

Electric Powered Air Compressors for Dugout Aeration

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Considerations when evaluating the suitability of an air compressor for dugout aeration are:

- (1) Is it made for continuous operation?
- (2) Does it operate optimally between 6-10 psi (typical dugout operating pressure). A maximum continuous operating pressure between 20 psi and 30 psi, often is a good indicator of this?
- (3) Is the air flow rate between 0.5 cfm and 1.0 cfm at 10 psi?
- (4) How many years will it operate before it can not be economically repaired (ie motor's field coil damaged for compressors where the electric motor and compressor are in one housing unit)?
- (5) Capital cost
- (6) Energy cost
- (7) Repair cost
- (8) Maintenance required
- (8) Loudness (if it is to be in the home)

Electric powered compressors can be used to move air long distances. Air moved at 1 cfm through a nominal ½ inch diameter polyethylene plastic tubing, 2500 ft. long, loses only 1 psi of pressure.

Current Compressor Models

Presently there are only four manufactures of air compressors in North America that are suited for dugout aeration. They are (1) Gast, (2) Thomas, (3) Koenders, (4) Federal Equipment Company. Suitable models are the following:

Make	Gast
Model	DOA-P101-AA
Compressor type	Diaphragm
Motor type	Shaded Pole Inductance Motor
Purchase cost & location	\$380 - Edmonton at Wainbee (403) 434-9528
Power consumption @ 5 / 10 psi	199 watts / 212 watts
Annual Energy Cost @ 5 / 10 psi	\$96 / \$102 (continuous use)
Air flow rate @ 5 / 10 psi	1.1 / 1.0 cfm (from manufacturer)
Energy Efficiency @ 5 / 10 psi	7.9% / 12.2%
Maximum pressure	60 psi

Comments: When treated properly there are situations where this compressor has given 10 to 15 years of service under continuous operation. Commonly sold for dugout aeration purposes.

Make	Gast
Model	DOA-P108-DB
Compressor type	Diaphragm
Motor type	Permanent Split Capacitor Inductance Motor
Purchase cost & location	\$425 - Edmonton at Wainbee (403) 434-9528
Power consumption @ 5 / 10 psi	139 watts / 147 watts
Annual Energy Cost @ 5 / 10 psi	\$67 / \$71 (continuous use)
Air flow rate @ 5 / 10 psi	1.0 / 0.9 cfm (from manufacturer)
Energy Efficiency @ 5 / 10 psi	10.6% / 16.5%
Maximum pressure	60 psi

Comments: Same as the Gast DOA-101-AA compressor but with a more energy efficient motor. Strongly recommended over Gast DOA-101-AA since energy payback is less than two years under continuous operation.

Make	Thomas
Model	2107CEF18
Motor type	Permanent Split Capacitor Inductance Motor
Compressor type	Diaphragm
Purchase cost	\$355* - Dayton, Ohio, USA - Mosier Fluid Power (800) 232 -0676
Power consumption @ 5 / 10 psi	90 watts / 98 watts
Annual Energy Cost @ 5 / 10 psi	\$43 / \$47 (continuous use)
Air flow rate @ 5 / 10 psi	1.24 / 1.05 cfm (from manufacturer)
Energy Efficiency @ 5 / 10 psi	20/1% / 28.7%
Maximum pressure	20 psi (continuous)
Comments:	Long term durability is unknown, but Thomas indicates that they have the same longevity and are made to the same standard as their 917CA series . This compressor is more energy efficient than all other compressors operating in common dugout aeration conditions (ie. under 1.5 cfm and 15 psi.)

Make	Thomas
Model	107CEF18
Motor type	Permanent Split Capacitor Inductance Motor
Compressor type	Diaphragm
Purchase cost	\$285* - Dayton, Ohio, USA - Mosier Fluid Power (800) 232 -0676
Power consumption @ 5 / 10 psi	71 watts / 77 watts
Annual Energy Cost @ 5 / 10 psi	\$34 / \$37 (continuous use)
Air flow rate @ 5 / 10 psi	0.66 / 0.55 cfm (from manufacturer)
Energy Efficiency @ 5 / 10 psi	13.6% / 19.1%
Maximum pressure	30 psi (continuous)
Comments:	Long term durability is unknown, but Thomas indicates that they have the same longevity and are made to the same standard as their 917CA series .

Make	Thomas
Model	917CA18
Compressor type	Diaphragm
Motor type	Shaded Pole Inductance Motor
Purchase cost & location	\$315* - Dayton, Ohio, USA - Mosier Fluid Power (800) 232 -0676
Power consumption @ 5 / 10 psi	163 watts / 173 watts
Annual Energy Cost @ 5 / 10 psi	\$79 / \$84 (continuous use)
Air flow rate @ 5 / 10 psi	1.11 / .96 cfm (from manufacturer)
Energy Efficiency @ 5 / 10 psi	9.9% / 14.8%
Maximum pressure	30 psi (continuous)
Comments:	When treated properly there are situations where this compressor model has given 10 to 15 years of service under continuous operation.

Make	Koenders
Model	EL2
Compressor type	Diaphragm
Motor type	Capacitor Start Capacitor Run Inductance Motor
Purchase cost & location	\$375 at most UFA, Peavymart, some Home Hardware stores
Power consumption @ 5 / 10 psi	158 watts / 187 watts
Annual Energy Cost @ 5 / 10 psi	\$76 / \$90 (continuous use)
Air flow rate @ 5 / 10 psi	1.37 / 1.15 cfm
Energy Efficiency @ 5 / 10 psi	12.7% / 16.5%
Maximum pressure	20 psi
Comments:	This electric powered compressor is specifically designed for dugout aeration. It is nicely encased in a plastic container, well suited for outdoor installations without an enclosure . It has an energy efficient 1/4 hp electric motor, with a high starting torque. This compressor will start easily after a electric power outage. In one installation only the rubber drive belt needed replacing after 3 years of continuous use. The overall design makes it very serviceable.

Make	Federal Equipment Company (formally WR Brown)
Model	410
Compressor type	Diaphragm
Motor type	Shaded Pole Inductance Motor
Purchase cost & location	\$170 Renown Industries Ltd. - Edmonton - (403) 435 - 3447
Power consumption @ 5 / 10 psi	166 watts / 180 watts
Annual Energy Cost @ 5 / 10 psi	\$80 / \$87 (continuous use) @ 10 psi
Air flow rate @ 5 / 10 psi	1.37 / 1.16 cfm
Energy Efficiency @ 5 / 10 psi	11.8% / 16.9%
Maximum pressure	45 psi

Comments: This compressor does not tend to have the same long life as the Thomas, Koenders, or Gast compressors. Renown Industries Ltd. In Edmonton (a distributor) does not recommend it for continuous use as in dugout aeration systems.

*Notes: This price is in Canadian dollars using an exchange rate of \$1.00 Canadian = \$.71 USA; and sent by US Air Parcel Post and Canada Post as the broker. Air compressors are a duty free item. Its tariff item classification number is 8414409010; have the shipper include this number as part of the description to ensure duty free status.

- Annual Energy Cost assumes that a kilowatt hour costs 5.5 cents.
- Airflow rates are in terms of cubic feet per minute of air at 1 atmosphere pressure and 20°C at the compressor inlet.
- Prices quoted are for purchase of single units. Significant savings can be obtained on some models by purchasing multiple units.
- Permanent Split Capacitor electric motors are much more energy efficient than Shaded Pole electric motors and are highly recommended over Shaded Pole motors.
- Performance testing is done with an ambient temperature of approximately 20 degree Celsius.

For new current model compressors the Gast DOA-101-AA and the Koenders are more commonly purchased than the Thomas . This is likely because they are more available (ie. They are what are more commonly sold for aeration in stores which deal with farmers and have more authorized distributors in Canada than Thomas compressors).

For new dugout aeration compressors the following are recommended buys based on a combination of initial capital cost and long term energy cost. Energy cost is given significant weight, since these compressors, if run under good operating conditions, often function 10 years or longer.

- (1st choice) Thomas 2107CEF18 - Purchased direct from the United States
- (2nd choice) Koenders EL2 For out door installations.
- (3rd choice) Gast DOA-P108-**DB** (Not the DOA -101-**AA**)

A diaphragm type compressor is relatively easy to fix. The motor's field electrical coil is the only thing that is not practical to fix, so if it burns out or develops a short circuit the compressor motor assembly is generally not worth fixing. To rewind the field coil can generally cost approximately \$200. It is for this reason that all that can be done to protect the motor should be done. Note, the Koenders EL2 is different in that the motor and compressor are not one unit so the motor can be replaced. The compressor should therefore be kept in a **dry, dust free location** with ambient temperature kept under 40°C, and **preferably cooler**. Continuous operation is better for a compressor than intermittent operation if it is in an unheated location in the winter time.

Used and Discontinued Compressors Models

Most compressors used for dugout aeration in the Peace River Region have been sold discounted through Princess Auto. They have in the past sold Gast, Thomas, and W R Brown. Often their compressors are surplus items, either used or new discontinued models of diaphragm and rotary vane compressors suitable for dugout aeration at 1/5 to 1/10 the cost of the new units. The positive aspect of these surplus items is their low purchase cost. The down side is that they stock the surplus compressors for a limited time; once they have sold out the store often will not have them again. Also the used compressors have a limited service life as is; however, if the motor's field coil windings in a diaphragm compressor are in good shape then doing maintenance and replacements as described below can make the compressor essentially as good as new. Rotary vane compressors are louder and often cost more to repair than similar capacity diaphragm compressors but at the low surplus price that they have in the past been sold for, they can be a good choice. The 1997 Princess Auto catalog has no compressor that is recommended.

What can be done to repair or improve the longevity of a used diaphragm compressor is (1) give it a thorough cleaning, (2) replace the compressor diaphragm especially if it is cracked or perforated (\$10 to \$20), (3) replace sealed bearing (this may need to be done by a professional; to replace three bearings cost \$90 to \$150 labour, and \$10 to \$20 for the bearings, purchase the highest quality bearing possible) , (4) straighten or replace one or both one way valves. The bearings should be checked more often after 5 years of continuous use in good operating conditions or if the compressor is purchased used or operated in less favourable conditions. When replacing a damaged diaphragm, one made from a reinforced hypalon rubber will last many times longer than the more commonly used reinforced neoprene rubber material.

Compressors that Princess Auto have sold in the past as used surplus items, but are no longer available, and were well suited to dugout aeration are:

Make	Thomas
Model	907AE18
Compressor type	Diaphragm
Motor type	Permanent Split Capacitor Inductance Motor
Purchase cost	\$70
Power consumption @ 5 / 10 psi	100 watts / 108 watts
Annual Energy Cost @ 5 / 10 psi	\$48 / \$52 (continuous use)
Air flow rate @ 5 / 10 psi	1.20 / .95 cfm (from manufacturer)
Energy Efficiency @ 5 / 10 psi	17.6% / 23.5%
Maximum pressure	30 psi (continuous) estimated
Comments:	This compressor was made specially for Xerox in the early 1980's. Sold by Princess Auto from late 1980's to early 1990's. Exceptional value on purchase price and a energy efficiency basis.

Make	Thomas
Model	107AE20
Compressor type	Diaphragm
Motor type	Permanent Split Capacitor Inductance Motor
Purchase cost	\$70
Power consumption @ 5 / 10 psi	70 watts / 74 watts
Annual Energy Cost @ 5 / 10 psi	\$34 / \$36 (continuous use)
Air flow rate @ 5 / 10 psi	0.61 / 0.46 cfm (from manufacturer)
Energy Efficiency @ 5 / 10 psi	12.7% / 16.9%
Maximum pressure	30 psi (continuous) estimated
Comments:	Sold by Princess Auto from early 1990's to 1996. Exceptional value on purchase price and a energy basis. With a good diffuser this low air flow rate has been shown to be effective for large dugout aeration. By changing the original capacitor with a different one, this model uses very little energy. See following comments

Compressor Performance under different conditions

The lower the temperature that a diaphragm compressor is operated at the more efficient it is; both the energy consumption reduces and the flow increases. A Thomas 907AE18 had the following changes when it was tested with the ambient air temperature 21° C and -6° C

	<u>21° C</u>	<u>-7° C</u>
Power consumption @ 5 / 10 psi	106 watts / 119 watts	99 watts / 112 watts
Air flow rate @ 5 / 10 psi	1.09 / .83 cfm	1.09 / 0.88 cfm
Energy Efficiency @ 5 / 10 psi	15.0% / 18.6%	16.1% / 21/1%
Maximum efficiency	19.1% @ 12.5 psi	23.6% @ 12.5 psi
Grams of Oxygen / 100 watts @ 5/10 psi	8.1 / 5.5	9.6 / 6.9

Note: this Thomas 907AE18 compressor in the above test has had extensive use; that may be why its performance at 21°C is less than that given in previous data for the same model compressor

Changing the capacitor on a compressor with a permanent slit capacitor motor to a capacitor with a lower microfarad value can also be used to optimize a compressor efficiency to typical aeration operating pressure. On a Thomas 107AE20 compressor the changing the capacitor from manufacturer design of 6.87 uF to 4.90 uF resulted in the following changes:

	<u>6.87 uF</u>	<u>4.90 uF</u>
Power consumption @ 5 / 10 psi	70 watts / 74 watts	49 watts / 54 watts
Energy Cost @ 5 / 10 psi	\$34 / \$36	\$24 / \$26
Air flow rate @ 5 / 10 psi	0.61 / 0.46 cfm	0.61 / 0.51 cfm
Energy Efficiency @ 5 / 10 psi	12.7% / 16.9%	18.3% / 25.3%
Maximum efficiency	21% @ 20 psi	25.3 @ 12.5 psi

Care must be taken when making changes to the motor's capacitor. The above mentioned change will also lower the motor's starting torque. In the above situation the change in starting torque caused no problems for typical dugout aeration conditions.



Manufacturer Thomas
Model 2107CEF18
Weight 3.1kg



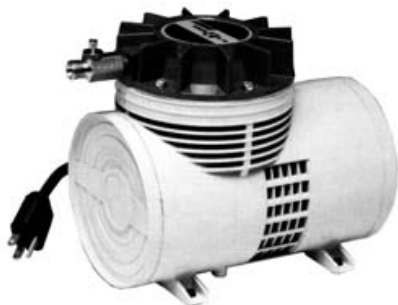
Manufacturer Thomas
Model 107CEF18
Weight 2.7kg



Manufacturer Thomas
Model 917CA18
Weight 4.9kg



Manufacturer Gast
Model DOA-P101-AA
Weight 6.6kg



Manufacturer Federal Equipment Company
Model 410
Weight 4.5kg



Manufacturer Koenders
Model EL2
Weight 40.0kg

Koenders EL2 is shown to a 10 : 1 scale, all other compressors are shown to a 4 : 1 scale