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Operating Instructions

Best Practices for Operation of:

BMG-735-P

Version 1.1

November 2018

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Implementation Guide

Best Practices for Operation of BMG-735-P

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Comments relating to the material contained in this document may be submitted to: info@diamaticusa.com

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1. Introduction:

1.1. *Purpose and Scope*

This document is the Best Practices for Operation of the BMG-735-P.

It has been developed to aid owners and operators in the implementation of the following three Best Practices:

- Emissions Safety
- Proper Start Up and Shut down procedures.
- Standard Maintenance

This group of Best Practices offers a set of processes and procedures that address the proper operation and maintenance. The scope of these Best Practices, although general enough for many propane powered machines has some aspects that are specific to the BMG-735-P.

1.2. *About This Document*

The structure of this document is as follows:

Chapter 1: Introduction

- This section introduces the document and describes the purpose and scope of the Implementation Guide.

Chapter 2: Emissions Safety

- This section covers CO (carbon monoxide) safety, proper ventilation techniques and monitoring.

Chapter 3: Proper Startup and Shutdown

- This section provides a guide for operators to learn how the proper startup and shutdown procedures.

Chapter 4: Basic Maintenance

- This section looks at basic daily and weekly maintenance items that will ensure long service life.

Chapter 5: Contact Information

2. Emissions Safety

The BMG-735-P is a LPG powered machine and produces emissions. Though LPG is a cleaner burning fuel than gasoline is still produces harmful emissions including CO (carbon monoxide). It is extremely important to use in a well and properly ventilated area. The information provided in the following overview has been condensed to provide the reader with a summary of the material presented.

2.1. Potential Effects of CO Exposure

- **Work place/industry guidelines** for CO exposure limits vary substantially from region to region (OSHA) Permissible Exposure Limit (PEL) for CO is 50 ppm, as an 8-hour time weighted average.
- Limits for permissible exposure to CO vary substantially from region to region. City, State, and Industry requirements should be consulted prior to use of any equipment.
- The current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for CO is 50 ppm, as an 8-hour time weighted average (TWA). This is computed by making measurements at intervals over 8 hours, then adding the sums of the concentrations and the intervals, and dividing by 8 hours. For example:

Time	Interval		PPM	
8:00-9:00	1 HR		100	
9:00-10:00	1 HR		25	
10:00-11:00	1 HR		25	
11:00-12:00	1 HR		50	
12:00-1:00	1 HR		50	400ppm/8HR=50ppm TWA
1:00-2:00	1 HR		50	
2:00-3:00	1 HR		50	
3:00-4:00	1 HR		50	
Time intervals =	8 HR	ppm =	400	

- The current National Institute for Occupational Health and Safety (NIOSH), immediately dangerous to life and health concentration (IDLH) recommended level for CO is 1,200 ppm. NIOSH defines the IDLH exposure level as the concentration that could result in irreversible health effects or death, or prevent escape from the contaminated environment within 30 minutes.
- **Definition of CO effects** - The toxic effects of carbon monoxide in the blood are the result of tissue hypoxia (lack of oxygen). The severity depends on the state of activity of the individual and his tissue oxygen needs. The toxic effects of carbon monoxide in the blood are the result of tissue hypoxia (lack of oxygen). carbon monoxide combines with hemoglobin to form carboxyhemoglobin. Since CO and oxygen react with the same group in the hemoglobin molecule, carboxyhemoglobin is incapable of carrying Oxygen. The affinity of hemoglobin for CO is 200 to 240 times greater than for oxygen. The extent of saturation of hemoglobin with CO depends on the concentration of the gas, the quantity of inspired air and on the time of exposure. The severity depends on the state of activity of the individual

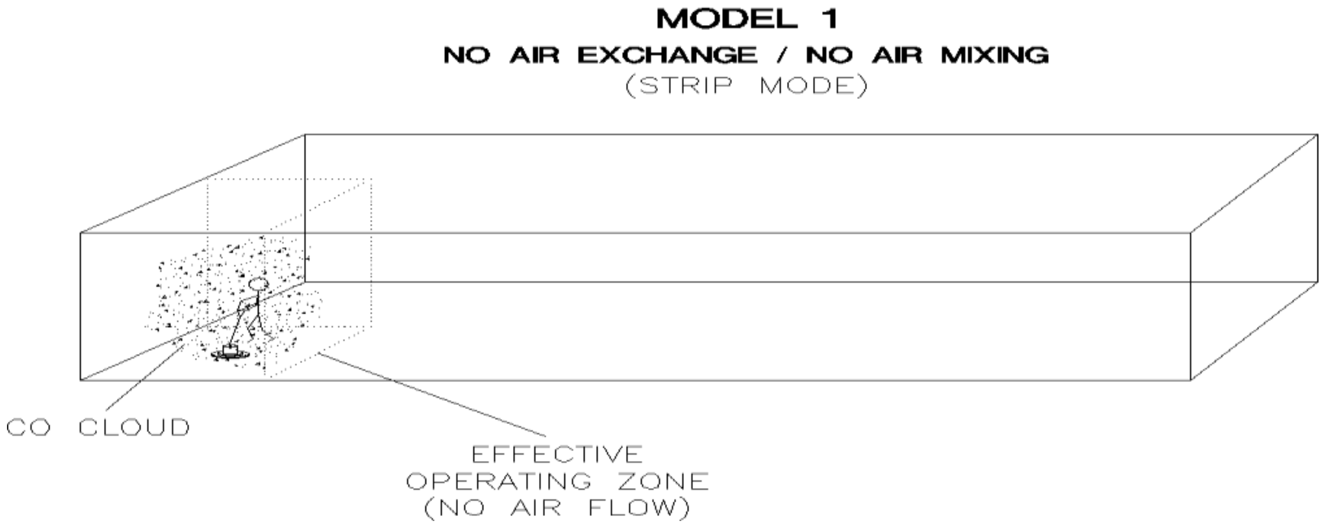
and his tissue oxygen needs. According to Harrison's Principles of Internal Medicine 7th edition, no symptoms will develop at a concentration of 0.01% CO (100ppm) in inspired air, since this will not raise blood saturation above 10 %. Exposure to 0.05% (500ppm) for 1 hour during light activity will produce a blood concentration of 20% carboxyhemoglobin and result in a mild or throbbing headache. Greater activity or longer exposure causes a blood saturation of 30 to 50 %. At this point head ache, irritability, confusion, dizziness, visual disturbance, nausea, vomiting, and fainting can be experienced. Exposure for one hour to concentrations of 0.1% (1000ppm) in inspired air the blood will contain 50 to 80% carboxyhemoglobin which results in coma, convulsions, respiratory failure and death. On inhalation of high concentrations of CO, saturation of the blood proceeds so rapidly that unconsciousness may occur suddenly without warning.

2.2. Methods to Reduce the Risks of CO Poisoning

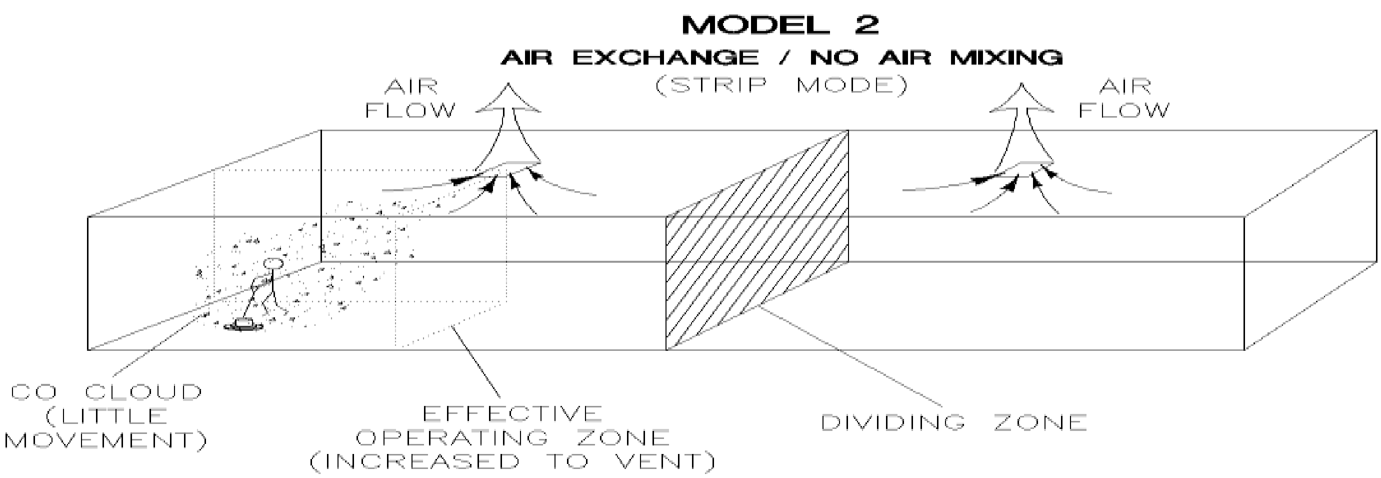
- **Air Exchange and CO Diffusion** - CO does not mix with air on its own. Air currents can "stir" the CO and dilute the concentration values by mixing it with the available air. When using equipment over a large area in a short time "stirring" occurs as you walk.

    - The most reliable method to prevent CO Poisoning is to ensure all the CO produced is vented outside. With wood stoves or gas heaters this is performed with ductwork that carries the exhaust and CO outside. Non-stationary combustion type equipment must be used in such a way that CO is not allowed to rise to a harmful or dangerous level.
    - CO does not readily dissipate or mix with air on its own. Air currents can "stir" the CO and dilute the concentration or ppm values by mixing it with the available air. When using equipment over a large area in a short time "stirring" occurs as you walk, or to say it another way, your Effective Operating Zone is large. When activity is concentrated to a smaller area as in a grinding application, the Effective Operating Zone is small, and "stirring" must be forced by the use of fans to increase the Effective Operating Zone and reduce high concentrations of CO.

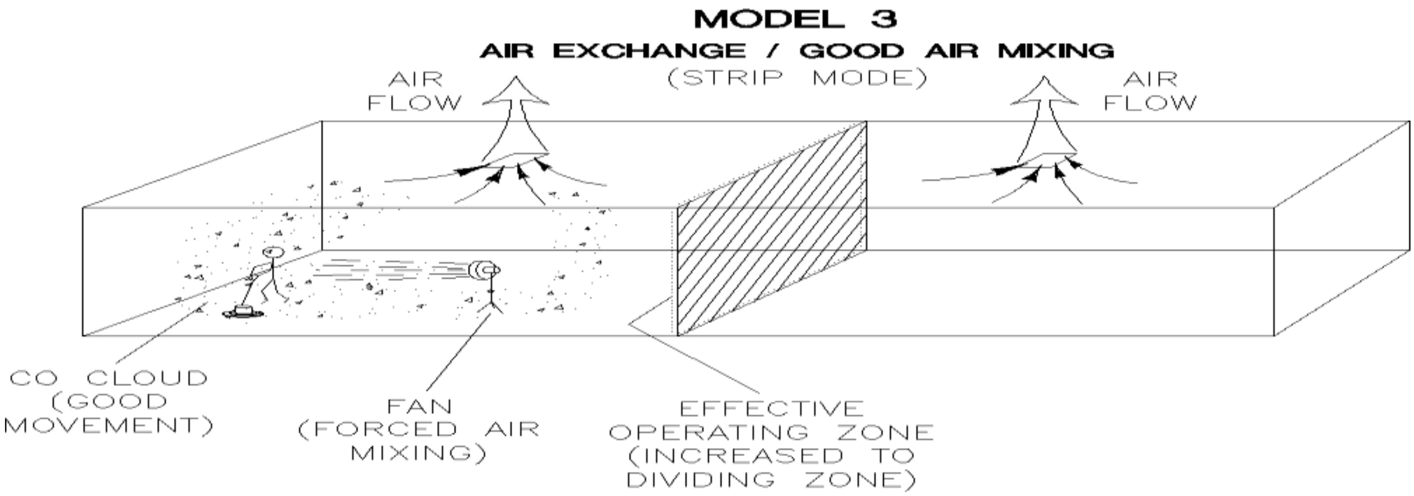
    - Air exchange rates (air exchange is defined as the exhausting of internal air to the external atmosphere), the size of the Effective Operating Zone, amount of CO produced, level of human activity, and the duration of exposure are all factors in the determination of the production of carboxyhemoglobin and the amount of CO blood saturation.
- **Application Considerations** (Burnishing versus Grinding) - When activity is concentrated to a smaller area as in a grinding application, air "stirring" must be forced by the use of fans to reduce the risk of high concentrations of CO.
    - When using equipment over a large area in a short time, as in most burnishing applications, your Effective Operating Zone is large. When activity is concentrated to a smaller area as in grinding applications, the Effective Operating Zone is small and stirring or <u>CO mixing **MUST** be forced</u> by the use of fans to increase the Effective Operating Zone and reduce high concentrations of CO.
    - Caution: air mixing in itself may not be sufficient to reduce CO to a safe level. The Effective Operating Zone can be defined as the area covered in a given time.



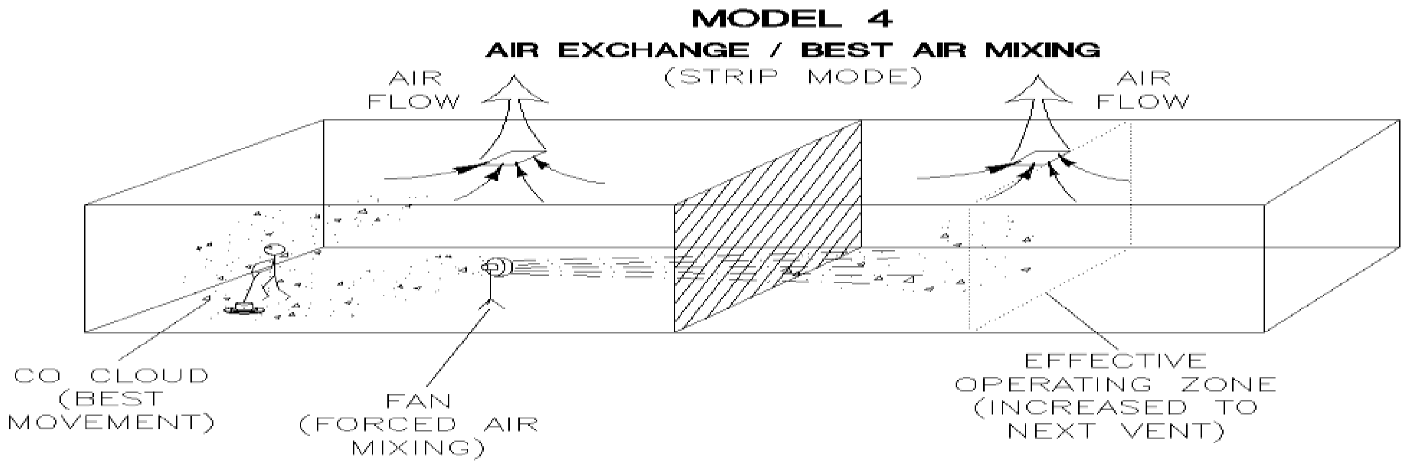
- Grinding is quite a different type of operation than burnishing, and carries with it substantially more hazards, as grinding is a low movement operation compared to burnishing (less floor space for the same time). As shown in Model 1, the CO concentrations rise much quicker as the "Effective Operating Zone" is a very small area compared to the total building size.



- Notice the CO concentration and the Effective Operating Zone with air exchange. The CO cloud is still concentrated in a small area. Note the "Dividing Zone" shown above, this is the line where airflow changes direction. In Model 2, air changes are cut in ½ as little or no CO crosses the Dividing Zone to be exhausted.



- Notice the CO concentration and the Effective Operating Zone (Expanded to the Dividing zone) with air exchange and forced air mixing with use of a fan. Placing of 4 large CFM fans in each corner of the work zone is most effective. The CO cloud is still concentrated on one side of the Dividing zone. Note the “Dividing Zone” shown above, this is the line where airflow changes direction. In Model 3, air changes are cut in ½ as little or no CO crosses the Dividing Zone to be exhausted.



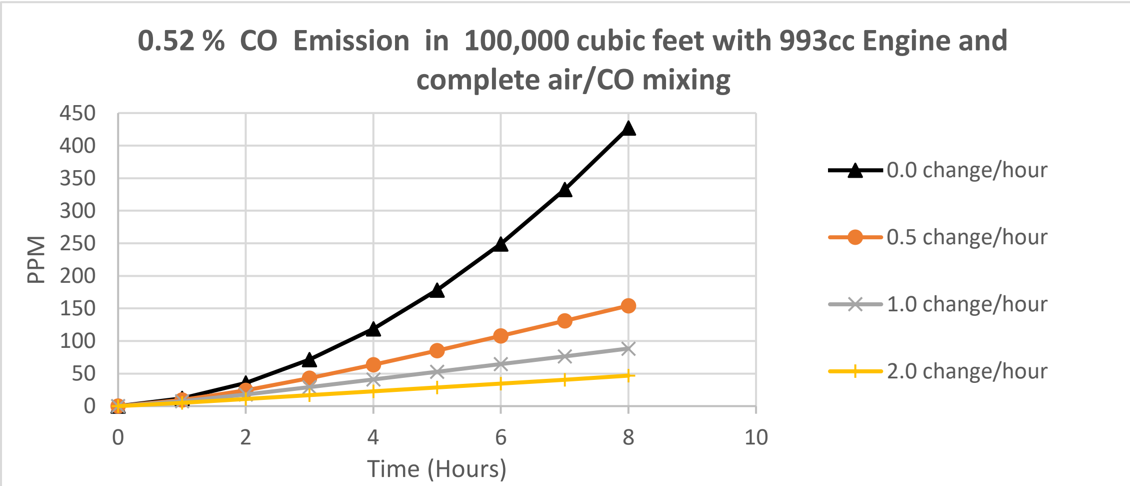
- Notice the CO concentration and the Effective Operating Zone (Expanded through the Dividing zone to the second vent) with air exchange and forced air mixing through the dividing Zone. The CO cloud is diluted with the available air in the building. Note the “Dividing Zone” shown above, this is the line where airflow changes direction. In Model 4, air changes are full as forced air mixing has moved and mixed the CO between all air zones.

- **Air Quality Monitoring** – Deployment of a monitor/detector is essential for the safe operation of any equipment that has the potential to produce CO.

    - CO detectors for use in residential settings are not designed for use in typical workplace settings. Monitoring requirements in an occupational setting are different from monitoring requirements in the home. In the workplace, it is frequently necessary to monitor a worker's exposure to carbon monoxide over an entire work shift and determine the time-weighted average (TWA) concentration of the exposure. It may also be necessary to have carbon monoxide monitors with alarm capabilities in the workplace. The direct-reading instruments are frequently equipped with audio and/or visual alarms and may be used for area and/or personal exposure monitoring. Some have microprocessors and memory for storing CO concentration readings taken during the day. It is significant to note that some of the devices mentioned for workplace CO monitoring are not capable of monitoring TWAs, and not all are equipped with alarms. The appropriate monitor must be chosen on an application-by-application basis. For more information on the availability of workplace CO monitors or their application, call the National Institute for Occupational Safety and Health at 1-800-35- NIOSH (1-800-356-4674).
    - **Room Size and Time Estimations for Parts Per Million (PPM) CO.** The fundamental factors in area CO levels involve: The concentration and volume of CO production; The size of the area; The amount of *air exchange if any; The amount of time CO is produced.

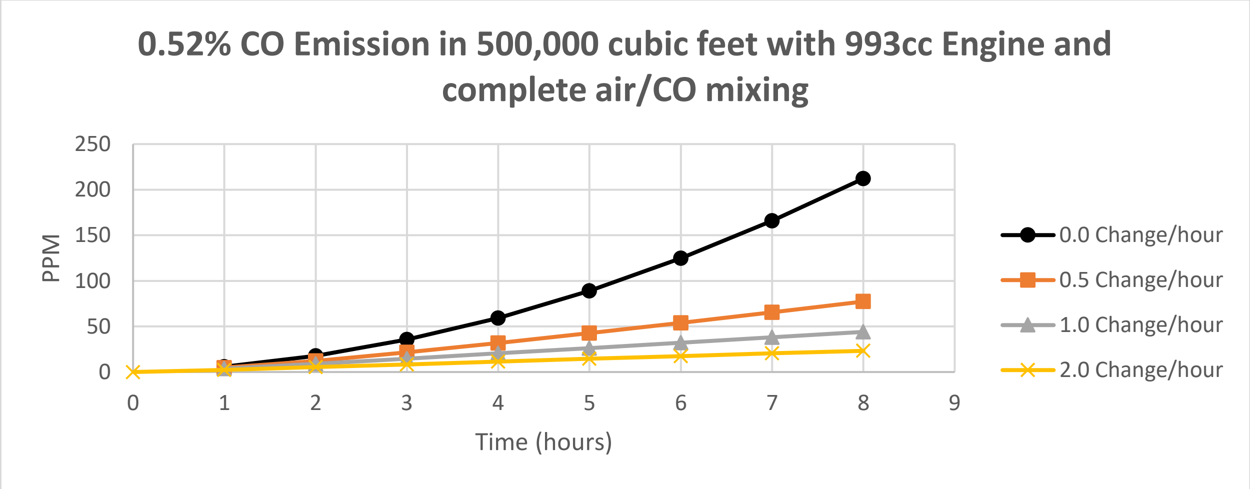
    - Multiplying length, width, and height will determine the volume or cubic feet in a room. So, an empty building 100ft by 100ft with a 10ft ceiling would be 100,000 cubic ft. in size. Any material that is in the room and takes space would reduce the cubic feet.

*** Air exchange is defined as the exhausting of internal air to the external atmosphere. The graph below depicts the relationships of air exchange to time and CO ppm with cubic feet area and percent CO emissions remaining constant**



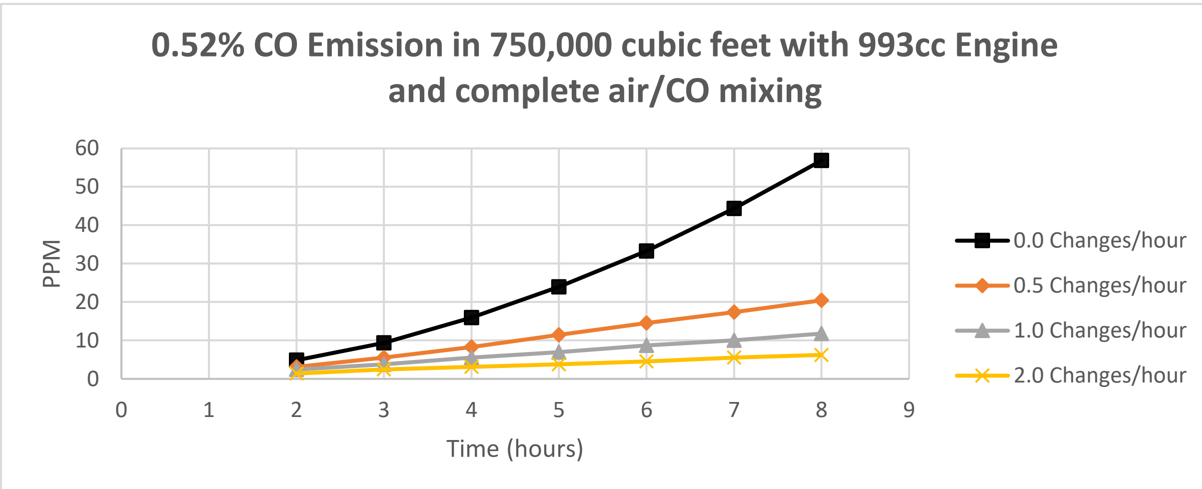
8 Hour Time Weighted Average (OSHA Method)									
0.52% CO 100,000cf	Hours Operation	1	2	3	4	5	6	7	8
TWA (OSHA Method)	0 change/hr	11.787	35.707	71.413	118.907	178.187	249.253	332.453	427.093
	1/2 change/hr	9.36	24.267	42.987	63.44	85.28	107.813	131.04	154.267
	1 change/hr	7.627	17.68	29.12	40.907	52.693	64.48	76.267	88.4
	2 change/hr	5.2	11.093	16.987	22.88	28.773	34.667	40.56	46.8

Based on the CO production rates shown above the TWA would be exceeded in a 100 x 100 x 10-foot (empty) space after 4 hours with 1 air changes per hour. (Assumes no additional CO exposure during 8-hour time period.



8 Hour Time Weighted Average (OSHA Method)									
0.52% CO 500,000cf	Hours Operation	1	2	3	4	5	6	7	8
TWA (OSHA Method)	0 change/hr	5.893	17.68	35.707	59.28	89.093	124.8	166.053	212.16
	1/2 change/hr	4.853	12.133	21.493	31.893	42.64	54.08	65.52	77.307
	1 change/hr	3.813	9.013	14.56	20.453	26.347	32.24	38.133	44.027
	2 change/hr	2.427	5.547	8.32	11.44	14.56	17.333	20.453	23.227

Based on the CO production rates shown above the TWA would be exceeded in a 100 x 500 x 10-foot (empty) space after 5 hours with 1/2 air changes per hour. (Assumes no additional CO exposure during 8-hour time period)



The graph above depicts the relationships of air exchange to time and CO ppm with cubic feet area and percent CO emissions remaining constant.

8 Hour Time Weighted Average (OSHA Method)									
0.52% 750,000cf	Hours Operation	1	2	3	4	5	6	7	8
TWA (OSHA Method)	0 change/hr	1.733	4.853	9.36	15.947	23.92	33.28	44.373	56.853
	1/2 change/hr	1.387	3.12	5.547	8.32	11.44	14.56	17.333	20.453
	1 change/hr	1.04	2.427	3.813	5.547	6.933	8.667	10.053	11.787
	2 change/hr	0.693	1.387	2.427	3.12	3.813	4.507	5.547	6.24

Based on the CO production rates shown above the TWA <u>would not be exceeded</u> in a 100 x 750 x 10-foot (empty) space after 8 hours with 0 air changes per hour. (Assumes no additional CO exposure during 8-hour time period)

Maintenance of Equipment

Warning: The proper maintenance of equipment is vital to safe operation. LPG engines are dependent on engine tune up, and air filter replacement. CO concentration (production) skyrockets when the air to fuel ratio becomes fuel rich. Follow the recommended Maintenance Schedule for the engine found in the Engine Operator/Owner Manual as well as the Maintenance and Adjustments schedule found in the Propane Floor Equipment Operator's Manual that were supplied with the equipment.

- **Room Size and Time Estimations** - The concentration and volume of CO production, the size of the area and the amount of air exchange are factors involved with determining safe time limits for operation in a specific room size.

- **Maintenance of Equipment** - LPG engines are dependent on engine tune up, and air filter replacement. CO concentration (production) skyrockets when the air to fuel ratio becomes fuel rich. Follow the recommended Maintenance Schedule for the engine

- **CO Safety Equipment Available**
  - Automated emissions monitoring will shut down the engine when high emissions are detected.
  - Three-way type catalytic converter to scrub CO, Hydro Carbons (HC), and Nitrous Oxide (NOx) from the engine exhaust providing the lowest possible emissions
  - High cubic feet per minute (CFM) fans (forced air mixing)
  - Digital combustion analyzers for tail pipe emissions monitoring

2.3 EDA System: Emission Data Analyzer

- **How it works. THE EDA IS NOT A CO DETECTION DEVICE.** It is an engine monitoring device to alert owner/operators of an issue with the engine. It uses an O2 sensor in the three way catalytic muffler to monitor engine emissions.

- **Start UP**. The startup hold period begins when the ignition switch is activated. During this 7-8 second period the red-light glows while the system is calibrating. When all systems are checked and have passed the red light will turn green indicating the engine is ready to start.

- **Operation**. After the engine has started it takes approximately 90 seconds for the engine to reach operating temperature. At this point, if the light continues to glow green the engine and components are functioning properly. If the engine is running rich or if there is a component failure the green light will start flashing red for 60 seconds. After 60 seconds the flashing red light will turn solid red and open the ground circuit to the fuel lock-off and shut off the fuel to the engine. The EDA is directly wired in conjunction with the oil pressure and fuel lock-off valve.

- **Engine conditions that can cause a red alert or shutdown**
  - Clogged or restricted air filter
  - Fuel regulator not adjusted correctly
  - Fuel regulator exposed to liquid ingestion and freezing
  - Overfilled vapor cylinder or incorrect liquid cylinder causing liquid ingestion in regulator
  - Damaged regulator from liquid ingestion
  - Damaged, worn or improperly adjusted spark plugs.

3. Proper Startup, Operation and Shutdown

3.1. *Proper Start Up and Operation*

- Wear correct PPE including; steel toe boots, CO monitor, gloves, eye and hearing protection.
- No loose-fitting clothing or Jewelry. Make sure work area is well ventilated.
- Check engine oil. Add if below the fill line. Do not overfill.
- With safety key removed and E-stop engaged. Tilt machine back and install diamond tooling. Make sure mating surfaces are clean of dirt and debris. Once installed, slowly lower machine back to work surface.
- Install properly filled **<u>vapor</u>** propane tank and ensure hose coupler is secure. 99% of all propane related issues are from improperly/overfilled tanks.
- Turn tank valve counter clockwise to open valve and supply fuel.
- Ensure safety key is installed in dead-man control and attach lanyard to your wrist or belt loop.
- Ensure Ignition switch is in the off position, the E-stop is disengaged and the throttle is pushed all the way down to idle position.
- Turn the ignition switch clockwise one click to the run position. Wait for red emission control light to go out for Kawasaki engine or turn green for Briggs and Stratton engine.
- Turn the ignition clockwise to engage the starter. Once engine fires and runs let go of ignition switch. Let engine idle for 1 minute. Engine will idle at 1480-1520 RPM when warm
- The BMG-735P is equipped with a heavy-duty centrifugal clutch. To start grinding, turn the throttle lock counter clockwise. With one hand on the operator's handle, use your other hand to depress the red button in the center of the throttle cable and pull up on the black knob simultaneously. Pull the throttle as far as you can and let go of red button. Turn throttle lock clockwise to secure throttle. You can now fine tune the rpm by rotating the adjustment knob. Counter clockwise will raise the rpm and clockwise will decrease the rpm. **DO NOT RUN BELOW 2500 RPM CLUTCH DAMAGE WILL RESULT. DO NOT RUN ABOVE 3550 RPM ENGINE DAMAGE WILL RESULT.**

3.2. *Proper Shutdown*

- Turn throttle lock counter clockwise.
- Depress red button and push throttle cable down until is stops at idle (1480-1520 rpm).
- Turn the propane bottle valve clockwise and shut off fuel. Let the engine run out of fuel and shut down. Please note the exhaust and engine will have hot surfaces.
- Depress E-Stop switch and turn ignition switch to off position.
- To re-start engine, follow steps above in the startup section 3.1

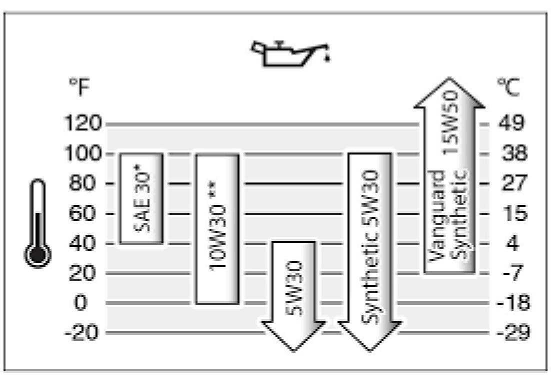
4. Maintenance

4.1. Daily Maintenance

- Check engine oil prior to operation. Engine oil is also coolant for an air-cooled engine. If the engine is low on oil it is low on coolant. Add oil if required.
- Check air filter prior and after each use. Clean with low pressure air. 20 PSI or less. **Do not tap or bang air filter.**
- Check all hardware for tightness.
- Check Supermag tooling plates for excessive wear or damage. Replace if worn or damaged.
- Verify propane tanks are not overfilled.
- **CLEAN MACHINE AFTER EACH USE.** Concrete dust and slurry are very abrasive. Excess dust or slurry can cause premature wear of components. Wet grinding slurry is very alkaline and will cause damage to seals, bearings and powder coated surfaces. It is imperative to rinse the machines clean with low pressure water (garden hose) and flush all slurry from the travel wheels, semi rigid couplers, drum and tooling plates after each use. **CLEAN MACHINE IS A HAPPY MACHINE**

4.2. Engine Maintenance

- CHECK ENGINE OIL DAILY
- Check air filter daily and clean as needed
- Oil and filter change every 100 hours of operation
- Engine oil type see below



4.3. *Weekly Maintenance*

- Check clutch belt and lower belt for wear and proper tension every 40 hrs. Refer to Service manual and website videos for reference.
- Check throttle cable for proper operation. Replace if damaged.
- Check brush seal for wear or damage. Replace if damaged
- Check all hardware for tightness
- Check water supply system for proper operation and leaks.
- Check semi rigid coupler rubber bushings for wear or damage. Replace if damaged or excessive wear is detected.

5. Contact Information

Operator manual can be viewed and downloaded at: here

(https://www.diamaticusa.com/sites/diamatic2/uploads/documents/2017_Documents/2018_Manuals/BMG-735-Pro-P_operating_manual.pdf)

Service and parts manual can be viewed and downloaded at: here

(https://www.diamaticusa.com/sites/diamatic2/uploads/documents/2017_Documents/2018_Manuals/BMG-735-P_service_manual_1.pdf)

*All manuals can also be found on our website: www.Diamaticusa.com

For technical questions and assistance contact one of the persons listed below:

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