

LFGTE Facility Preventative Maintenance Plan

Preventive Maintenance Plan

Midland Landfill Gas Compression and Energy Generation

December 30, 2010

HRG Project No. 20100011

Prepared For:

City of Midland

Prepared By:



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Preventive Maintenance Plan
Midland Landfill Gas Compression and Energy Generation

This Preventive Maintenance Plan presents recommended maintenance and spare parts inventory for the City of Midland Landfill Gas (LFG) Compression and Energy Generation system. The purpose of this plan is to document preventive maintenance procedures to ensure efficient operation, special emphasis is placed on the reciprocating engine generators which are regulated under Air Permit 45-10A.

System Description

The City of Midland has constructed a gas to energy facility (GTE) at the wastewater treatment plant. The GTE facility consists of two Catapiller G3520C reciprocating engine generators, engine heat recovery system, engine cooling system and electrical generation equipment. The engine exhaust is discharged to atmosphere after heat recovery. There are no additional emission control equipment beyond the standard engine fuel use and combustion controls.

The Cat 3520 engines operate on low BTU fuel, primarily LFG from the City of Midland Landfill, plus a small flow from the two anaerobic digesters at the wastewater plant. LFG is extracted from the landfill, compressed, chilled and sent to the GTE plant though a 3 mile long, 8 inch diameter pipeline. Digester gas is compressed and piped to the GTE plant, mixing with the LFG prior to the engine fuel header pipe.

Major System Components

Major components of the Midland LFG compression and energy generation system are listed below:

- LFG compression system: moisture separator, two Vilter, Model VSG 1551 oil flooded single screw compressors, two combination remote LFG and oil coolers.
- LFG chilling and re-heating system: refrigerant system, refrigerant to LFG chiller heat exchanger, gas to gas re-heater.
- LFG pipeline: 8 inch diameter, HDPE, below grade pipe.
- Digester gas compression skid, manufactured by Perennial Energy, Inc.
- Recipricating engine generators: two Cat 3520 engines, discharge silencers and heat recover silencers, two radiators for engine cooling.



Preventive Maintenance Plan
Midland Landfill Gas Compression and Energy Generation

Preventive Maintenance and Recommended Spare Parts

Documentation of recommended preventive maintenance is presented in the following attachments for the system major components. Additional maintenance information is presented in operation and maintenance manuals for each system.

A list of recommended spare parts is also presented in the following attachments. Note that Attachment C contains a recommended parts list for the Caterpillar G3520C engine generators. This list identifies the parts that are recommended to be readily available at the site.

Attachment A – Vilter Oil, Flooded, Single Screw Compressor

Attachment B – Perennial Energy, Inc. Digester Gas Compression System

Attachment C – Caterpillar 3520C Engine generator Set

Attachment D – Sullair Air Compressor Systems

Attachment E – Shallbetter Switchgear and Balance of Plant Control Panels

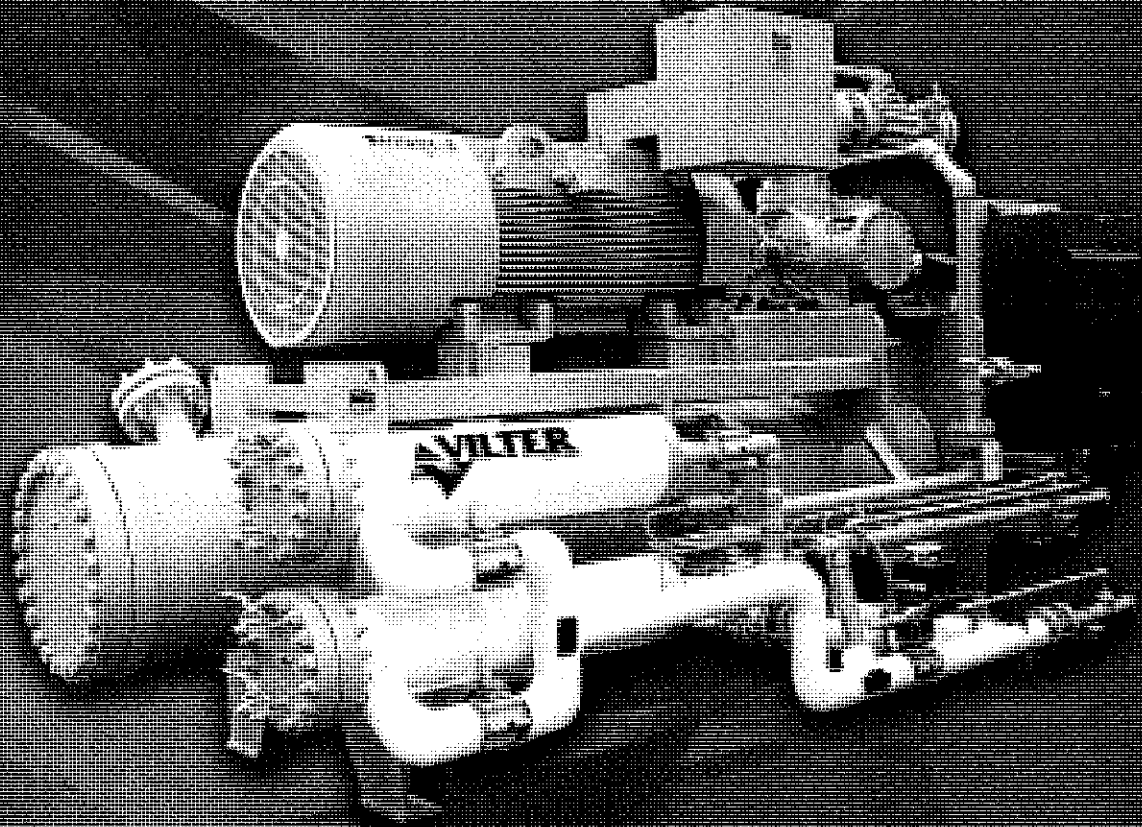
Preventive Maintenance Plan
Midland Landfill Gas Compression and Energy Generation

ATTACHMENT A
Vilter Screw Compressor
Preventive Maintenance and Spare Parts

VILTER[®]

Since 1867

VSG/VSSG Operation and Service Manual



VIN 4510155G
January 2009 Rev. 00
Price \$ 00.00

Installation

have to be added to bring the oil level to the normal operating point. With the unit operating, oil should be added through the charging connection at the suction strainer. The normal operating level is the middle of the UPPER sight glass on the oil separator. See Table 2 for approximate separator oil charge requirements.

TABLE 2. OIL CHARGE

Oil Sep Size	Approximate Oil Charge – Gal.
16"	20 to 27
20"	22 to 31
20"	20 to 25
30"	30 to 35
20"	30 to 40
24"	40 to 50
30"	60 to 75
36"	95 to 105
42"	145 to 165

The oil level may be above the top sight glass at this time. Electrically forcing on the oil pump will aid in pre-lubing the various oil lines, oil filter, and other items in the oil circuit before starting the unit. Add oil as required to bring the level back up to the middle of UPPER sight glass before starting the unit. Do not mix oils.

A. Oil For Single Screw Compressors

Due to the need for adequate lubrication, Vilter recommends only the use of Vilter lubricants, designed specifically for Vilter compressors. With the extensive research that has been performed, we are able to offer refrigerant specific lubricating oils. Use of oil not specified or supplied by Vilter will void the compressor warranty.

Please contact your local Vilter representative or the Home Office for further information.

SYSTEM CHARGING

CAUTION

When charging the system, make sure the compressor unit is pressurized from the discharge side of the compressor. Pressurizing the compressor from the suction side may cause rotation of the compressor, without oil supply, which could lead to internal damage.

After the system is leak-free and evacuation has been completed, it is ready for charging. Before actual charging, however, the entire operation of the system should be inspected as outlined below:

A. Compressors

1. Proper oil level.
2. Voltage agrees with motor characteristics.
3. Properly sized motor fuses and heaters.
4. Direct drivers aligned and couplings tight.
5. All suction and discharge valves open.
6. All transducers and RTD's calibrated and reading correctly.

B. Controls

Controls should be at the initial set points. See microprocessor manual for further information.

When sufficient refrigerant has been charged into

MAINTENANCE SUGGESTIONS

Note: The controller also has a maintenance chart programmed into the software, please refer to the appropriate controller manual.

Careful checking of system for leaks and proper operation of all components upon installation will start the system on its way to a long life of satisfactory service. To ensure the desired trouble-free operation, however, a systematic maintenance program is a prerequisite. The following maintenance schedule is suggested.

Installation

A. Daily

1. Check oil levels.
2. Check all pressure and temperature readings.
3. Check micronic oil filter inlet and outlet pressures for excessive pressure drop. Change filter when pressure drop exceeds 15 psi or every six months, whichever occurs first. For proper procedure for changing micronic oil filter and for charging oil into the system, see Operation Section.
4. Clean strainers each time filter cartridge is replaced.
5. Check compressor sound for abnormal noises.
6. Check shaft seals for excessive oil leakage. A small amount of oil leakage (approximately 10 drops/min) is normal. This allows lubrication of the seal faces.

B. Weekly (Items 1 thru 6 above plus 7 thru 9)

7. Check the system for leaks with a suitable leak detector.
8. Check oil pressures and review microprocessor log and log sheets.
9. Check refrigerant levels in vessels.

C. Monthly

(Items 1 thru 8 above plus 9 thru 13)

10. Oil all motors and bearings. Follow manufacturer's instructions on lubrication.
11. Check calibration and operation of all controls, particularly safety controls.
12. Check oil cooler for any evidence of corrosion, scaling or other fouling.
13. Operate compressor capacity through the range both automatically and manually.

D. Trionthly

(About 2000 operating hours)

Check movement of compressor rotor at drive coupling end to determine bearing float. (Refer to Service Section.)

E. Yearly

(Items 1 thru 13 and "D" above plus 14 thru 28)

14. Check entire system thoroughly for leaks.
15. Remove all rust from equipment, clean and paint.
16. Flush out sediment, etc. from water circuits.
17. Clean all oil strainers.
18. Clean suction strainer – compressors.
19. Check motors and fans for shaft wear and end play.
20. Check operation and general condition of microprocessor and other electrical controls.
21. Clean all water strainers.
22. Check drains to make sure water will flow away from equipment.
23. Drain and clean entire oil system at receiver drain. Recharge with new clean moisture free oil. For proper procedure for changing micronic oil filter and charging oil into the system, see Start-Up and Operation section.
24. Check compressor coupling. For integrity and alignment.
25. Check oil pump for wear.
26. Check the calibration of the microprocessor pressure transducers and RTD's for accuracy.
27. Check mounting bolts for compressor and motor.

Installation

SYSTEM LEAKS

There are any number of reasons why leaks develop in the system (i.e. such as drying out of valve packing, yielding of gaskets, improper replacement of valve caps and loosening of joints due to vibration). For these reasons, the need for periodic leak testing cannot be over-emphasized. Similarly, when any service operations are performed on the system, care should be exercised to insure all opened flanges are tightened, all plugs that were removed are replaced with a suitable thread filling compound, all packing glands on valve stems are tightened, and all valve caps are replaced. When operation is restored, all joints opened or any valves moved during the servicing should be checked for leaks.

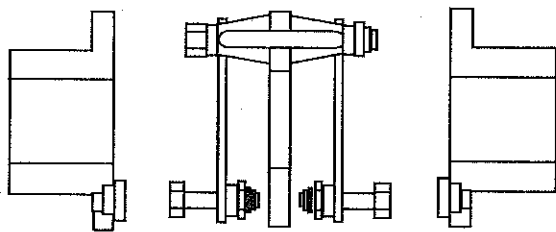
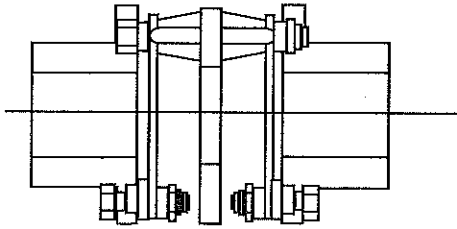
G. Year Round Operation

On a continual basis:

1. Guard against liquid slugging of compressor.
2. Maintain unit in clean condition and paint as necessary.
3. Grease valve stems and threads for the valve caps.

When equipment is operated 24 hours a day year round, it is highly recommended that a yearly check of all internal parts be made (see Service Section). While the highest material standards are maintained throughout all Vilter compressors, continuous operation and any presence of dirt may prove injurious to the machine. To forestall needless shutdowns or prevent possible machine breakdowns, the side covers should be removed yearly, and a visual inspection be made of the internal parts. In this way, a small amount of time spent checking machine conditions once a year may prevent extensive shutdowns later with subsequent product loss and expensive repairs.

Installation



COUPLING INFORMATION

All other coupling information can be found in the vendor section of this manual.

COUPLINGS INSTALLATION AND ALIGNMENT

These instructions are intended to help you to install and align the coupling. Covered here will be general information, hub mounting, alignment, assembly, locknut torquing, discpack replacement, and part numbers. The coupling as received, may or may not be assembled.

*If assembled, the locknuts are not torqued.

*If coupling is assembled, remove the bolts that attach the hubs to the disc packs. Remove both hubs. Leave the disc packs attached to the center member.

A. Hub Mounting:

1. Clean hub bores and shafts. Remove any nicks or burrs. If bore is tapered, check for good contact pattern. If the bore is straight, measure the bore and shaft diameters to assure proper fit. The key(s) should have a snug side-to-side fit with a small clearance over the top.

NOTE: If the hub position on the shaft does not allow enough room to install the short bolts in the hub after hub mounting, install the bolts and disc pack before mounting hub on shaft.

B. Straight Bore:

1. Install key(s) in the shaft. If the hub is an interference fit, heat the hub in an oil bath or oven until bore is sufficiently larger than the shaft. 350° F. is usually sufficient. An open flame is not recommended. However, if flame heating is necessary, use a very large rose bud tip to give even heat distribution. A thermal heat stick will help determine hub temperature. **DO NOT SPOT HEAT THE HUB OR DISTORTION MAY OCCUR.** With the hubs expanded, slide it up the shaft to the desired axial position. A pre-set axial stop device can be helpful.

C. Taper Bore:

1. Put the hub on the shaft without key(s) in place. Lightly tap hub up the shaft with a soft hammer. This will assure a metal-to-metal fit between shaft and hub. This is the starting point for the axial draw. Record this position between shaft and hub face with a depth micrometer. Mount a dial indicator to read axial hub movement. Set the indicator to "0". Remove hub and install key(s). Remount hub, drawing it up the shaft to the "0" set point. Continue to advance hub up the taper to the desired axial position. Use the indicator as a guide only. A pre-set axial stop device can be helpful. Check the final results with a depth micrometer. The hub may have to be heated in order to reach the desired position on the shaft. **DO NOT SPOT HEAT THE HUB OR DISTORTION MAY OCCUR.** Install shaft locknut to hold hub in place.

D. Shaft Alignment.

Move equipment into place.

a. *Soft Foot.* The equipment must sit flat on its base. Anysoft foot must be corrected now.

b. *Axial Spacing.* The axial spacing of the shafts should be positioned so that the disc packs (flexing elements) are flat when the equipment is running under normal operating conditions. This means there is a minimal amount of waviness in

Installation

Coupling Size (DBZ)	Total Indicator Reading (T.I.R.) Angle		Parallel		Torque Ft.-Lbs. (In.-Lbs.)
	Min	Max	Min	Max	
50	.004	.004	1.36	1.37	(24)
62	.004	.004	1.74	1.75	(36)
75	.004	.004	1.77	1.78	(36)
101	.004	.004	2.08	2.10	(96)
126	.004	.004	2.46	2.48	(156)
163	.004	.004	2.46	2.48	(156)
201	.004	.004	2.96	2.98	25
226	.004	.004	3.83	3.83	30
263	.004	.004	4.33	4.35	40
301	.004	.004	4.90	4.93	95
351	.004	.004	5.90	5.93	175
401	.004	.004	6.71	6.75	150
451	.004	.004	7.27	7.31	190

the disc pack when viewed from the side. This will result in a flexing element that is centered and parallel to its mating flange faces. Move the connected equipment to accomplish the above.

NOTE: The disc pack is designed to an optimal thickness and is not to be used for axial adjustments.

As a guide, maximum and minimum values for dimension "E" are given. These dimensions are suggested for initial installation. Additional capacity is available to compensate for thermal and structural movement. Maximum axial capacity values for these couplings are also given. See chart above.

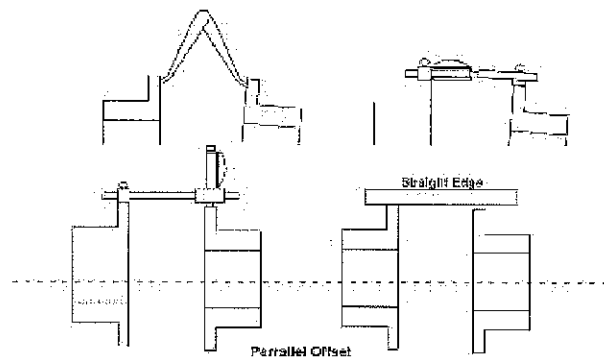
c. *Angular Alignment.* Rigidly mount a dial indicator on one hub or shaft, reading the face of the other hub flange, as shown on next page. Rotate both shafts together, making sure the shaft axial spacing remains constant. Adjust the equipment by shimming and/or moving so that the indicator reading is within .002 inch per inch of coupling flange.

d. *Parallel Offset.* Rigidly mount a dial indicator on one hub or shaft, reading the other hub flange outside diameter, as shown in Figure 3. Indicator set-up sag must be compensated for. Rotate both shafts together. Adjust the equipment by shimming and/or moving so that the indicator reading is within .002 inch per inch of the axial length between flex

elements. See drawing below.

Note: If the driver or driven equipment alignment specification is tighter than these recommendations, the specification should be used. Also, be sure to compensate for thermal movement in the equipment. The coupling is capable of approximately four times the above shaft alignment tolerances. However, close alignment at installation will provide longer service with smoother operation.

Note: Alignment of C-Flange Units should be checked when compressor or motor are replaced.



E. Final assembly

With the coupling in good alignment the bolts will fit through the holes in the flanges and the disc packs more easily.

a. If the coupling arrived assembled, the disc packs are still attached to the center ring. Before taking the disc packs off, first install one hub bolt through each disc pack and secure with lock out. This will help when the pack is reinstalled later. If the coupling was shipped disassembled, the bolt through the pack is not required as the discs in the pack are factory taped together.

b. Remove the long bolts. Mount the disc packs on the hubs with one bolt through the disc pack aligned with a clearance hole in the hub. Install the short bolts through the hub, disc pack, bevel washer or link, and secure with a lockout.

b. Remove the long bolts. Mount the disc packs on the hubs with one bolt through the disc pack aligned with a clearance hole in the hub. Install the short bolts through the hub, disc pack, bevel washer or link, and secure with a lockout.

NOTE: All bolt threads should be lubricated. A clean motor oil is recommended. On size 226 and larger, a link must be put on bolt first. Remove the disc pack alignment bolt. Proceed to mount the second disc pack to the other hub in the same way.

C. Position one set of short bolts in each hub on top. Now slide the center ring down into place straddling the short bolts with the center ring bushings. If coupling is dynamically balanced, the center ring match marks must lineup with both hub match marks. When one bushing is in-line with the hole in the disc pack, slide one long bolt through washer or link, disc pack, center ring, disc pack, washer or link, and then secure with a locknut. The long bolt requires a minimum clearance "R" for installation between back side of coupling flange and stationary equipment. See Figure 1 and Table I for value of "R." On size 226 and larger a link must be put on the bolt first. Now install the rest of the long bolts in the same manner.

D. Torque the long bolt locknuts at this time.

NOTE: With the coupling in good alignment, the bolts will fit through the holes in the flanges and the disc pack more easily. It is recommended that all locknuts be retightened after several hours of initial operation. E. For further help with the installation or alignment, consult Rexnord.

F. Disc Pack Replacement.

If it becomes necessary to replace the disc pack, it can be done as follows:

A. Remove all the long bolts and lower the center ring by sliding it out from between the two disc packs.

B. Remove one short bolt from the disc pack/hub connection and reinstall it through a hub clearance hole and into the hole in the disc pack. Put the nut on. This will keep the discs together and maintains the disc orientation for later reinstallation. Remove the rest of the short bolts and take off the disc pack. Repeat for the second disc pack.

C. Replace the pack(s) if required. Recheck alignment per Section D. Reassemble per Section E.

Recommended Spare Parts List

Spare Parts List

COMPONENT	SPARE PARTS FOR:		VP. #	PART DESCRIPTION	QTY	WHERE USED:	MULT
	VSG 751-1801	VSG 301-701					
Gasket Oil Separator	X X X X X X X	X X X X X X X	93559A 2879A	Cover Gasket Defogger/Coalescent Element	1 1 2 3 4 5 1	20" Oil Separator 20" Oil Separator 24" Oil Separator 30" Oil Separator 36" Oil Separator 42" Oil Separator 20" Oil Separator	112R 140A
Gaskets: choose separator size	X X X X	X	93559A 93560A	Cover Gasket, 13" x 12" Cover Gasket, 16" x 15"	1 1 1 1	24" Oil Separator 30" Oil Separator 36" Oil Separator 42" Oil Separator	112R
Oil Filter +++	X		1833C	Oil Filter Element Before April - 2000	1	Single Element Filter Tank	112R
VSS Units Oil Filter +++	X X		35197A	Filter Tank Cover Gasket (Included with 1833C)	2 1	Dual Element Filter Tank Single or Dual Element Filter Tank	112R 112R
VSS/VSM Oil Filter +++	X X X X X X X	X	3109A 3110A 3111A 3112A KT773A KT773B KT774	Duplex Housing - 16" Bowl Duplex Housing - 39" Bowl Single Housing - 16" Bowl Single Housing - 39" Bowl 16" Oil Filter Element 16" Oil Filter Element 39" Oil Filter Element	< or = 30" Oil Separator > 30" Oil Separator < or = 30" Oil Separator > 30" Oil Separator (3109 B-Duplex Housing) (3109 B-Single Housing) (3110 B Single & Duplex Housing)	111R 111R 111R 111R 111R 111R 111R	
Safety Relief Valves	X X X	X X X	1498C 1498A 1528B	300 Psig R-717 Relief Valve 250 Psig R-717 Relief Valve 300 Psig Halocarbon Relief Valve,	2 2 2	300 Psig R-717 Dual Relief Valve 250 Psig R-717 Dual Relief Valve 300 Psig Halocarbon Dual Relief Valve	2HVF 2HVF 2HVF
Safety Relief Valves	X X	X X	1528H 1528M	1/2" x 5/8" 300 Psig Halocarbon Relief Valve, 3/4" x 3/4" 300 Psig Halocarbon Relief Valve, 1" x 1"	2 2	300 Psig Halocarbon Dual Relief Valve 300 Psig Halocarbon Dual Relief Valve	2HVF 2HVF

NOTE : RECOMMENDED SPARE PARTS MARKED BY A (+++) are to check part # with correct Model Screw Compressor marked with "X"

Spare Parts List

COMPONENT	SPARE PARTS FOR:		VP. #	PART DESCRIPTION	WHERE USED: QTY DESCRIPTION	MULT	
	VSG. 751-1801	VSG 301-701					
Replacement Solenoid Valve Coils	X	X	2650W	Solenoid Coil, 115V/50 Hz., <i>Yellow and Blue Leads</i>	1 2650 Series Solenoid Valve, 115V/50Hz	2HVF	
	X	X	2650X	Solenoid Coil, 230V/50 Hz., <i>Yellow Leads</i>	1 2650 Series Solenoid Valve, 230V/50Hz	2HVF	
	X	X	2650Y	Solenoid Coil, 120V/60 Hz., <i>Blue leads</i>	1 2650 Series Solenoid Valve, 120V/60Hz.	2HVF	
	X	X	2650Z	Solenoid Coil, 240V/60 Hz., <i>Red Leads</i>	1 2650 Series Solenoid Valve, 240V/60Hz.	2HVF	
Viking Oil Pump & repl'mt shaft seals	X		2954B	Bare 11 GPM Oil Pump	1 11 GPM Oil Pump Before 1996	111R	
	X		KT718A	Replacement Shaft Seal for 11 GPM Oil Pump	1 11 GPM Oil Pump Before 1996	111R	
	X		2954E	Bare 22 GPM Oil Pump	1 22 GPM Oil Pump Before 1996	111R	
	X		2954H	Bare 31 GPM Oil Pump	1 31 GPM Oil Pump Before 1996	111R	
	X		KT718C	Replacement Shaft Seal for 22 and 31 GPM Oil Pumps	1 22 and 31 GPM Oil Pumps Before 1996	111R	
		X		3022AU	10 GPM Oil Pump w/Bracket	1 Was 3022A (Before 1995) hub OK	111R
Haight Oil Pump <i>(note req'd hub)</i>	X	X	3022CX	Replacement Shaft Seal	1 10U Oil Pumps AFTER 4-19-02	111R	
	X	X	1548LA	Flange Gasket	2		
	X	X	3022DU	20 GPM Oil Pump w/Bracket	1 Was 3022D (Before 1995) req's 2913E hub	111R	
	X	X	3022CU	Replacement Shaft Seal	1 24U Oil Pumps AFTER 4-19-02	111R	
	X	X	1548AA	Flange Gasket	2		
	X	X	3022GU	30 GPM Oil Pump w/Bracket	1 Was 3022G (Before 1995) req's 2913E hub	111R	
	X	X	3022CU	Replacement Shaft Seal	1 30U Oil Pumps AFTER 4-19-02	111R	
	X		1548AA	Flange Gasket	2		
	& repl'mt shaft seals	X		3022JU	40 GPM Oil Pump w/Bracket	1 Was 3022J (Before 1995) req's 2913S hub	111R
		X		3022CU	Replacement Shaft Seal	1 40U Oil Pumps AFTER 4-19-02	111R
X			1548AA	Flange Gasket	2		
X			3022MU	54 GPM Oil Pump w/Bracket	1 Was 3022M (Before 1995) req's 2913S hub	111R	
X			3022CV	Replacement Shaft Seal	1 54U Oil Pumps AFTER 4-19-02	111R	
X			1548BA	Flange Gasket	2		
X			3022QU	80 GPM Oil Pump w/Bracket	1 Was 3022Q (Before 1995) req's 2913R hub	111R	
X			3022CV	Replacement Shaft Seal	1 80U Oil Pumps AFTER 4-19-02	111R	
X			1548BA	Flange Gasket	2		
Heater <i>(pre 1999)</i>		X		2545A	1.5KW/240V—375W/120V	1 before 1999 on 20" & 24" Separator	112R
		X		2545B	2KW/240V—500W/120V	1 before 1999 on 30" Separator	112R
		X		2545C	2.5KW/240V—625W/120V	1 before 1999 on 36" Separator	112R
	X		2545D	3KW/240V—750W/120V	1 before 1999 on 42" Separator	112R	
	X		3116C	750W/120V Cartridge Heater	>> after 1999 on all separators—qty 1 or 2	111R	

Spare Parts Cont....

Spare Parts List

COMPONENT	SPARE PARTS FOR:		VP. #	PART DESCRIPTION	QTY	WHERE USED: DESCRIPTION	MULT
	VSG	VSG					
VILTER OIL +++	751-1801	301-701					
	X	X	3100A	HALOCARBON — 5 GAL CAN		FOR ALL SCREW & RECIP COMP	2HVF
	X	X	3100B	HALOCARBON — 55GAL. DRUM		FOR ALL SCREW & RECIP COMP	2HVF
Shaft Seal	X		KT709AG	Shaft Seal Kit	1	VSSG 451-601	111R
GAS	X		KT709BG	Shaft Seal Kit	1	VGS751 - 1201	111R
+++	X		KT709CG	Shaft Seal Kit	1	VSG1501 - 1801	111R
		X	KT709DG	Shaft Seal Kit	1	VSG 71-401	111R
Slide Valve	X	X	KT720A	Gearmotor/ Capacity Slide Valve	1	All Single Screw Compressors	111R
Motors	X	X	KT720C	Gearmotor/ Volume Slide Valve	1	All Single Screw Compressors	111R
+++	X	X	25972A	NEW Capacity & Volume Optical Actuator Assembly	1	Complete Retrofit for all Viss/Vant panels & Compressors after 1/01/02	111R
Shaft Seal	X		A25931A	VSR'S & 451 & 601	1	2-Checks, Baffle, Teflon Seal	111R
Baffle		X	A25942AA	VSM	1	& Retainer Ring	111R
Assembly	X		A25932A	751-1201	1	"	111R
	X		A25933A	1501-1801	1	"	111R
		X	A26034B	VSM 501-701	1	"	111R
Hubbel	X		2803				

Preventive Maintenance Plan
Midland Landfill Gas Compression and Energy Generation

ATTACHMENT B
Perennial Energy, Inc. Digester Gas Compression System
Preventive Maintenance and Spare Parts



OPERATION & MAINTENANCE

MANUAL

for a

**59 SCFM
GAS COMPRESSION STATION**

for the

**MIDLAND WWTP
MIDLAND, MICHIGAN**

P.O. # EM10009

ENGINEER / CLIENT

Cleveland Brothers
336 Fairville Ave.
Harrisburg, PA 17112
Phone: 717-526-2121
Fax: 717-526-2071

MANUFACTURER

PERENNIAL ENERGY, INC.
1375 County Road 8690
West Plains, MO 65775
Phone: 417-256-2002
Fax: 417-256-2801

PEI # 1624

NOVEMBER 2010

Compression Skid **MAINTENANCE SCHEDULE**

<u>FREQUENCY</u>	<u>CHECK</u>
Daily	<ul style="list-style-type: none">A. Fill out the Daily Compression Station Data Log.B. Visually inspect unit - repair any breaks, leaks, and loose wires.C. Follow all Manufacturers' Recommendations in Section 7.D. Test Lamps by pushing the RUN Lamp and the ALARM/SHUTDOWN Lamp.
Two Months	<ul style="list-style-type: none">A. Lubricate Compressors per Manufacturer's instructions.
Three Months	<p>Turn system off and perform the following procedures:</p> <ul style="list-style-type: none">A. Check Compressor - Turn the COMPRESSOR switch to the "TEST" position. Verify that the selected blower starts smoothly and operates properly. After the blower has ramped to maximum speed, turn the COMPRESSOR switch to the "AUTO" position and verify that the blower stops properly.B. Zero out the pressure, delta pressure, and vacuum gauges by closing off the valves in the gas lines to the gauges and opening the valves in the tees to atmosphere. Adjust the zeroing screw until the needle points to zero.C. Remove the 4" blind flange inspection port on the demister and remove any debris that has collected.D. If the pressure drop across the demister reaches two times its original value, open up the top of the demister and pull out the element. There is a handle at the top that is attached to the demister element. Hose the element down opposite of landfill gas flow with high pressure water and put it back in the demister container.
Annually	<p>Shut the system down and perform the following checks:</p> <ul style="list-style-type: none">A. Check for loose bolts on the structure and at the flanges.

**RECOMMENDED SPARE PARTS LIST FOR COMPRESSION STATION
JOB #1624 MIDLAND WWTP**

<u>Device</u>	<u>Part Number</u>	<u>Reference Designator</u>
CPU	6114	CP-PLC-1
Analog Input Module	6116	CP-AI-1
Thermocouple Input Module	2703	CP-AI-2
Analog Output Module	6117	CP-AO-1
Digital Input Module	2698	CP-DI-1
Digital Input Module	6115	CP-DI-2
Power Supply	1702	CP-E/E-2
Relay Module	2700	CP-RM-1
Surge Arrester	129	CP-SSR-1
Surge Arrester	469	CP-SSR-2
Surge Arrester	471	CP-SSR-3
Surge Arrester	470	CP-SSR-4

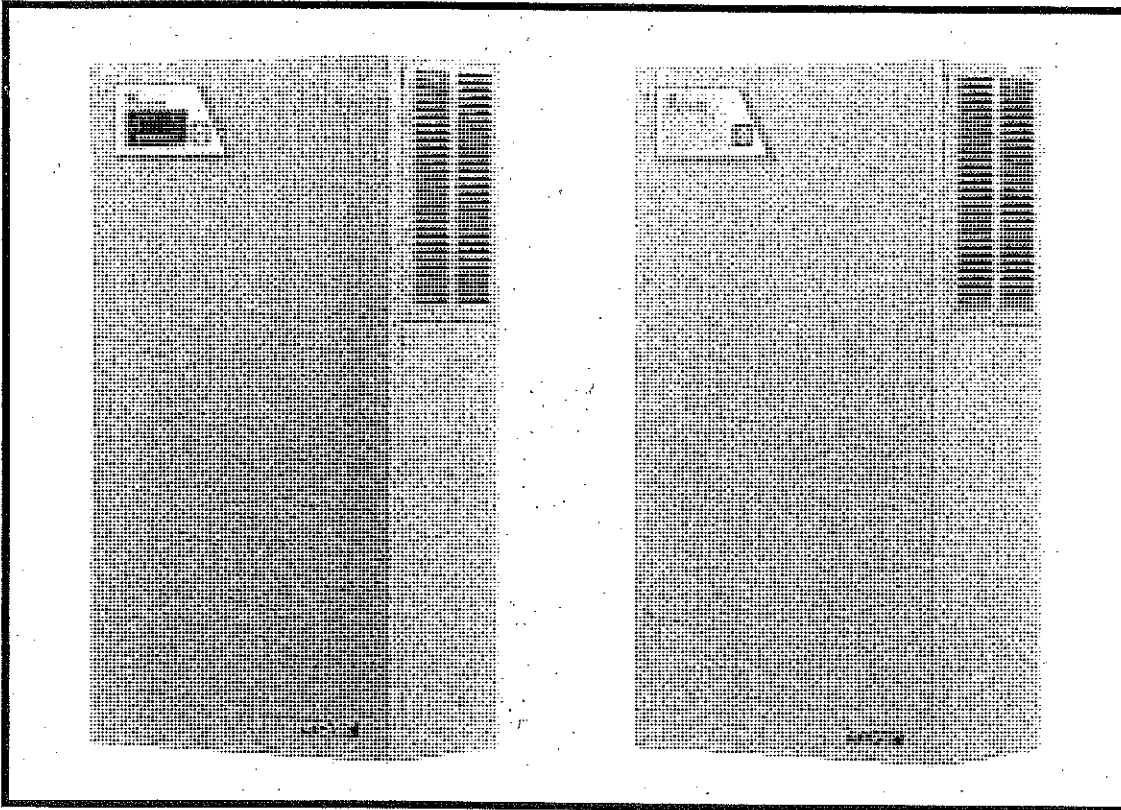
INSTRUCTION MANUAL FOR:

CP-AC-1

PROAIR™ XR™

CR29

apw Thermal Management



“Manufacturing the **McLean** brand of products”

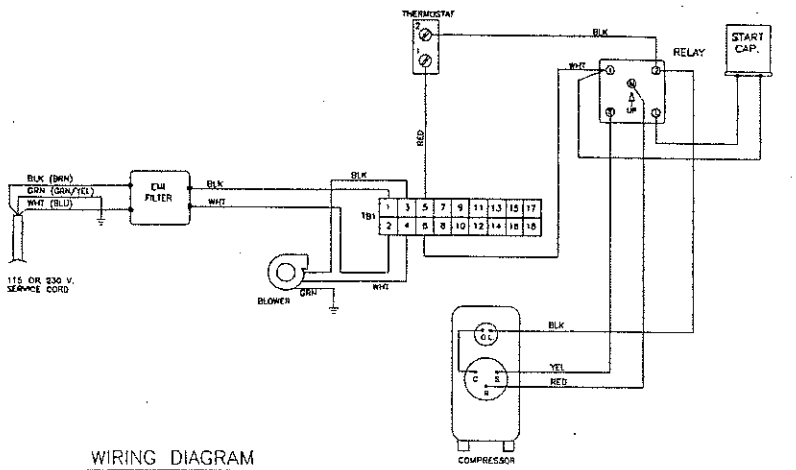
6. MAINTENANCE

The ProAir™ CR-29 series air conditioner is designed to be maintenance free, with the exception of the condenser air inlet filter. To ensure reliable, continuous operation, the inlet filter inside top right corner of the ProAir™ should be removed and cleaned or replaced periodically.

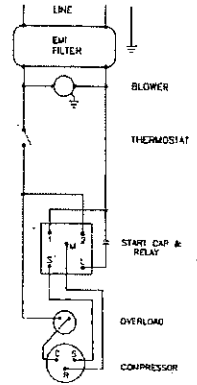
Clean by flushing the filter with warm water and allow it to dry thoroughly. Recoat the filter with RP Super Filter Coat adhesive (part number 52-6064-03), or equivalent. Reinstall cleaned or new filter.

7. WIRING SCHEMATIC

4000 BTU UNITS

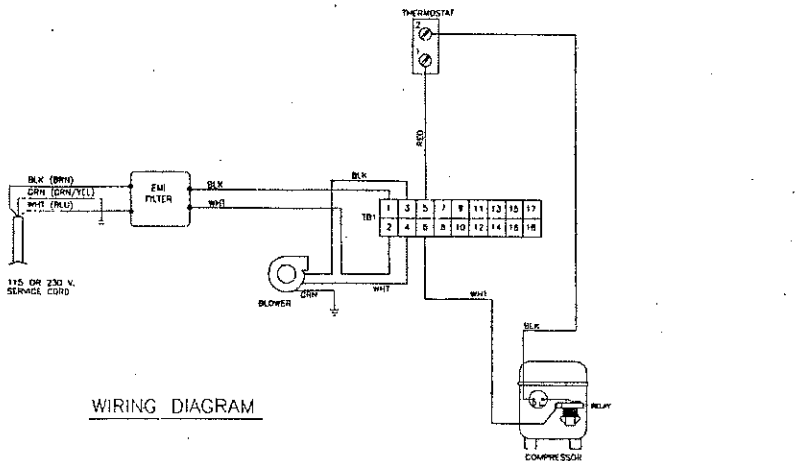


WIRING DIAGRAM

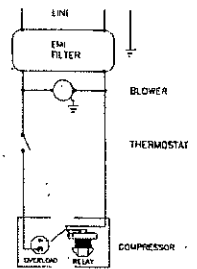


ELECTRICAL SCHEMATIC

2000 BTU UNITS



WIRING DIAGRAM



ELECTRICAL SCHEMATIC

Note: For voltage, hertz, and options not shown in this manual, refer to the wiring diagram attached to the unit.

Level II Wiring Schematic on Page 6



INSTRUCTIONS

INSTALLATION, OPERATION & MAINTENANCE

COMPRESSORS and VACUUM PUMPS

**EXPECTED SOUND CHARACTERISRICS OF SINGLE STAGE ROTARY VACUUM PUMPS
EXPECTED SOUND PRESSURE LEVELS db**

Ro-Flo Model	Speed RPM	Disch Press PSIG	dB A @ 3'	OCTAVE CENTER FREQUENCIES hz										dB C @ 3'
				31.5	63	125	250	500	1000	2000	4000	8000	16000	
5CCA	1160	25"HgV	75	61	60	66	72	89	70	66	61	59	52	76
5CCB	1740	25"HgV	76	62	61	68	73	74	70	69	63	60	55	57
7DA	865	25"HgV	80	66	65	69	74	77	71	71	62	59	64	82
7DB	1160	25"HgV	82	63	70	68	72	78	76	73	64	65	59	84
8DA	865	25"HgV	85	64	73	72	76	79	74	75	66	61	56	87
8DB	1160	25"HgV	86	62	71	74	77	82	78	77	72	72	62	88
8DE	1160	25"HgV	86	62	71	74	77	82	78	77	72	72	62	88
10GB	865	25"HgV	87	69	72	75	80	81	80	80	75	76	56	89
10GC	1160	25"HgV	88	68	73	76	81	83	81	82	78	78	61	90
11S	865	25"HgV	88	72	71	76	82	81	84	81	77	80	57	89
11L	865	25"HgV	88	71	73	77	83	82	79	80	79	81	60	90
12S	865	25"HgV	88	71	72	76	82	80	77	79	80	70	63	89
12L	865	25"HgV	88	73	69	78	84	79	82	78	80	63	64	90
17S	690	25"HgV	88	74	74	81	84	81	81	81	79	69	60	90
17L	690	25"HgV	89	74	75	82	84	80	83	82	78	67	62	92
19S	575	25"HgV	90	71	74	84	83	84	82	80	79	70	60	92
19L	575	25"HgV	91	73	77	85	82	83	83	81	78	73	65	93
23C	495	25"HgV	87	69	75	78	79	78	79	77	76	70	64	89
23D	495	25"HgV	88	72	77	82	83	82	82	82	77	69	62	90
23E	495	25"HgV	88	72	78	84	84	81	83	81	80	71	59	91
27D	435	25"HgV	89	78	82	85	85	83	84	84	79	70	58	92
27E	435	25"HgV	90	78	83	86	86	83	84	85	80	70	60	93
33D	435	25"HgV	93	86	89	90	88	88	86	84	80	72	64	95

VIBRATION

The maximum allowable vertical or horizontal overall vibration displacement amplitude for *Ro-Flo*® compressors or vacuum pumps measured at the bearing housings is 2 mils peak to peak. In normal operation, the expected amplitude is approximately 0.5 mils peak to peak.

The maximum allowable vertical or horizontal overall vibration velocity amplitude for *Ro-Flo*® compressors or vacuum pumps is .31 in./sec peak (.22 in/sec rms). In normal operation, the expected amplitude is approximately .21 in/sec peak (.15 in/sec rms).

CAUTION

1. Ro-Flo Compressors, LLC recommends the use of PPE (sound level protection) to avoid health hazard due to high noise level during normal operation.
2. Ro-Flo Compressors, LLC recommends the piping be sound proofed, particularly the discharge piping.
3. Ro-Flo Compressors, LLC recommends the customer establish an EHS plan to avoid an exposure risk in excess of Permissible Exposure Limit (PEL) as expressed as OSHA.

IV. MAINTENANCE

PREVENTIVE MAINTENANCE

A good maintenance program should provide for periodic inspection of the machine and it's components. The composition and temperature of the gas handled, as well as the severity of operating conditions, will determine the extent of preventative maintenance necessary. The following schedule showing typical frequency of maintenance should be adjusted to meet the needs of each installation.

MAINTENANCE SCHEDULE

24 Hours (Daily)

- Drain all points of liquid accumulation in the gas system (receivers, control lines, drop-legs, interconnecting piping, separators, etc...).
- Fill lubricator supply tank and check feeds to assure oil is flowing to all points.
- Note the temperature at the discharge flange and verify it is as expected for the operating compression ratio and gas inlet temperature. (Refer to Temperature Checks in the Operations section).

- inspect water piping for possible leaks.

300 Hours

- Inspect and clean inlet filter after first 300 hours and as frequently as necessary thereafter. If filter is oil bath type, change oil. Check filter skirt adjustment.

2000 Hours (Quarterly)

- Check blade to determine wear rate and general condition using the "Blade Criteria" (Page 20). Initially, a blade inspection can be made by draining coolant from jacket area and removing only the outboard cylinder head. A new gasket should be used on reassembly of the cylinder head. This will permit a concurrent inspection of the cylinder bore, outboard bearing, seal rings and rotor. Excessive or erratic wear of the bore and/or wear and deposits in the rotor slots are signs of inadequate air filtration and/or inadequate lubrication. Subsequent blade checks between scheduled blade change-outs may be made through the cylinder inlet port or (on some models) the inspection port at each end of the cylinder adjacent to discharge flange.

4000 Hours (Semi-Annually)

- Check blades as in 2000 hour inspection.
- Inspect inlet filter and, if supplied, radiator for dirt build-up.
- Check temperature switches to verify they actuate at the set temperatures.
- Recheck coupling alignment.

8000 Hours (Annually)

- Completely disassemble unit.
- Inspect mechanical seal carbon(s) and it's mating ring. If the carbon(s) are cracked, chipped or worn, replace the complete seal assembly. To illustrate seal removal, see applicable single face or double bellows seal instructions on Page 30.
- Inspect bearing inner race and rollers for rough marks, pitting or scoring. Replace bearings only if visible defects are found. If replacement is required, the inner race is removed by heating with a torch, or bearing induction heater.
- Inspect the cylinder bore for any unusual wear pattern which may have produced horizontal or circumferential grooves of .010 in., or greater, from a through circle. Honing or hand stoning may be used to improve bore condition where bore deviations are not severe. When scoring or severe wear is found, re-boring is required along with subsequent realignment of the rotor and re-doweling.
- Check blades as in 2000 hour inspection.
- Replace the cylinder head gaskets

- Inspect cylinder coolant jackets and the waterside of other system intercoolers or after-coolers for possible build-up of solids and/or mineral film coating the mineral deposits. If a radiator is used, clean the exterior surfaces to ensure maximum cooling efficiency.
- Inspect non-return valves, safety valves, drain traps, temperature and pressure switches for their mechanical condition. Test each to verify that it operates exactly as requires.

DISMANTLING PROCEDURE

Outboard Cylinder Head:

- Drain water jackets.
- With the end cover remaining bolted to the cylinder head, remove cylinder head nuts and jack head away from cylinder at an uniform rate on each of the two dowel pins. Two jackscrews are provided with each compressor for this purpose.
- When the cylinder head is free from the dowel pins, it is lifted off using an eyebolt in the tapped hole at the top of the cylinder head.
- **NOTE:** Booster units require removal of seal and support for the shaft as illustrated on Figure 12.

Inboard, or Drive end, Cylinder Head:

- Remove drive sheave or coupling hub and spacer.
- Unbolt seal, or packing gland as illustrated.
- On models fitted with a bearing locknut, lock-washer, and "H" ring, these must be removed before jacking the cylinder head away from the cylinder as described under "Dismantling Procedure Outboard Cylinder Head".

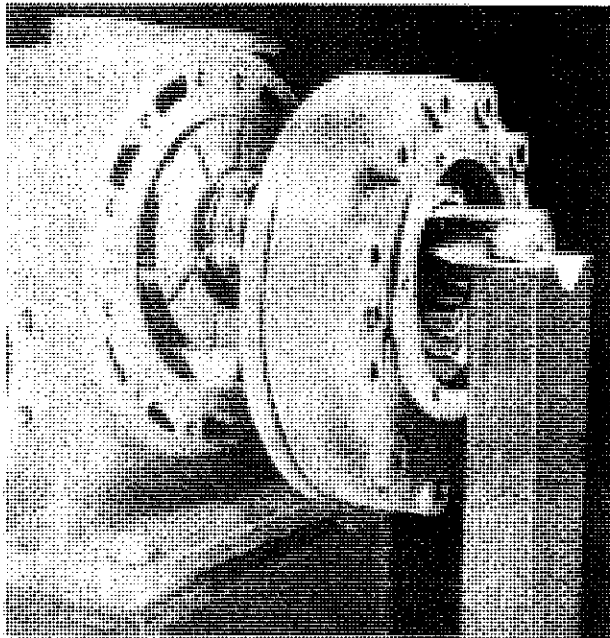


FIG. 12 – Shaft support booster unit

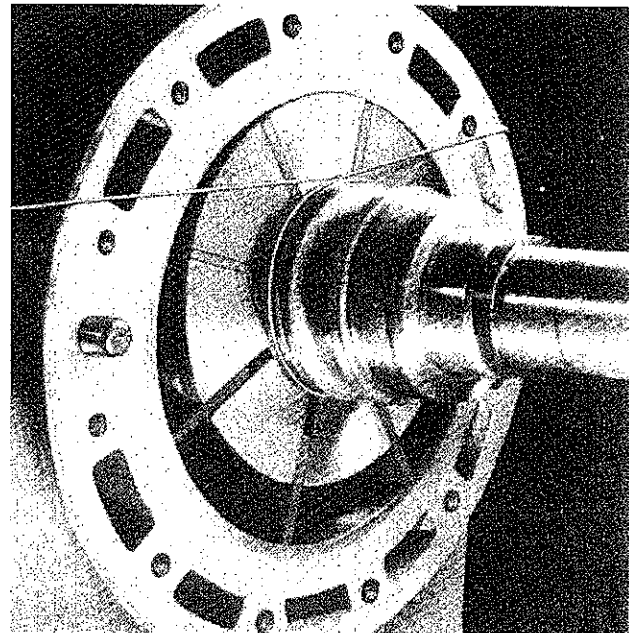


FIG. 13 – Compressing seal ring prior to replacing cylinder head

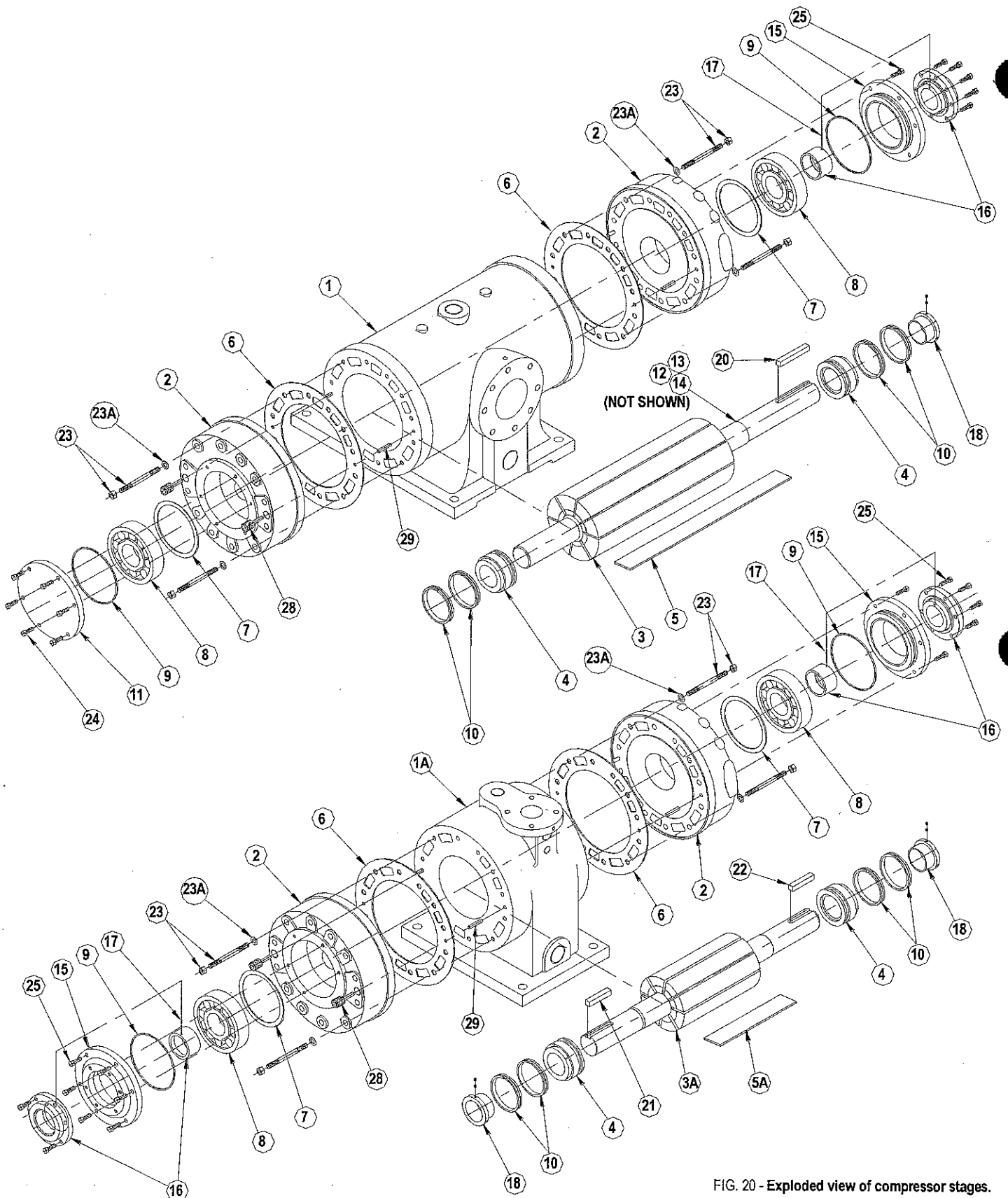


FIG. 20 - Exploded view of compressor stages.

Note: Some Ro-Flo® models are fitted with stuffing box or double bellows type seal in lieu of the single face mechanical seal shown above.

Ro-Flo® COMPRESSOR PARTS LIST

ITEM	PART DESCRIPTION	NO. REQ'D PER STAGE	REMARKS
1	Cylinder, Low Pressure	1	
1A	Cylinder, High Pressure (Booster)	1	
2	Cylinder Head	2	
3	Rotor Shaft, Low Pressure	1	
3A	Rotor Shaft, High Pressure (Booster)	1	
4	Bearing Spacer Ring	2	
*5	Rotor Blade Set, Low Pressure	1	
*5A	Rotor Blade Set, High Pressure (Booster)	1	
*6	Cylinder Head Gasket	2	
7	Bearing Shim Set	2	
*8	Roller Bearing	2	
*9	O-Ring	2	
*10	Seal Ring	4	
11	End Cover	1	
12	Bearing H-Ring	1	Required on Models 17S and Up Supplied With KP (single face) Mechanical Seals and Models 11S and Up Supplied With Crane (Double Face) Mechanical Seals. (Items 12, 13, 14)
13	Bearing Lock Washer	1	
14	Bearing Lock Nut	1	
15	Seal Adapter		One per Shaft Extension
*16	Mechanical Seal Assembly		One per Shaft Extension
17	Seal Drive Pin		One per Seal
18	Locking Sleeve		One per Seal
19	Seal Spacer	2	Models 208 and 210 Only – Not Used on Boosters 211 and Up
20	Square Key, Low Pressure	1	
21	Square Key, Inter-stage (Booster)	1	
22	Square Key, Drive End (Booster)	1	
23	Stud and Nut – (Threaded into Cylinder End)		
23A	Washer – Cylinder Head Stud		As required, Low Pressure and High Pressure (Booster)
24	Screw – End Cover		
25	Screw – Seal Adapter		
26	Screw – Seal		
27	Lock Washer - Seal		
28	Jack Screw – Cylinder Head	2	
29	Dowel Pin – Cylinder Head	4	

* Recommended Spare Part.

HOW TO ORDER REPLACEMENT PARTS

Machine serial numbers together with part descriptions are required when placing parts orders. The exploded view with the accompanying cross-reference to part description will aid in identifying parts. Maintenance and rebuild kits are also available. Please call Ro-Flo Compressors, LLC for quotations and placing orders. Office 920-574-2653



Xchanger, Inc.

Heat Exchangers



Installation



Operation



Maintenance



6.0 MAINTENANCE

Depending on the model, and your operating environment, the maintenance requirements may vary.

6.1 LUBRICATION

6.1.1 C/HP/HR/TV SERIES

No lubrication is required for the heat exchangers. Accessories may require lubrication, per their manuals.

6.1.2 AALC SERIES

Refer to the maintenance instructions provided with the motor(s).

6.2 C/HP/TV SERIES CORE REMOVAL AND INSTALLATION

It may be necessary to occasionally remove the fin-tube core from the housing for inspection or cleaning.

For units with removable cores, the following steps describe the procedure for removing the fin-tube core from the heat exchanger housing. Units which are all-welded will need to be returned to the factory for service. [See page 2 & 3 for reference to terminology.]

6.2.1 C/TV SERIES Core Removal

1. Disconnect service fluid and remove any connections from the service hubs (i.e. sweat on bronze flanges, screwed on threaded flanges, etc.). If the core and cover are welded together, the flanges do not need to be removed, as the cover will remain with the core.
2. Remove the bolts securing the hub plate assemblies to the front cover.
3. Remove the hub plate assembly (hub plate, O-ring, and backing washer). Some prying with a screwdriver or similar tool may be required to break the bond of the sealant.
4. Remove the bolts securing the front and rear housing covers to the housing.
5. Remove the front and rear covers. Some prying with a screwdriver or similar tool may be required to break the bond of the sealant.
6. Remove the bolts securing the core to the housing. Check both sides.
7. Remove the core from the housing by pulling evenly on the headers or the casing and/or pushing evenly on the 180° tube return bends on the back side of the core. Take care not to damage the headers or return bends.

6.2.2 HP SERIES Core Removal

1. Remove the flange bolts around the removable dished head cover.
2. Disconnect the core connections from the internal service connections.
3. Remove the bolts holding the core to the side of the housing.
4. Remove the core from the housing.

6.3 CLEANING

Xchanger, Inc. heat exchangers perform best when clean. It is recommended that they be prevented from becoming fouled since their design is such that once plugged or coated, it may not be possible to fully clean them. The sections below offer suggestions, where applicable, if cleaning is attempted.

6.3.1 AA/HR SERIES Internal Gas Passages

The internal process gas passages in these heat exchangers are not cleanable. Filtered air is absolutely required for these units. If plugging does occur, core replacement is recommended.

6.3.2 AA/HR/LC SERIES Service Gas Passages

For dirt/dust contamination, a soap and water wash is usually adequate to clean the service side of these units. If not, the use of an appropriate solvent or compressed air is recommended. Pressure washers can damage the fins, and should not be used.

6.3.3 C/HP/TV SERIES Gas Passages

These heat exchangers may require disassembly for cleaning. See Section 6.2 for disassembly instructions. Once access is obtained, the cleaning options described in Section 6.3.2 can be used.

6.3.4 C/HP/LC/TV SERIES Fluid Passages

The tube interior can become coated with sediment. This coating will reduce the thermal capacity of the heat exchanger. To try to restore a fouled heat exchanger to the original capacity, an appropriate solvent or cleaner compatible with the tube material can be circulated through the circuit to clean the tube interior.

6.4 FREEZING PROTECTION - C/HP/LC/TV SERIES

6.4.1 Drainable Circuits

If the heat exchanger is equipped with a drainable tube circuit, the tubes can be drained by simply opening the service and outlet to atmosphere. These units should be installed with a slight slope toward the service connection end to facilitate complete drainage.

6.4.2 Non-trapped Circuits

These tube circuits run horizontally and downward across the exchanger. If the exchanger is installed level, when the service inlet and outlet are opened to atmosphere, the service fluid may drain out of the low connection sufficiently to prevent freezing damage. If the exchanger is installed out of level, some service fluid will hang up in the now trapped points of the core. In this case, antifreeze should be added as discussed below.

7.0 SPARE PARTS

7.1 C/HP/TV SERIES

Normally, no spare parts are recommended. If a specific exchanger includes special parts or accessories that could be a spare part, or if an accessory itself uses spare parts, they would be noted on the data sheet, certified drawing, or on accompanying documentation.

Please note that the manufacturing and shipping time for replacement cores is often 6 weeks. If this length of downtime would present a significant problem, it may be advisable to stock a spare core.

7.2 AA/LC SERIES

A spare electric motor is recommended.

7.3 HR SERIES

Normally, no spare parts are recommended. Similar to the C/HP/TV Series above, any special parts would be noted on a case by case basis.

9.0 SERVICE

Should assistance in installation, demonstration, or repair of any equipment be required, please contact Xchanger, Inc. at:

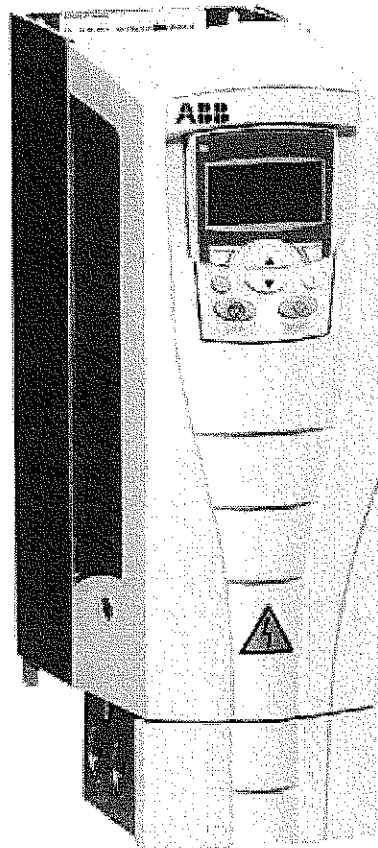
Mail: 1401 South 7th Street
Hopkins, MN 55343 USA
Ph: 952-933-2559
Fax: 952-933-5647
E-mail: info@xchanger.com

ACS550

User's Manual

ACS550-01 Drives (0.75...160 kW)

ACS550-U1 Drives (1...200 hp)



ABB

Maintenance



WARNING! Read chapter *Safety* on page 5 before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

Maintenance	Interval	Instruction
Heatsink temperature check and cleaning	Depends on the dustiness of the environment (every 6...12 months)	See <i>Heatsink</i> on page 265.
Main cooling fan replacement	Every six years	See <i>Main fan replacement</i> on page 266.
Internal enclosure cooling fan replacement (IP54/UL type 12 drives)	Every three years.	See <i>Internal enclosure fan replacement</i> on page 268.
Capacitor reformatting	Every year when stored	See <i>Reformatting</i> on page 269.
Capacitor replacement (frame sizes RS and R6)	Every nine years	See <i>Replacement</i> on page 269.
Replace battery in the Assistant Control Panel	Every ten years	See <i>Battery</i> on page 269.

Consult your local ABB Service representative for more details on the maintenance. On the internet, go to www.abb.com/drive and select *Drive Services – Maintenance and Field Services*.

Heatsink

The heatsink fins accumulate dust from the cooling air. Since a dusty heatsink is less efficient at cooling the drive, overtemperature faults become more likely. In a "normal" environment (not dusty, not clean) check the heatsink annually, in a dusty environment check more often.

Clean the heatsink as follows (when necessary):

1. Remove power from the drive.
2. Remove the cooling fan (see section *Main fan replacement* on page 266).
3. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.

Note: if there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.

4. Reinstall the cooling fan.
5. Restore power.

Main fan replacement

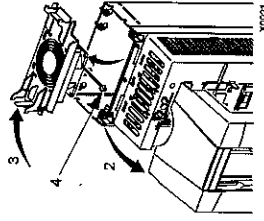
The drive's main cooling fan has a life span of about 60 000 operating hours at maximum rated operating temperature and drive load. The expected life span doubles for each 10 °C (18 °F) drop in the fan temperature (fan temperature is a function of ambient temperatures and drive loads).

Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Frame sizes R1...R4

To replace the fan:

1. Remove power from the drive.
2. Remove drive cover.
3. For frame size:
 - R1, R2: Press together the retaining clips on the fan cover sides, and lift.
 - R3, R4: Press in on the lever located on the left side of the fan mount, and rotate the fan up and out.
4. Disconnect the fan cable.
5. Reinstall the fan in reverse order.
6. Restore power.



Frame size R5

To replace the fan:

1. Remove power from drive.
2. Remove the screws attaching the fan.
3. Remove the fan: Swing the fan out on its hinges.
4. Disconnect the fan cable.
5. Reinstall the fan in reverse order.
6. Restore power.

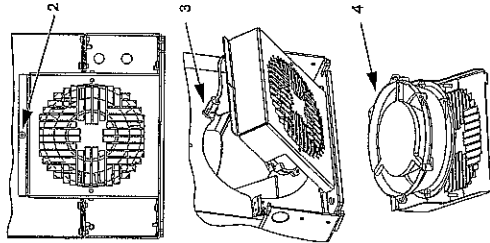


Arrows in the fan show the directions of the rotation and air flow.

Frame size R6

To replace the fan:

1. Remove power from the drive.
2. Remove the screw attaching the fan casing and let the casing lean down against the limiters.
3. Slide out the cable connector and disconnect it.
4. Take off the casing and replace the fan onto the casing's pins.
5. Reinstall the casing in reverse order.
6. Restore power.



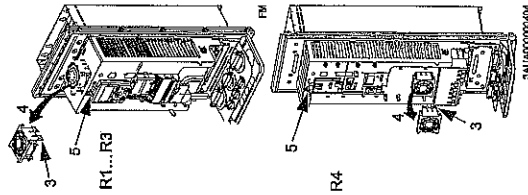
Internal enclosure fan replacement

IP54 / UL type 12 enclosures have an additional internal fan to circulate air inside the enclosure.

Frame sizes R1... R4

To replace the internal enclosure fan in frame sizes R1 to R3 (located at the top of the drive) and R4 (located in front of the drive):

1. Remove power from the drive.
2. Remove the front cover.
3. The housing that holds the fan in place has barbed retaining clips at each corner. Press all four clips toward the center to release the barbs.
4. When the clips/barbs are free, pull the housing up to remove from the drive.
5. Disconnect the fan cable.
6. Install the fan in reverse order:
 - The fan air flow is up (refer to the arrow on fan).
 - The fan wire harness is toward the front.
 - The notched housing barb is located in the right-rear corner.
 - The fan cable connects just forward of the fan at the top of the drive.



Frame sizes R5 and R6

To replace the internal enclosure fan in frame sizes R5 or R6:

1. Remove power from the drive.
2. Remove the front cover.
3. Lift the fan out and disconnect the cable.
4. Install the fan in reverse order.
5. Restore power.

Capacitors

Reforming

The drive DC link capacitors need to be reformed (re-aged) if the drive has been non-operational for more than one year. Without reforming, capacitors may be damaged when the drive starts to operate. It is therefore recommended to reform the capacitors once a year. See section *Serial number* on page 13 for how to check the date of manufacture from the serial number shown on the drive labels.

For information on reforming the capacitors, refer to *Guide for Capacitor Reforming* in ACS50, ACS55, ACS150, ACS310, ACS320, ACS350, ACS550 and ACH550 (3AFE68735190 [English]), available on the Internet (go to www.abb.com) and enter the code in the Search field).

Replacement

The drive intermediate circuit employs several electrolytic capacitors. Their life span is from 35 000...90 000 hours depending on drive loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by a input power fuse failure or a fault trip. Contact ABB if capacitor failure is suspected. Replacements for frame size R5 and R6 are available from ABB. Do not use other than ABB specified spare parts.

Control panel

Cleaning

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Battery

A battery is only used in Assistant Control Panels that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years. To remove the battery, use a coin to rotate the battery holder on the back of the control panel. Replace the battery with type CR2032.

Note: The battery is NOT required for any control panel or drive function, except the clock.

Technical data

Ratings

By type designation, the table below provides ratings for the ACS550 adjustable speed AC drive, including:

- IEC ratings
- NEMA ratings (shaded columns)
- frame size.

Ratings, 208...240 V drives

Abbreviated column headers are described in section Symbols on page 273.

Type	Normal use			Heavy-duty use			Frame size
	I_{2N} A	P_N kW	P_N hp	I_{2Hd} A	P_{Hd} kW	P_{Hd} hp	
Three-phase supply voltage, 208...240 V							
-04A6-2	4.6	0.75	1	3.5	0.56	0.75	R1
-06A6-2	6.6	1.1	1.5	4.8	0.75	1	R1
-07A6-2	7.5	1.5	2	6.8	1.1	1.5	R1
-012A-2	11.8	2.2	3	7.5	1.5	2	R1
-017A-2	16.7	4	5	11.8	2.2	3	R1
-024A-2	24.2	6.5	7.5	16.7	4	5	R2
-031A-2	30.8	7.5	10	24.2	5.5	7.5	R2
-046A-2	46.2	11	15	30.8	7.5	10	R3
-059A-2	59.4	15	20	46.2	11	15	R3
-075A-2	74.8	18.5	25	59.4	15	20	R4
-088A-2	88.0	22	30	74.8	18.5	25	R4
-114A-2	114	30	40	88.0	22	30	R4
-143A-2	143	37	50	114	30	40	R6
-178A-2	178	45	60	150	37	50	R6
-221A-2	221	55	75	178	45	60	R6
-248A-2	248	75	100	192	55	75	R6

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Technical data

Ratings, 380...480 V drives

Abbreviated column headers are described in section Symbols on page 273.

Type	Normal use			Heavy-duty use			Frame size
	I_{2N} A	P_N kW	P_N hp	I_{2Hd} A	P_{Hd} kW	P_{Hd} hp	
Three-phase supply voltage, 380...480 V							
-03A3-4	3.3	1.1	1.5	2.4	0.75	1	R1
-04A4-4	4.1	1.5	2	3.3	1.1	1.5	R1
-06A4-4	5.4	2.2	Note 1	4.1	1.5	Note 1	R1
-08A4-4	6.9	3	3	5.4	2.2	3	R1
-08A8-4	8.8	4	5	6.9	3	3	R1
-012A-4	11.9	5.5	7.5	8.8	4	5	R1
-015A-4	15.4	7.5	10	11.9	5.5	7.5	R2
-023A-4	23	11	15	16.4	7.5	10	R2
-031A-4	31	15	20	23	11	15	R3
-038A-4	38	18.5	25	31	15	20	R3
-046A-4	46	22	30	38	18.5	25	R3
-059A-4	59	30	40	44	22	30	R4
-072A-4	72	37	50	59	30	40	R4
-076A-4	77	Note 2	Note 2	72	Note 2	50	R4
-087A-4	87	45	Note 1	77	37	Note 1	R4
-097A-4	97	Note 2	Note 2	97	Note 2	60	R4
-125A-4	125	55	Note 1	87	45	Note 1	R5
-125A-4	125	Note 2	Note 2	96	Note 2	75	R5
-157A-4	157	75	125	124	55	100	R6
-180A-4	180	90	150	158	75	125	R6
-195A-4	205	110	Note 1	162	90	Note 1	R6
-248A-4	246	132	200	192	110	150	R6
-290A-4	290	160	Note 1	246	132	200	R6

00467918.xls C

1. Not available in ACS550-U1 series.
2. Not available in ACS550-01 series.

Technical data

Preventive Maintenance Plan
Midland Landfill Gas Compression and Energy Generation

ATTACHMENT C
Caterpillar G3520 Engine Generator Sets
Preventive Maintenance and Spare Parts



Operation and Maintenance Manual

G3500C and G3500E Generator Sets

GZA1-Up (Generator Set)
GSB1-Up (Generator Set)
GZB1-Up (Generator Set)
TJB1-Up (Generator Set)
GZC1-Up (Generator Set)
TJC1-Up (Generator Set)
MAD1-Up (Generator Set)
GZG1-Up (Generator Set)
GZH1-Up (Generator Set)
GZJ1-Up (Generator Set)
GZK1-Up (Generator Set)
GZL1-Up (Generator Set)
HAL1-Up (Generator Set)
GZM1-Up (Generator Set)
GZN1-Up (Generator Set)
B9P1-Up (Generator Set)
RLP1-Up (Generator Set)
SSR1-Up (Generator Set)
GAS1-Up (Generator Set)
LGS1-Up (Generator Set)
NGS1-Up (Generator Set)
HAT1-Up (Generator Set)

CWW1-Up (Generator Set)
GTX1-Up (Generator Set)
CWY1-Up (Generator Set)
SLY1-Up (Generator Set)
SXY1-Up (Generator Set)
GZZ1-Up (Generator Set)

103675805

**Maintenance Interval Schedule
(Landfill)****SMCS Code:** 1000; 4450; 7500**S/N:** MAD1-Up**S/N:** GZJ1-Up**S/N:** GZK1-Up**S/N:** LGS1-Up**S/N:** HAT1-Up

Ensure that all safety information, warnings and instructions are read and understood before any operation or any maintenance procedures are performed.

The user is responsible for the performance of maintenance, including all adjustments, the use of proper lubricants, fluids, filters, and the replacement of components due to normal wear and aging. Failure to adhere to proper maintenance intervals and procedures may result in diminished performance of the product and/or accelerated wear of components.

Use mileage, fuel consumption, service hours, or calendar time, **WHICH EVER OCCURS FIRST**, in order to determine the maintenance intervals. Products that operate in severe operating conditions may require more frequent maintenance.

Note: Before each consecutive interval is performed, all maintenance from the previous interval must be performed.

When Required

Cooling System Coolant Sample (Level 2) - Obtain	87
Engine Air Cleaner Element - Replace	91
Engine Oil - Change	93
Fuel Metering Valve - Check	100
Generator - Dry	102
Generator Bearing - Lubricate	105
Generator Set - Test	109
Insulation - Test	118
Overhaul Considerations	127
Space Heater - Check	129
Stator Winding Temperature - Measure/Record ..	131
Throttle Control Valve - Check	131

Daily

Cooling System Coolant Level - Check	86
Engine Oil Level - Check	96
Fuel System Fuel Filter Differential Pressure - Check	100

Fumes Disposal Filter Differential Pressure - Check	101
Generator Load - Check	108
Power Factor - Check	128
Turbocharger - Inspect	131
Voltage and Frequency - Check	135
Walk-Around Inspection	135

Initial 250 Service Hours

Crankcase Blowby - Measure/Record	88
Cylinder Pressure - Measure/Record	90

Every 250 Service Hours

Battery Electrolyte Level - Check	81
Cooling System Coolant Sample (Level 1) - Obtain	86
Cooling System Supplemental Coolant Additive (SCA) - Test/Add	87
Engine Oil Sample - Obtain	97
Fumes Disposal Filter - Drain	101

Every 1000 Service Hours

Aftercooler Condensation - Drain	81
Alternator - Inspect	81
Belts - Inspect/Adjust/Replace	82
Crankcase Pressure - Measure	89
Crankshaft Vibration Damper - Inspect	89
Engine Crankcase Breather - Clean	92
Engine Oil Filter - Change	95
Engine Speed/Timing Sensor - Clean/Inspect	98
Engine Valve Lash and Bridge - Adjust	99
Flexible Coupling - Inspect	100
Gas Pressure Regulator Condensation - Drain ..	102
Hoses and Clamps - Inspect/Replace	110
Inlet Air System - Inspect	117
Radiator - Clean	128
Valve Stem Projection - Measure/Record	133
Water Pump - Inspect	136

Every 2000 Service Hours

Compressor Bypass - Check	83
Generator - Inspect	104
Generator Set Vibration - Inspect	109
Ignition System Spark Plugs - Inspect/Replace ..	111
Stator Lead - Check	131

Every Year

Cooling System Coolant Sample (Level 2) - Obtain	87
--------------------------------------------------------	----

Every 4000 Service Hours

Crankcase Blowby - Measure/Record	88
Cylinder Pressure - Measure/Record	90
Engine Mounts - Check	93
Engine Protective Devices - Check	97
Ignition System Timing - Check/Adjust	117
Starting Motor - Inspect	130

Maintenance Section
Maintenance Interval Schedule

Between 7500 and 8000 Service Hours

Overhaul (Top End) 124

Every 8000 Service Hours

Fumes Disposal Filter Element - Replace 101

Oil Temperature Regulators - Replace 121

Rotating Rectifier - Check 129

Varistor - Test 134

Water Temperature Regulator - Replace 137

Winding - Test 138

Between 22 500 and 24 000 Service Hours

Crankshaft Vibration Damper - Inspect 90

Overhaul (In-Frame) 121

Every 24 000 Service Hours or 3 Years

Cooling System Coolant (NGEC) - Change 83

Between 37 500 and 40 000 Service Hours

Crankshaft Vibration Damper - Inspect 90

Overhaul (Major) 122



**MAXIM Model MBT 831-16-2PVW-165-SWG
Heat Recovery Silencer**

**For
Cleveland Brothers Equip. Co.
Purchase Order No.: EM100009**

**By
MAXIM Silencer Incorporated
Stafford, Texas, U.S.A.
Order 410199-01**

MAINTENANCE

After the MBT has been at operating conditions for at least one but not more than eight (8) hours, the system should be shut down and all flange bolts retightened. Failure to perform this operation may result in flange leakage and, in the case of the exhaust gas connections, distortion of the flanges.

If internal scaling occurs, commercial boiler cleaning compounds and solvents can be used for cleaning. The tube bundle drain should also be opened on a periodic basis to prevent sludge accumulation in the bottom of the tube bundle.

System cleanliness is the single most important factor in long, efficient operation of the heat recovery equipment. Waterside cleanliness can be accomplished only through continuous, effective, water treatment.

The exhaust gas side of the heat recovery unit may require cleaning when used with natural gas fueled engines and will very likely require cleaning at regular intervals with oil fueled engines. Short periods of dry operation at exhaust temperatures exceeding 600 °F are an effective way of cleaning soot from the exhaust gas side of the MBT. If gas side fouling occurs and dry operation is not desirable, a low temperature soot release agent can be injected into the hot exhaust gas stream to effectively remove hydrocarbon buildups. If the deposits can not be removed by the above-mentioned methods, the surfaces can be cleaned with an air or steam lance or by brushing. Once the soot has been removed it can be washed out through the gas side drain connection.

The gas side pressure drop across the HRU and the inlet and outlet gas temperatures for known flow and load conditions should be recorded during the first few weeks of operation. These figures can be used as benchmarks to determine future fouling and the need to clean the gas side surfaces. The frequency of cleaning is dependent on fuel, engine load, and other factors, which can best be determined by regular inspection of the unit's condition. Monitoring the gas side pressure drop is a convenient means of recognizing excessive gas fouling.

If inspection of the unit indicates that repair of the pressure containing parts is necessary; this work must be done in accordance with the National Board Inspection Code. This requires that an inspector commissioned by the National Board of Boiler and Pressure Vessel Inspectors approves the proposed repair procedures and the repairs carried out by an organization authorized to repair pressure vessels. Consult the owner's insurance carrier or MAXIM for guidance.

Model	G3520CLF	Serial #:	GZJ
-------	----------	-----------	-----

Priority Description:

1 = readily available at site
2 = available at local dealer

Suggested Quantity	Priority	Part Number	Description	Comments	GROUP No.
2	2	1059741	Element As	Air filter	1329326
1	2	1101168	Switch As	Jacket water pressure	2072451
1	2	1308299	Sensor Gp	Temperature - manifold air	2072451
1	2	1309811	SENSOR GP-TEMP	Jacket water Lines/tanks	2072451
1	2	1520807	Sensor	Turbo- exhaust sensor	2094749
1	2	1638523	Sensor Gp	Pressure - filtered and unfiltered oil	2072451
1	2	1946724	SENSOR GP-PRESS	Compressor outlet air line	2615731
2	2	1952431	Sensor Gp	Detonation	2072451
10	2	2002003	Screw - Adjusting	Valve Mechanism Group	2018289, 2585407
1	2	2006551	MANIFOLD	MANIFOLD GP-EXHAUST	2064169
1	2	2006552	MANIFOLD	MANIFOLD GP-EXHAUST	2064169
2	2	2006554	Bellows As	MANIFOLD GP-EXHAUST	2064169
2	2	2034571	Seal	Manifold section to cylinder head	2064169
2	2	2037859	Gasket	Rocker base to cylinder head	2018289, 2585407
2	2	2059470	Mount - Shock	ECM box mount	2059452
4	2	2065988	Seal	Riser tube to water manifold	2006406
2	2	2072371	Sensor Gp	exhaust temp	2094749
1	2	2091823	Gasket	Jacket water water outlet	2078571, 2365194
20	2	2434291	Spark Plug	Ignition GP - Gas Engine	2356098
1	2	2448861	Clamp	Exhaust manifold clamp	2064169
1	2	2645140	Bellows As	MANIFOLD GP-EXHAUST	2655230
1	2	2659034	Sensor Gp	Speed - engine timing	2072451, 2659034
1	2	2766793	Sensor Gp	Pressure - jacket water outlet	2072451
5	2	2965820	Seal	Valve cover to base	2221956, 2445628
3	2	2997609	Gasket Kit	single cylinder head gasket kit	
1	2	3049396	Actuator As	Bypass Actuator Assembly	2231164
5	2	3053447	Seal	Manifold sections to bellows	2064169
1	2	3084493	Bellows As	MANIFOLD GP-EXHAUST	2655230
2	2	3103180	TRANSFORMER GP-A		2356098, 2655252
1	2	3136079	THROTTLE		2398100
1	2	3223617	Control Gp	ADEM III control	1546713
5	2	10R5992	Cylinder Pack As		
2	2	10R7928	Cylinder Head - Gp	Reman complete head including valves	
1	2	2355751	Gasket	fuel line inlet	2478600, 2353951, 2935847, 2935848
10	2	4W6682	Push Rod - Valve	Mechanism GP - Valve	2585407
4	2	6V3603	SEAL-O-RING	Lines GP- Air	2064164
1	2	7E6016	GASKET (FOR ALL ENGINES)	Regulator GP- Housing (Outlet Control)	2361062
20	2	9Y6792	Gasket	Spark Plug	2356098, 2655252
8	2	See Engine Consist for Part Number	Jacket Water Regulators		
2	2	See Engine Consist for Part Number	SCAC Regulators		



www.clevelandbrothers.com

Cleveland Brothers Equipment Co., Inc.
336 N. Fairville Avenue
Harrisburg, PA 17112
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1-800-538-1020

Since 1948

AirX Radiators

Replacement belt Pt# - 5/3VX950

Preventive Maintenance Plan
Midland Landfill Gas Compression and Energy Generation

ATTACHMENT D
Sullair Air Compressors
Preventive Maintenance and Spare Parts



SULLAIR®

USER MANUAL

WS CONTROLLER USER INTERFACE MANUAL

WARRANTY NOTICE

Failure to follow the instructions
and procedures in this manual or,
misuse of this equipment will
VOID its warranty!

PART NUMBER:
02250165-411 R01

KEEP FOR
FUTURE
REFERENCE

©SULLAIR CORPORATION

The information in this manual is current
as of its publication date, and applies to
compressor serial number:

20080301000

and all subsequent serial numbers.

Section 6

MAINTENANCE

6.1 GENERAL

WARNING

Before any repairs are attempted, refer to *Section 1: Safety* before proceeding.

As you proceed in reading this section, it will be easy to see that the Maintenance Program for the air compressor is quite simple. The use of the service indicators provided for the fluid filter, air filter and fluid separator will alert you when service maintenance is required. When the WS Controller display indicates service, maintenance for that specific item is required. Refer to *Filter Maintenance* on page 52.

6.2 DAILY OPERATION

Prior to starting the compressor, it is necessary to check the fluid level in the separator/sump tank. Should the level be low, simply add the necessary amount. If the addition of fluid becomes too frequent, a simple problem has developed which is causing this excessive loss. See the *Section 6.9: Troubleshooting— Introduction* on page 55 under **EXCESSIVE COMPRESSOR FLUID CONSUMPTION** for a probable cause and remedy.

WARNING



WARNING

HIGH-PRESSURE HAZARD!

- **DO NOT** remove caps, plugs, and/or other components when compressor is running or pressurized. Stop compressor and relieve all internal pressure before doing so.
- Failure to comply could result in death or serious injury.

After a routine start has been made, observe the controller display and be sure it monitors the correct readings for their particular phase of operation. After the compressor has warmed up, it is recommended that a general check on the overall compressor be made to assure that the compressor is running properly.

6.3 MAINTENANCE AFTER INITIAL 50 HOURS OF OPERATION

After the initial 50 hours of operation, a few maintenance requirements are needed to clean the system of any foreign materials. Perform the following maintenance operations to prevent unnecessary problems.

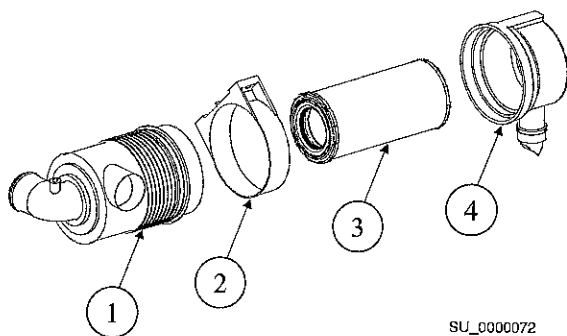
1. Clean the return line strainer. Refer to *Discharge, Discharge, Separator/Sump Tank and Piping System* on page 22 for location.
2. Clean the return line orifice.

6.4 MAINTENANCE EVERY 2000 HOURS

After 2000 hours of operation, it will be necessary to perform the following:

6.7 AIR FILTER MAINTENANCE

Refer to *Figure 6-2*. Air filter maintenance should be performed when the maintenance indicator shows red with the compressor running full load, or once a year, whichever comes first. If the filter needs to be replaced, order a replacement element. Below you will find procedures on how to replace the air filter element.



SU_0000072

1. Filter Head
2. Element*
3. Body
* Air Filter Replacement Kit—P/N 02250125-372

Figure 6-2: Air Filter Assembly

Air Filter Element Replacement

1. Clean exterior of air filter housing.
2. Rotate end cover counterclockwise and remove.
3. Remove air filter element by pulling it out of the housing.
4. Clean interior of housing using a damp cloth. **DO NOT** blow dirt out with compressed air.
5. At this time replace the element.
6. Reassemble in the reverse order of the disassembly.

6.8 SEPARATOR MAINTENANCE

Replace the separator element when indicated by the WS Controller or after one (1) year, whichever comes first. The separator element must be replaced. **DO NOT** attempt to clean the separator element.

Separator Element Replacement

Refer to *Figure 6-3*. The separator element must be changed when indicated by the WS Controller, or once a year, whichever occurs first. Follow the procedure explained below for separator element replacement.

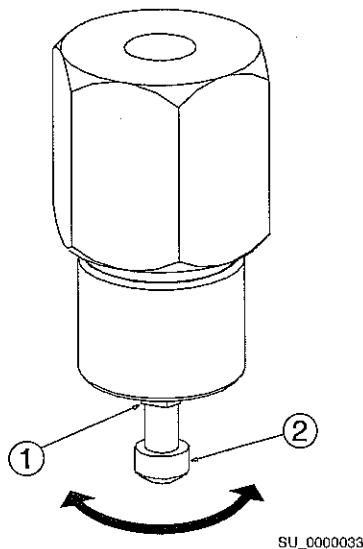
NOTE

Relieve all pressure from the separator/sump tank and all compressor lines.

1. Loosen and remove the six (6) hex head cap screws (8.8 M12 x 40 mm) from the cover plate.
2. Lift the cover plate from the separator/sump tank.
3. Remove the separator element.
4. Inspect the separator/sump tank for rust, dirt, etc.
5. Reinsert the separator element into the separator/sump tank taking care not to dent the element against the tank opening.
6. Install a new O-ring in the O-ring groove on the underside of the separator/sump tank cover.
7. Replace the cover plate, washers and cap screws. Torque to 70 ft-lbs (95 N·m).
8. Clean the return line strainer before restarting the compressor.

Pressure Regulator Adjustment

Start the compressor and adjust the service valve to maintain service air pressure approximately at 1 psi over rated pressure. Turn the inlet valve regulator adjusting screw until air just begins to escape from the control air orifice (located at the bottom of the regulator; refer to *Figure 6-5*). Lock the adjusting screw in place with the locknut. The regulator is now properly set.



1. Locking Nut
2. Adjustment Screw

Figure 6-5: Separator Element Assembly

Water Condensate Drain Maintenance

If your compressor is fitted with the standard solenoid condensate drain valve, it is necessary to periodically clean the strainer. Remove the knurled cap from the strainer and remove the strainer screen. Clean the screen and reinstall. If the screen is damaged, the strainer assembly must be replaced (P/N 241772).

Control Line Strainer

The regulator and solenoid valve(s), which control the compressor, are protected by a strainer. Every 12 months it is necessary to clean the strainer. Remove the hex cap from the strainer and remove the strainer screen. Clean the screen and reinstall. If the screen is damaged, the strainer assembly must be replaced (P/N 241772).

Shaft Coupling Maintenance

The compressor unit and motor are rigidly connected via a mounting adapter housing. This arrangement makes coupling alignment unnecessary. The coupling is a jaw type in shear. If the elastomeric element requires replacement due to wear or breakage, order replacement element no. 02250152-669, and follow the following steps:

1. Remove the protective grill from the adapter housing.
2. Loosen the retaining screw located on the outer sleeve. Slide the sleeve to one side, exposing the coupling element.
3. Unwrap the coupling element from the coupling jaws.
4. Install the new element by wrapping it around the jaws, engaging the cogs on the element into the jaws.
5. Reinstall the outer sleeve and torque the securing screws to 10 in-lb (1.13 N·m). Install the protective grill.

6.9 TROUBLESHOOTING—INTRODUCTION

The information contained in the Troubleshooting Guide has been compiled from field report data and factory experience. It contains symptoms and usual causes for the described problems. However, DO NOT assume that these are the only problems that may occur. All available data concerning a problem should be systematically analyzed before undertaking any repairs or component replacement procedures.

A detailed visual inspection is worth performing for almost all problems and may avoid unnecessary additional damage to the compressor. Always remember to:

1. Check for loose wiring.
2. Check for damaged piping.
3. Check for parts damaged by heat or an electrical short circuit, usually apparent by discoloration or a burnt odor.

Should your problem persist after making the recommended check, consult your nearest Sullair representative.

Sullair 3009v Compressor - spare parts

3009 V

3009V Compressor

s/n 201005190047
p10/138382a

408893	valva shuttle	\$80.50
02250157-500	kit sol	\$68.50
250019-453	kit sol	\$81.00
02250049-634	val blwdn	\$98.00
02250155-175	p,thermister	\$57.00
02250155-174	xdcr,press	\$142.50
02250186-214	kit element	\$172.50
02250157-596	hose	\$145.50
02250155-709	element	\$68.00
02250110-988	kit rpr	\$48.50
02250092-081	viv,therm	\$102.00
250022-669	sullube	\$379.00
02250125-372	elem air	\$49.00
02250117-782	filter	\$36.00
826502-369	o-ring	\$25.50
02250164-607	kit inlet	\$98.50
02250164-606	kit inlet	\$21.50



Corporate Order Entry Reports eRegister Documents Contact Logout

Enter Complete Serial Number:

201005190047

Serial number is case sensitive, please use capital letters.

Search Results

Matching records found: 1

Serial Number	Part Number	
201005190047	P10/138382A	View Sales Notes View Consumables View Attachments

Header Information

Serial Number: 201005190047 **Part Number:** P10/138382A
Part Description: 3009V/A/SUL460/60/S4
Sold To Name: CLEVELAND BROTHERS INC **Ship To Name:** MIDLAND LANDFILL **End User Name:** MIDLAND LANDFILL
City, State and Country: MURRYSVILLE, PA, US **City, State and Country:** MIDLAND, MI, US **City, State and Country:** MIDLAND, MI, US
Startup Date: 10/07/2010 **Shipped Date:** 08/07/2010
Sales Order Number: 1832444

Item Number	Item Description	Quantity
408893	VALVE, SHUTTLE 1/4" (DBL CHK) 80.50	0
02250157-500	KIT, SOL VLV 3WNO 24VDC + 68.50	0
250019-453	KIT, REPAIR PRESS REG VALVE 81.00	0
02250049-634	VLV, BLWDN 1/4 NPT HI PRS 98.00	0
02250155-175	P, THERMISTER 3000 OHM NTC 6'L 57.00	0
02250155-174	XDCR, PRESS 0-250# RATIOMETRIC 142.50	0
02250186-214	KIT, ELEM 6.5D X 9.0LNG 172.50	0
02250157-596	HOSE, LP F-JIC 1.5 X 23"L 145.50	0
02250155-709	ELEM, FLTR CORELESS 2.5DIA 9"L 68.00	0
02250110-988	KIT, RPR 1-5/8" SAE MPV 48.50	0
02250092-081	VLV, THRM 195F 1 1/2-18 102.00	0
02250174-268-25022-669	6LR, AIR/OIL P10-40HP STD LUBE 379.00	0
02250125-372	ELEM, AIR FLTR 8" 49.00	0
02250117-782	FLTR, ASSEMBLY GENESIS FILTR + 36.00	0
826502-369	O-RING, VITON 8 X 3/16" 25.50	0
250009-396	FL, SULLUBE 32 1GAL	0
02250164-607	KIT, INLET VLV REBUILD DXX102E 98.50	0
02250164-606	KIT, INLET VLV REPAIR D102E SP 21.50	0

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1.0 3850-23791 | hsapps.etc.com

Sullair SSD160 Dryer - Spare parts

ssd160 Dryer
dryer

02250182-538	kit poppet	\$243.50
02250182-534	kit repair exh.val	\$299.00
02250182-531	check val kit	\$241.50
02250180-771	val,sol	\$157.50
02250180-709	muffler	\$87.50
02250188-450	element	\$49.50
02250180-690	board ssd control	\$925.00
02250180-691	board power saver	\$1,640.50



SSD160 Spare Parts List



QTY.	SULLAIR PART #	DESCRIPTION	SULLAIR P & I	ITEM #	MODEL	Recommended Spare
2	02250180-751	VALVE, 1" REPRESSURIZATION	02250182-349	1	SSD160	
2	02250182-538	KIT, REPAIR FOR 1" POPPET REPRESSURIZATION VALVE TP7610-P1, KIT CONTENTS: 11 SEALS		243.50	SSD160	✓
2	02250180-736	VALVE, 1" N/C ANGLE SEAT POPPET VALVE	02250182-349	2	SSD160	
2	02250182-534	KIT, REPAIR FOR 1" N/C ANGLE SEAT POPPET EXHAUST VALVE TP7510-P1, KIT CONTENTS: 13 SEALS		299.00	SSD160	✓
2	02250180-714	VALVE, SAFETY RELIEF 1/2"	02250182-349	7	SSD160	
2	02250180-728	VALVE, 1" CHECK	02250182-349	9	SSD160	
2	02250182-531	KIT, REPAIR FOR 1" CHECK VALVE TP7410-C, KIT CONTENTS: 1 SPRING, 2 PLASTIC DISKS		241.50	SSD160	✓
1	02250180-718	VALVE, 1/4" MINI BALL VALVE			SSD160	
4	02250180-771	VALVE, SOLENOID, 3 WAY, 175 PSI	02250182-349	157.50 ST-S4	SSD160	✓
2	02250180-709	MUFFLER, 1"	02250182-349	87.50	SSD160	✓
4	02250182-410	SCREEN NIPPLE, 1"	02250182-349	5		
1	C/F	FILTER, CONTROL AIR	02250182-349	13		
1	02250180-450 02250180-667	ELEMENT, CONTROL FILTER		49.50	SSD160	✓
2	02250180-737	GAUGE, 0-200 PSIG, 2 1/2 INCH	02250182-349	6	SSD160	
176 LBS	02250180-892	DESICCANT ACTIVATED ALUMINA, F240 1/8", (50 LB BAG)			SSD160	
1	C/F	ORIFICE, PURGE	02250182-349	14		
1	02250180-773	INDICATOR, MOISTURE HUMIDITY	02250182-349	11	SSD160	
1	02250180-690	BOARD, STD CONTROL SSD		925.00	SSD160	✓
OPTIONAL EQUIPMENT						
1	02250180-665	PROBE, P.S. (POWER SAVER)	02250182-349	10	SSD160	
1	02250180-764	CONNECTOR, DIN			SSD160	
1	02250180-691	BOARD, OPT CONTROL (POWER SAVER)		1640.50	SSD160	✓
1	02250182-542	TUBE, PS/PSP AIR SAMPLE				
1	02250148-225	PROBE, DEW POINT SENSOR (POWER SAVER PLUS)	02250182-349	10	SSD160	
1	02250180-666	METER, PANEL ANALYZER PSP			SSD160	

Preventive Maintenance Plan
Midland Landfill Gas Compression and Energy Generation

ATTACHMENT E

**Shalbetter Switchgear and Balance of Plant Control Panels
Preventive Maintenance and Spare Parts**

Shallbetter Preventative Maintenance Offerings

Shallbetter offers many different options of preventative maintenance and service. The service levels of preventative maintenance are listed as Tiers 1 - 4 and range from inspection to total system commissioning. A short description explaining each Tier of preventative maintenance is listed below. Upon receipt of order a detailed service plan, customized to each job's specification will be supplied to the customer. For factory service other than preventative maintenance, please contact your Shallbetter representative or call the factory direct at 1-800-843-0051.

Tier I – Inspection

A factory trained service team will conduct a multipoint inspection on your equipment. A detailed report will be supplied indicating results and suggested actions. This option is for customers that conduct their own preventative maintenance but would like a factory inspection to ensure all possible vulnerabilities have been addressed.

Tier II – Cleaning

A factory trained service team will conduct a multipoint inspection and cleaning service on your equipment. All aspects of the gear will be inspected and cleaned addressing any possible vulnerabilities caused by debris, damage or aging. A detailed report will be supplied indicating results and suggested actions. This option best fits customers without a preventative maintenance program and with gear that is not considered "mission critical".

Tier III – Adjustment and Lubrication

A factory trained service team will conduct a multipoint inspection, cleaning, adjustment and lubrication services on your equipment. All moving parts will be adjusted and lubricated and all current carrying components will be checked for proper tightness per the manufacture's specifications. A detailed report will be supplied indicating results and suggested actions. This option best fits customers without a preventative maintenance program and with gear that requires a high degree of reliability.

Tier IIII – Preventative Maintenance, Testing and Recording

A factory trained service team will conduct full preventative maintenance including testing of all equipment components. This service includes all the preventative maintenance required to fully maintain equipment from cleaning to adjusting and lubricating, the testing of relays, circuit breaker / switches, transformer, capacitors, fuses and other electrical components found in power distribution equipment. A detailed report will be supplied indicating findings and suggested actions. Test results will be recorded for comparison with future testing. This option best fits customers without a preventative maintenance program and with gear that is considered "mission critical" or revenue generating.



SO53407 - CLEVELAND BROTHERS - MIDLAND - SMECG-30512250-A4B2-CU-1-GA-CBE

QTY	PART / DESCRIPTION	PART NUMBER
2	LIGHT BULB - 230 VAC TYPE 10S6 SYNCH	1438100000
2	PILOT LIGHT - 24VAC/DC GREEN LED	1431200002
2	PILOT LIGHT 24VAC/DC RED LED	1431200003
2	PILOT LIGHT 24VAC/DC WHITE LED	1431200004
2	GENERAL PURPOSE RELAY 24 VDC 3PDT CONTACT 11 PIN TERMINATION	1503900013
1	GENERAL PURPOSE POWER RELAY 24VDC DPDT 14 BLADE 4 POLE	1503900003
2	POWER RELAY 30A AT 28VDC CONTACTS SPNO-DM	1500450007
2	CIRCUIT BREAKER, UL489, 1P, 10A, 48VDC, 480/277VAC, 10KAIC, C-CURVE	3007940010
2	CIRCUIT BREAKER, UL489, 1P, 4A, 48VDC, 480/277VAC, 10KAIC, C-CURVE	3007940005
5	FUSE FAST ACTING 3AMP 32VDC ATC BLADE TYPE UL RECOGNIZED	1621190094

SO53580 - CLEVELAND BROTHERS - MIDLAND COMPRESSOR

QTY	PART / DESCRIPTION	PART NUMBER
1	PILOT LIGHT 24VAC/DC GREEN LED	1431200002
3	GENERAL PURPOSE RELAY 24 VDC	1503900000
4	FUSE FAST ACTING 3AMP 32VDC	1621190094
2	LITHIUM BATTERY MSDS 1769 BA	1769-BA
1	LITHIUM BATTERY MSDS 1756 BA2	1756-BA2