- Increased production
- 100% utilization of available horsepower
- No need to transport unit
- OEM components / same Ajax reliability
- One year warranty



Integral Concrete Skid



Description

- A traditional separate removable concrete base is also available for use with existing units. Existing units can be mounted to the traditional separate concrete base to allow for portability.



DPC-2802 with Integral Concrete Filled Skid

Benefits

- Portability. A single compressor package can be moved from site to site as needed with relative ease
- Reduced installation cost. A Concrete foundation is no longer required
- Reduced tear down cost.
- Reduced Inventory of compressor packages

ULE Conversion Kit



Description

- Incorporates distinct parts and configurations, enhancing the overall emissions performance of existing LE units at full horsepower.
- Features:
 - Enhanced intake system
 - Upgraded heads, pistons and a pre-chamber design
 - High-pressure fuel injection for enhanced air/fuel mixing
 - Tuned exhaust system as part of the air flow operation

Benefits

- Reduced NO_x emission to a level as low as 0.5 g/bhp-hr
- Enhanced fuel and combustion efficiency
- Enhanced air flow by way of the expansion chambers
- Ability to maximize horsepower while reducing emissions, all at an ambient temperature rating of 100°F

Resources



- engageRecip
www.engagerecip.com



- +1 844-RECIP-GE (US/Canada), +1 713-354-1299
(International)



- Diagnostics List & Recommended Spare Parts
Available on Spreadsheet



- Fact sheets
TBD

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