INSTALLATION AND MAINTENANCE OF FIELD GAS COMPRESSORS

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In today's times of material shortages and spiraling material costs, it has become increasingly important to emphasize proper installation techniques and a comprehensive maintenance program to assure long equipment life with minimum maintenance. Of prime consideration will be a scheduled maintenance program to prevent untimely and expensive downtime, and to prevent expensive major maintenance.

When designing the engine-compressor installation, several factors should be taken into consideration which can affect the overall performance of the installation. An adequate foundation must be provided to assure a stationary mounting base for the engine compressor skid and any accessory equipment not mounted on the skid. The use of portable concrete bases has become popular for units of 150 Hp and less where all equipment is mounted on a common skid. If the unit is installed inside a building or adjacent to other machinery, sufficient space must be allowed around the unit to permit maintenance and service work to be accomplished. In outdoor locations, units equipped with radiators should be oriented in relation to the prevailing winds so that the natural air flow is in the normal direction of air flow through the engine radiator. The orientation of units equipped with vertical discharge unitized coolers may be to suit other requirements. In multiple-unit installations, arrangements should be avoided which result in hot air from one unit radiator flowing to the air inlet of a second unit radiator or air cleaner. Installation of units inside buildings should be designed to allow for the passage of hot air from the radiators and/or coolers to the outside through adequate natural ventilation or through ducting to the outside of the building. Unitized vertical discharge coolers may frequently be installed outside the building to ease the disposal of heated air. The exhaust system must be properly designed for the operating conditions of the engine-compressor, both for proper scavenging of the power cylinders and for correct dissipation of exhaust heat. An operation and maintenance manual is available from the manufacturer of any quality engine-compressor package. A complete review of the manual is recommended for those responsible for the operation of the unit and installation instructions should be carefully studied prior to setting the unit at its location.

Accurate maintenance records are the key to any successful preventive maintenance program. Millions of dollars are spent annually on compressor parts and maintenance. A preventive maintenance program is designed to do what it says — prevent maintenance.

There are two important functions of records. They keep those responsible aware of those items that need attention, and they make it possible to pinpoint improper methods of preventive maintenance by the troubles that develop. No one person can bring this about. It will take cooperation at several levels in the oil company as well as cooperation with the supply company representatives.

The most likely system is to have the pumper keep records on the part for which he is responsible, and have the maintenance man keep his own separate records. Limited distribution of these records is a key feature of the preventive maintenance program to stress the importance of holding down the overall maintenance cost. Later, a system for recognizing successful methods employed by different foremen could be beneficial; but the emphasis should always be on having the man in actual contact with the equipment alert to

keep it running at minimum cost.

Because a year of operation is equivalent to approximately 440,000 miles at fifty miles per hour, it is helpful to know which parts are most likely to fail. Those that could be repaired or renewed at the same time could save special trips later. Records that could assist in making competent judgments are worthwhile. Whether these records show data by intervals of 30, 90, or 180 days is at the discretion of the individual companies.

Usually, each manufacturer has a book of instructions for operation and maintenance of his equipment. Following these instructions to the letter should assure optimum performance. Companies using this equipment may be taking a risk in omitting some of the attention recommended in the manufacturer's instructions. The manufacturer considers some of his instructions important enough to have them stenciled or tagged on the equipment. These should never be painted over or destroyed.

The system should be reviewed periodically to make sure that it could not be simplified, and that it will be complete enough to justify all preventive maintenance operations economically. A permanent file should be established for each field compressor unit. The manufacturer's operation and maintenance manual should contain such permanent data as serial numbers of units, serial numbers of major components, nameplate data, and shutdown settings. This manual should be kept in the permanent file at all times. The above information will greatly facilitate repair parts ordering. If the operation and maintenance manual has been lost or is not available, the form as illustrated in Fig. 1 is a very acceptable source for this permanent information. In addition to the data previously mentioned, this form requires type of ignition, size, type, and number of spark plugs, starter specifications, carburetion, belts, bearings, antifreeze - water mixture, oil capacities and specifications, filters; etc. Remember that this form is designed as a permanent record and should not contain any operating conditions or maintenance performed on a machine. Column 2 of Fig. 1 relates more specifically to the gas or compressor end of the machine. Data required on this form includes compressor cylinder and valve data, maximum working pressures on cylinders, and vessels and rod packing data.

If, for example, a pumper reported a suspected ignition problem on a particular unit, a maintenance man would be able to go to the permanent unit file to get such information as the type of magneto and the type and number of spark plugs required for that particular machine. The maintenance man can then take the proper parts with him avoiding a possible second trip back to the unit to make the repair. This particular system proves to be extremely useful in a field operating several different brands and types of field gas compressors.

Any number of formats could be used in the preventive maintenance program depending on the company's requirements and mode of operation. One successful approach is submitted in Figs. 2, 3, and 4. This system of preventive maintenance is presently in use by a major oil company operating several twin-cylinder, 2-cycle, integral engine-compressors. This program is designed to provide supervisory and maintenance personnel with all of the pertinent information they might require; yet it allows the most inexperienced pumper to find and record this information.

Figure 2 consists of the daily operating data. This information is usually the responsibility of the pumper and is gathered during his daily rounds. Data terminology, in most cases, is self explanatory even to inexperienced operators. This information is gathered simply by reading gauges and by visual inspections. Readings are taken upon the pumper's arrival at the location. If adjustment is indicated on any item, the adjusted reading is also recorded.

A substantial change in suction pressure for example, indicates to a supervisor that a choke adjustment or cylinder clearance adjustment is in order. With other conditions remaining constant, a decrease in meter differential pressure calls for an inspection of the compressor valves on this particular unit.

Shutdown switch settings, once set, should not require further adjustment. It is, however, good safety procedure to check and record these settings on a daily basis.

Preventive maintenance as it pertains to the pumper should be restricted to visual checks and the most simple of maintenance procedures. The monthly inspection report, Fig. 3, is to be completed by a competent maintenance man. The first step to be taken before completing this form is for the maintenance man to briefly review the pumper's daily operating data reports. In many cases, this review will immediately point out

required adjustment or repair. The maintenance man could then proceed to make the preventive maintenance checks as outlined on the monthly inspection reports. A check is placed in the square if the item is satisfactory. An "X" is placed in the square if the item is not satisfactory, due to needed adjustment, repair, replacement, or draining. The work performed on that item is then recorded in the space provided. As with all of the maintenance man's reporting, this form is to be used in conjunction with the manufacturer's service manual.

The semiannual inspection, Fig. 4, calls for a unit shutdown to test all safety devices for proper operation and setting. Normal checks and repairs as outlined on the semiannual inspection should not require more than four hours' time.

The annual and biannual inspections will naturally include a semiannual and monthly check. The annual and biannual inspection as outlined in Fig. 4 are performed by a competent mechanic with more training or experience than that of the pumper or maintenance man. On some machines, these inspections could require specialized skills or tools. The annual inspection will require an eight-hour shutdown. The biannual inspection may require eight to twelve hours, subject to required repairs.

Although the above system performs very successfully for its user, it will likely be necessary to custom-design a program to fit the machinery in operation as well as to fit the preventive maintenance program to your own mode of operation. It is advisable to consult the manufacturer of your engine-compressor package for his preventive maintenance suggestions, and use these as a basis for designing your program.

Some manufacturers now offer customer information programs designed to discuss design, operation, and maintenance of their own particular equipment. My personal experience with these programs has indicated that they are a valuable source of information and particularly useful as a training medium for personnel directly responsible for the operation, installation, and maintenance of heavy-duty oilfield equipment.

PORTABLE COMPRESSOR EQUIPMENT DATA SHEET

Name_____ Location_____
Unit Name Plate Data_____

Purchased From_____ P.O.#_____ Date_____ Co.No._____
Engine Mfg._____ Model_____ Ser.#_____ Co.No._____
Additional Nameplate Data:_____

Magneto #1_____ Type_____ Ser.#_____
Magneto #2_____ Type_____ Ser.#_____
Spark Plugs: Type_____ Size_____ No. Req'd_____

Shutdowns: Description

Oil Pressure_____ Range_____ Setting_____
Engine Overspeed_____ Range_____ Setting_____
Low Suction Press._____ Range_____ Setting_____
High Suction Press._____ Range_____ Setting_____
Low Discharge Press._____ Range_____ Setting_____
High Discharge Press._____ Range_____ Setting_____
High Scrubber Level_____ Range_____ Setting_____
Low Water Level_____ Range_____ Setting_____
High Discharge Temp._____ Range_____ Setting_____
Low Oil Level, Comp._____ Range_____ Setting_____
Low Oil Level, Lubricator_____ Range_____ Setting_____
Low Oil Level, Engine_____ Range_____ Setting_____
J.W. High Temp., Comp._____ Range_____ Setting_____
J.W. High Temp., Engine_____ Range_____ Setting_____

Starter_____ Type_____ Size_____ Model_____
WP_____ Serial No._____
Carburetor Mfg._____ Model_____ Size_____
Fan Belts: Size_____ No. Req'd._____
Fan Bearing_____ Idler Bearing_____
Radiator Louvers_____
Radiator Water Make-up_____
Drive Type_____ Inboard Bearing_____
Outboard Bearing_____
Drive Sheave_____
Drive Belts_____
Muffler_____ Type_____ Size_____
Crankcase Level Control_____
Tachometer_____ Type_____ Range_____
Fuel Filter_____ Type_____ Ser. No._____ Elements Req'd._____
( ) Oil Filter_____ Type_____ Element_____ No. Req'd._____
Air Cleaner_____
Starter Gas Filter_____ Type_____ Elements Req'd._____
Total Radiator Water Capacity_____

Remarks:_____

Compressor: Mfg._____ P. O. #_____ Date_____
Cylinder Size_____ Type_____ Rated RPM_____ Ser #_____
Additional Nameplate Data:_____
Co. No._____
Frame: Type_____ Rated RPM_____ Ser #_____
Additional Nameplate Data:_____
Co. No._____

Suction Valve: No. Req'd_____ Type_____ Part No._____
Discharge Valve: No. Req'd_____ Type_____ Part No._____
Rod Packing: Mfg._____ Rod Size_____ Gland Ser #_____
No. Breaker Rings_____ Dia._____ Cup Depth_____
No. Press. Rings_____ Dia._____ Cup Depth_____
Wiper Packing: Mfg._____ Rod Size_____ No. Rings_____
Cup Dia._____ Cup Depth_____
Lubricator_____ Type_____ Serial No._____
Compressor Sheave_____ Type_____ Size_____
Crankcase Level Control_____
Lubricator Level Control_____
Regulators:
Fuel (1st Stg): Mfg._____ Type_____ Date_____
Spring Range_____ Orifice_____ Max Inlet_____ PSI
Fuel (2nd Stg): Mfg._____ Type_____ Date_____
Spring Range_____ Orifice_____ Max Inlet_____ PSI
Low Pressure: Mfg._____ Type_____ Date_____
Spring Range_____ Orifice_____ Max Inlet_____ PSI
Blowcase (Comp Disch): Mfg._____ Type_____ Size_____
Valve_____ Inner Valve_____ Air_____
Blowcase (Comp Suct.): Mfg._____ Type_____ Size_____
Valve_____ Inner Valve_____ Air_____

FIG. 1

AJAX GAS COMPRESSOR

DAILY OPERATING DATA

		Before Adjustment	After Adjustment
1.	Fuel Gas Pressure	_____Lb.	_____Lb.
2.	Suction Pressure	_____Lb.	_____Lb.
3.	Interstage Pressure	_____Lb.	_____Lb.
4.	Discharge Pressure	_____Lb.	_____Lb.
5.	Suction Temperature	_____Deg.	_____Deg.
6.	Interstage Temperature	_____Deg.	_____Deg.
7.	Discharge Temperature	_____Deg.	_____Deg.
8.	Clearance Plug Position	_____	_____
9.	Compressor Speed	_____RPM	_____RPM
10.	Engine Water Temperature	_____Deg.	_____Deg.
11.	Compressor Jacket Water Temp.	_____Deg.	_____Deg.
12.	Exhaust Temp. No. 1 Cylinder	_____Deg.	_____Deg.
13.	Exhaust Temp. No. 2 Cylinder	_____Deg.	_____Deg.
14.	Meter Differential Pressure	_____Inches	_____Inches
15.	Meter Static Pressure	_____Lb.	_____Lb.
16.	Meter Run Temperature	_____Deg.	_____Deg.
17.	Meter Run Orifice Size	_____Inches	_____Inches
18.	Overspeed Switch	_____RPM	_____RPM

SHUT DOWN SWITCH SETTINGS

		High	Low
1.	Suction Pressure	_____Lb.	_____Lb.
2.	Interstage Pressure	_____Lb.	_____Lb.
3.	Discharge Pressure	_____Lb.	_____Lb.
4.	Suction Temperature	_____Deg.	_____Deg.
5.	Interstage Temperature	_____Deg.	_____Deg.
6.	Discharge Temperature	_____Deg.	_____Deg.
7.	Compressor Jacket Water Temp.	_____Deg.	_____Deg.
8.	Engine Jacket Water Temp.	_____Deg.	_____Deg.

PREVENTIVE MAINTENANCE

1.	Is lubricator float valve maintaining proper level?	Yes_____No_____
2.	Is each pump functioning?	Yes_____No_____
3.	Is crankcase oil level up to running level mark with unit in operation? Add oil if low - Do not overfill.	Yes_____No_____
4.	Check spark plug gap	Yes_____No_____
5.	Check fuel gas pressure-Adjust if necessary	Yes_____No_____
6.	Drain fuel liquid from fuel gas vol. tank	Yes_____No_____
7.	Check water level in radiator or cooler.	Yes_____No_____
8.	Check anti-freeze annually in fall	Yes_____No_____

FIG. 2

Date_____

AJAX COMPRESSORS
PREVENTATIVE MAINTENANCE INSPECTION REPORT

MONTHLY INSPECTION

Lease and Well No. _____

Model_____Serial No._____

Use ✓ in square if item is O.K.

Use X in square if item was adjusted, repaired, replaced, drained, etc., and indicate in space provided what was performed.

Consult service manual.

☐	Fuel Gas Scrubber - Drain	_____
☐	Fuel Gas System	_____
☐	Engine Air Cleaner - Replace Oil - Use 10 wt.	_____
☐	Ignition System - Spark Plug Gap	_____
☐	Governor and Linkage	_____
☐	Speed Controller System	_____
☐	Starting Air Compressor - Use Synthetic Oil	_____
☐	Air or Gas Starting System	_____
☐	Forced Feed Lubricator System	_____
☐	Compressor and Power Cylinder Rod & Packing	_____
☐	Crank Case Lubrication System	_____
☐	Drain Scavenging Chamber of Spent Oil	_____
☐	Lubrication System Safety Devices	_____
☐	Power Cylinder Compression	_____
☐	Crank Case Vents	_____
☐	Engine Jacket Water Cooling System	_____
☐	Compressor Jacket Water Cooling System	_____
☐	Overspeed Safety Devices	_____
☐	Liquid Dump Traps	_____
☐	Pressure Relief Valves	_____
☐	Instrument Panel	_____
☐	Engine Exhaust System	_____
☐	Compressor Gas Piping	_____
☐	Foundation	_____

*Do not drain with unit running.

FIG. 3

Date_____

AJAX COMPRESSORS
PREVENTIVE MAINTENANCE INSPECTION REPORT

Lease and Well No._____

Model_____Serial No._____

SEMI-ANNUAL INSPECTION

1. Test all safety devices for proper operation and setting.

Device	Setting	Device	Setting
Suction Pressure	Hi ___ Low ___	Overspeed	_____
Interstage Pressure	_____	Eng. Lub. LL Oil	_____
Discharge Pressure	_____	Crank Case LL Oil	_____
Interstage Temp.	_____	Crank Case HL Oil	_____
Discharge Temp.	_____	Engine H. Temp.	_____
Comp. Jacket Water Temp	_____	Cooler Low Water	_____
Eng. Jacket Water Temp	_____	Vibration - Cooler	_____

All of the above devices shut down unit when activated at above set levels.
Signed_____

2. Inspect and change spark plugs if necessary.
Inspected by_____Changed - Yes_____No_____

3. Inspect and tighten all exposed nuts and fasteners.
Above inspected by_____

4. Inspect and clean compressor valves - replace worn or broken parts.
Condition of valves Good____Fair____Poor____
Parts Replaced_____

5. Grease fan bearings.

ANNUAL INSPECTION

1. Replace spark plugs and cables.
Plugs and cables replaced by_____

2. Install exchange magneto.
Magneto exchanged? Yes_____No_____

3. Inspect governor and replace worn parts.
Parts replaced_____

4. Clean and inspect lubricator - replace worn parts.
Parts replaced_____

5. Clean breather caps on crank case. Cleaned? Yes_____No_____

ANNUAL INSPECTION (Continued)

6. Steam clean entire unit - check for cooler leaks.
Were there any leaks on cooling system? Yes_____No_____

7. Inspect and replace worn cooling system fan drive belts.
Belts replaced? Yes_____No_____

8. Drain and flush crank case.
Crank case drained and flushed? Yes_____No_____

9. Remove cylinder heads - inspect intake and exhaust parts - remove all carbon from parts.
Condition of intake parts Good_____Poor_____
Condition of exhaust parts Good_____Poor_____

10. Check compressor piston rod pressure packing.
Does packing leak? Yes_____No_____

Note: Do not disturb packing if it does not leak.

BI-ANNUAL INSPECTION

1. Inspect and, if necessary, replace worn piston rings - clean piston ring grooves.
Do rings meet recommended end gap and side clearance specifications?
Yes_____No_____

2. Inspect, and if necessary adjust crank pin bearings.
No. of layers removed to obtain proper clearance_____

3. Inspect and, if necessary, replace crosshead pin bearing.
Condition of bearing? Good_____Poor_____
Was bearing replaced? Yes_____No_____

4. Check cooler tubes and remove any accumulated deposits.
Condition of cooler tubes? Good_____Poor_____

FIG. 4