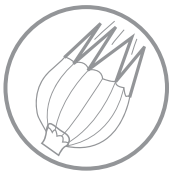
SPI INDUSTRIES

2010 VERSION A

GREEN DRAGON OPERATIONS AND SERVICE MANUAL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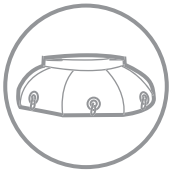
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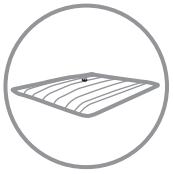
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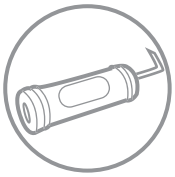
Environmental


Emergency Response

GREEN DRAGON OPERATIONS AND SERVICE MANUAL - Version A

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PLEASE READ BEFORE USING.

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Section 1: Dragon System Overview

The use of controlled, prescribed or back burning techniques provide an effective tool in the ongoing commitment to forest and wildland management. Delayed chemical ignition devices (DCIDs) have a lengthy, proven track record of providing a means of initiating these burns in an efficient, safe and controllable manner.

This manual details the operation and field maintenance of the Green Dragon from SEI Industries Ltd.

Dragon Eggs

Dragon Eggs are small, 26 mm diameter, two colour (orange/ white), ignition eggs made of high impact polystyrene (HIPS) plastic filled with three grams of potassium permanganate.

In this state, the eggs are stable provided the shells remain undamaged. When injected with ethylene glycol (anti-freeze), an exothermic reaction initiates.

After a delay of approximately 30 seconds, combustion commences with white smoke being expelled from the needle hole followed by sphere ignition.

Once ignited, the plastic shell is consumed as fuel. The total combustion time, following ignition, is about 80 seconds.

The Green Dragon injects a constant volume of glycol into each Dragon Egg regardless of the launch rate set by the operator. As such, the auto-ignite delay time is influenced primarily by the temperatures of the Dragon Eggs and glycol.

The indicated delay times are based on air/sphere temperatures of 50 –70 degrees F (10 – 20 degrees C). Increased temperatures will decrease the delay time. By diluting the glycol with water to a 50/50 mix, the delay time can be increased.

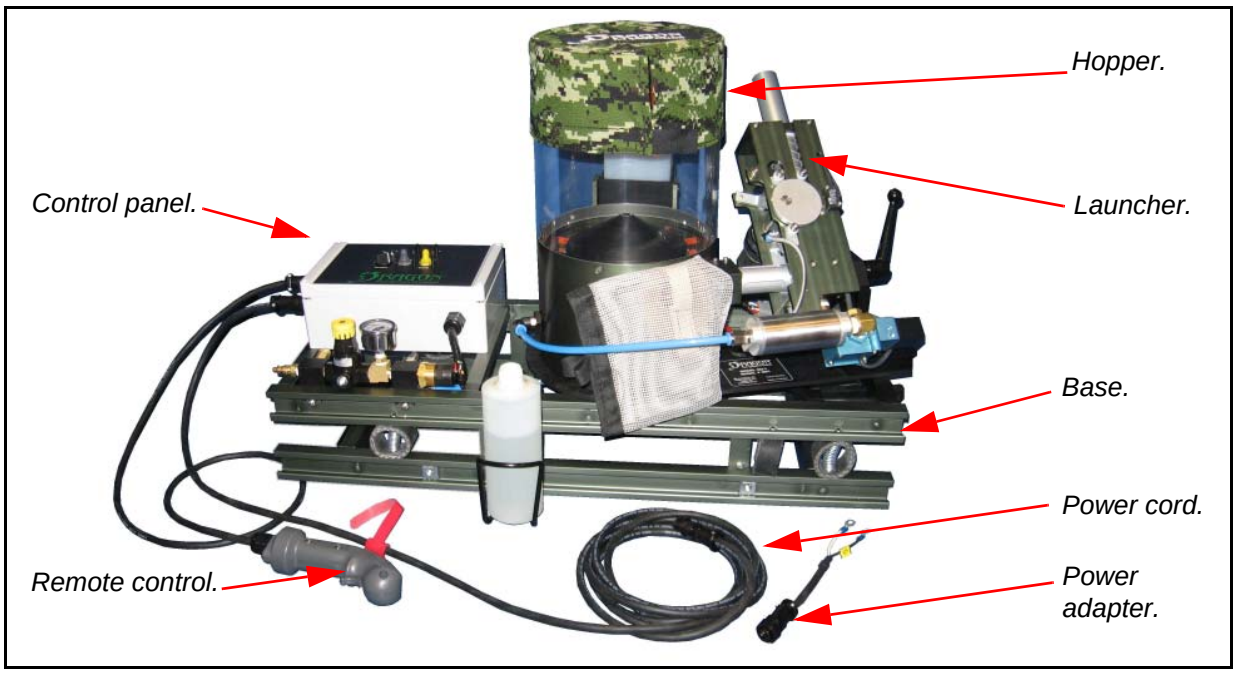
Green Dragon Dispenser

Standard Components

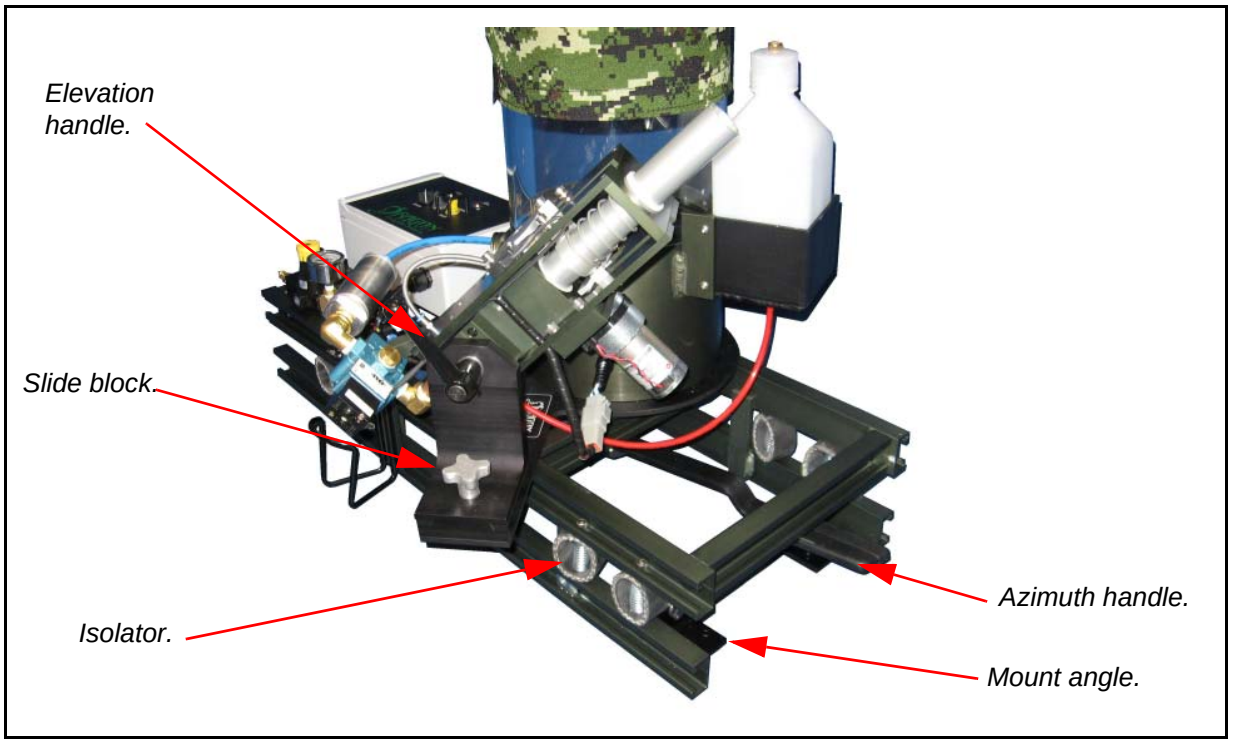
The primary function of the Green Dragon is to inject a measured amount of ethylene glycol into Dragon Eggs, thereby initiating an exothermic reaction, and then propel the primed eggs from the launcher.

The Green Dragon consists of eight major components.

COMPONENT	DESCRIPTION
Base Assembly	Attaches the dispenser to the operator's platform.
Hopper	Stores the unprimed eggs. Provides an egg to the launcher when required.
Launcher	Injects egg. Projects the charged egg away from the dispenser.
Gas System	Provides controlled amount of gas to expel eggs.
Glycol System	Stores the glycol. Provides a fixed quantity of glycol to the injection needle.
Main Control Panel	Provides warning indications. Loads outlet tube with eggs. Controls the launching speed. Arms the trigger switch.
Remote Control	Initiates the launching sequence. Changes the operational mode.
Power Cord	Connects the controller to a 12VDC power source.

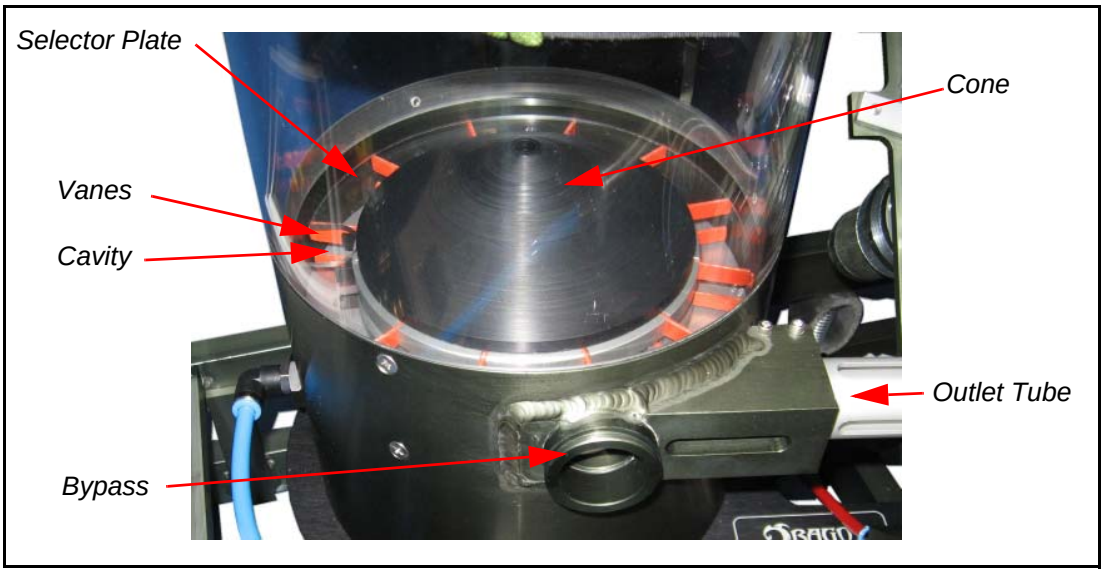


Base Assembly



- Mounting angles attach to either the side or end channels of the lower frame. These angles can be adjusted to any position within the channel.
- U-bolts are used to attach the mounting angles to tubular mount racks of ATV / UTV vehicles.
- The U-bolts can be removed and the angles attached directly to the shipping crate or other vehicle structures.
- Vibration isolators connect the lower frame to the upper frame.
- The azimuth lock handle controls the angle of the baseplate, hopper and launcher which rotate through 180° of adjustment.
- The elevation lock handle controls elevation of the launcher.
- The slide block allows separation of the launcher from the hopper to facilitate cleaning.

Hopper

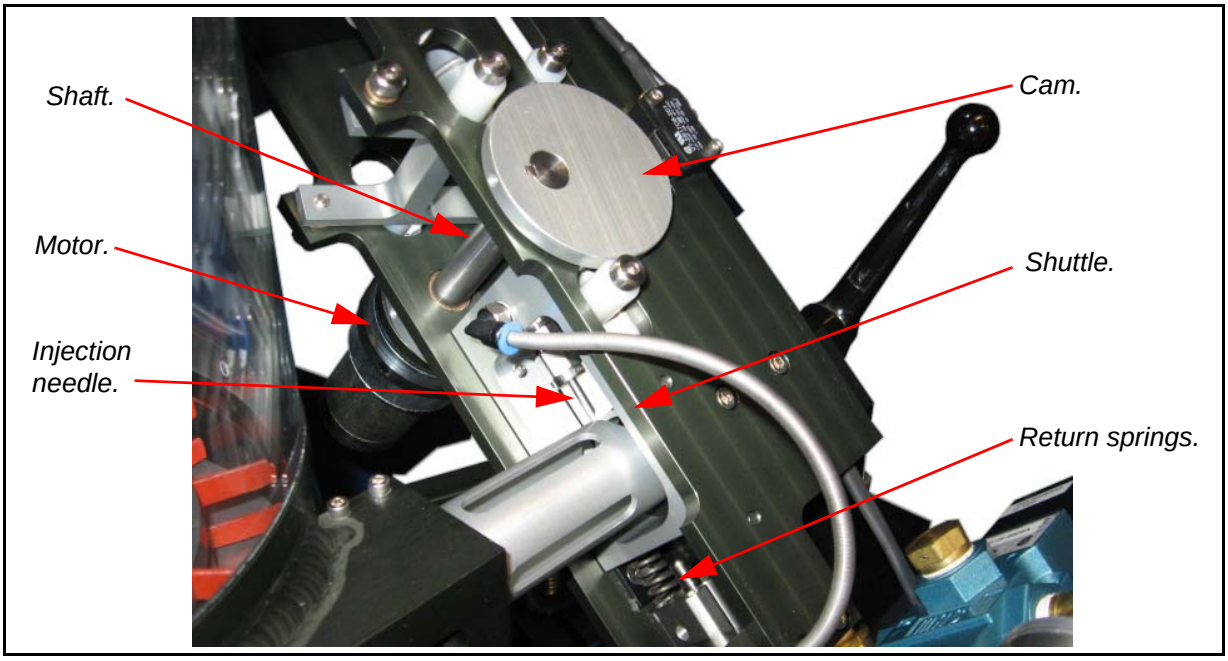


- Stores 450 unprimed eggs.
- The central cone forces the eggs to move towards the outer edge of the hopper.
- On each cycle, the selector plate picks up one egg from the hopper and allows it to drop into the cavity formed by the rotor, fixed vanes, and the hopper base.
- The extractor finger strips the egg in the rotor cavity and forces it into the outlet tube.
- The outlet tube connects the hopper to the launcher.
- The flexible vanes push on the queue of eggs in the hopper outlet tube that are waiting to be injected.
- The bypass port allows eggs to be rejected from the hopper if the outlet queue is full or the dispenser is jammed.

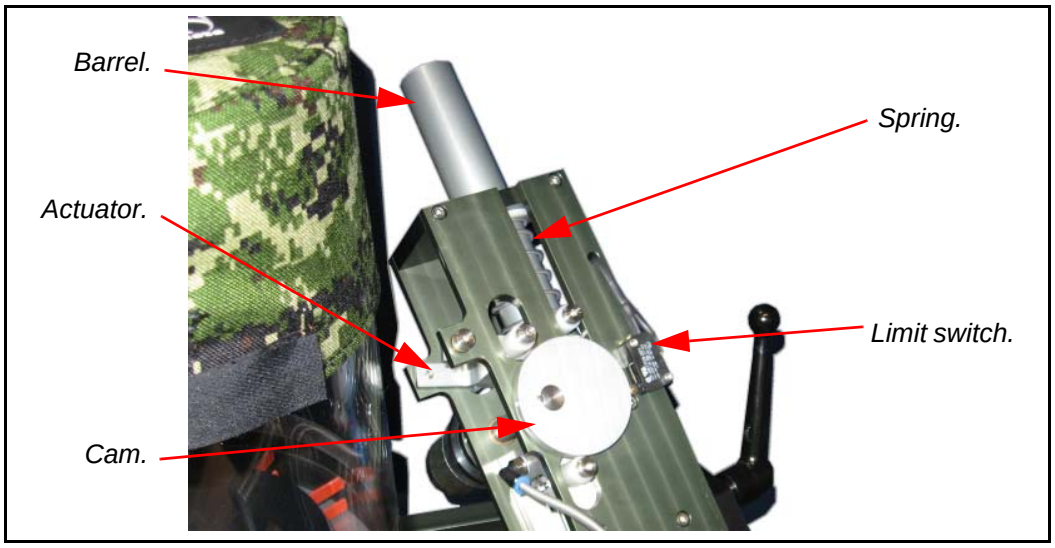
Launcher System

- The receiver block of the launcher is mounted between and upper and lower frame plates.
- The upper end of the receiver is bored out to receive the reciprocating barrel.
- The lower end of the receiver is closed by the breech plug.
- There is a side port in the receiver to receive eggs from the hopper.

Launcher System (continued)



- The drive motor, shaft and drive cams control the motion of the injection shuttle and barrel.
- The injection needle shuttle reciprocates to inject and retract the needle from the egg.
- The return springs work in opposition to the cams to return the injection shuttle to its upper position.
- The barrel actuator is driven by the cams and causes the barrel to extend.
- The barrel spring works in opposition to the barrel actuator to cause the barrel to retract.
- The limit switch is activated by the upper cam and sends a signal to the controller when the launch cycle is complete.



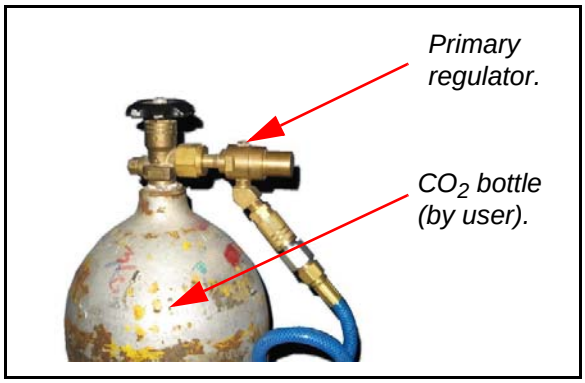
Gas System

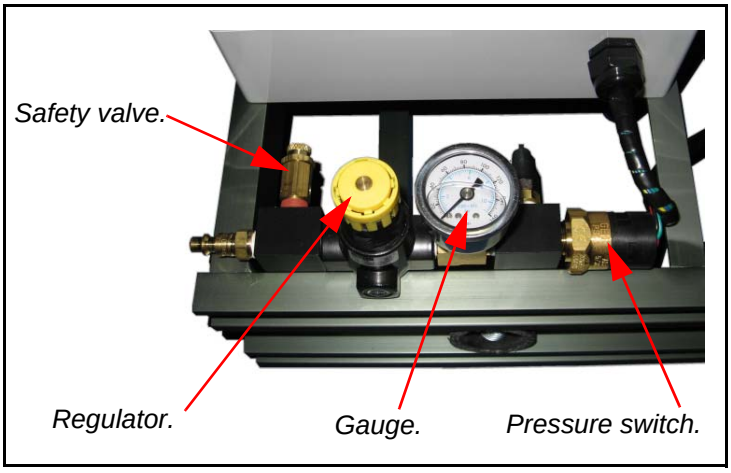
The Green Dragon will operate with a variety of non-flammable propellant gasses including, but not limited to, CO_2 and compressed air.

CAUTION

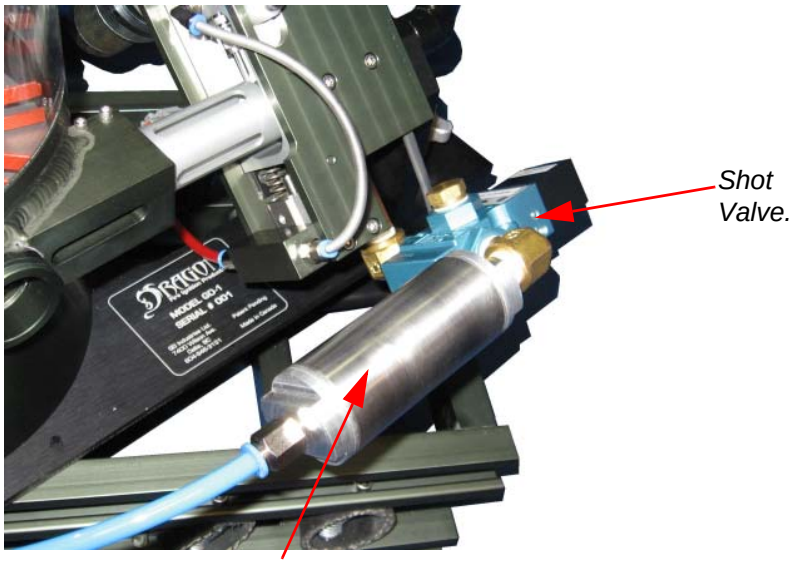
The propellant gas must be supplied at a pressure of 150 psi or less. The Green Dragon dispenser is supplied with a 150 psi regulator designed to attach to CO_2 bottles with CGA-320 fittings.

- The primary regulator is connected to the gas system using flexible hose and standard industrial quick connects.
- The safety valve protects the gas system from over pressure.
- The adjustable gas pressure regulator allows the operator to control the range of the projectile. Pushing down the outer ring locks the regulator setting.
- The pressure gauge displays the regulated gas pressure.
- The low-pressure switch measures the regulated gas pressure.





Gas System (continued)

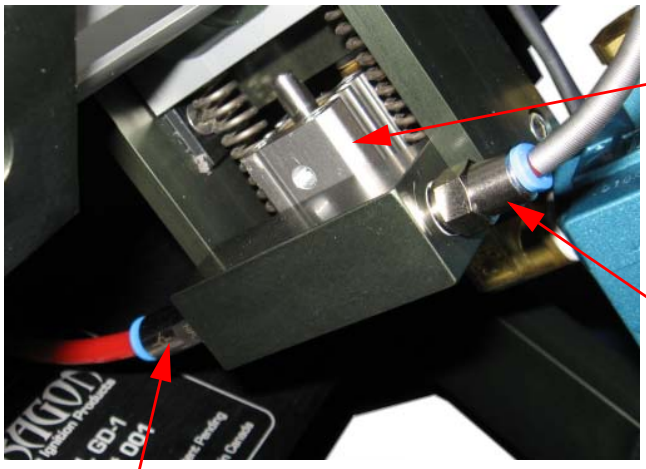


- The shot tank stores the gas charge to be used each time the launcher is cycled.
- The shot tank is connected to the breech of the launcher by a solenoid control valve. Operation of the valve is controlled at the main control panel.

Glycol System

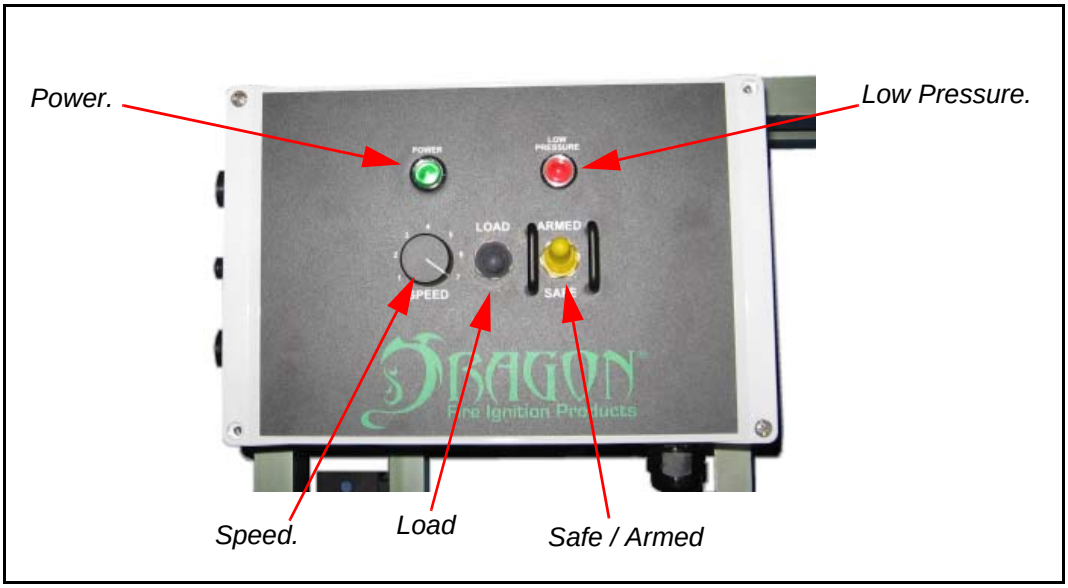
- The glycol bottle stores the glycol.
- A self-closing disconnect fitting is located on the bottom of the bottle. This allows the glycol supply tube to be removed from the bottle and the bottle to be removed from the dispenser for easier filling and draining.

Glycol System (continued)



- The glycol pump is a piston type pump operated by the action of the needle shuttle.
- The inlet check valve controls the flow of glycol into the pump from the glycol bottle
- The outlet check valve controls the flow of glycol out of the pump to the injection needle.

Main Control Panel

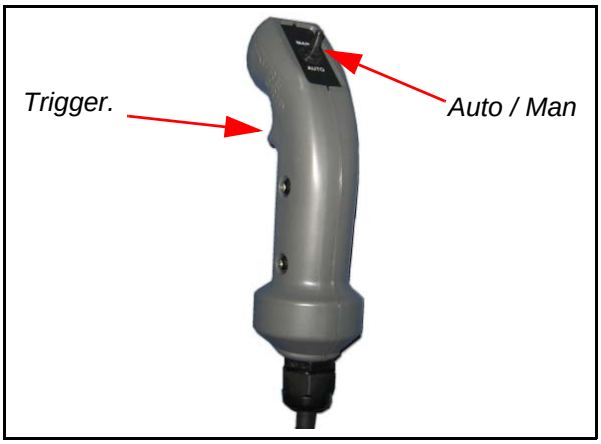


Main Control Panel (continued)

- A resetable circuit breaker is located on the end of the main control panel.
- The power indicator illuminates when the dispenser is connected to external power and the circuit breaker is in pushed in.
- The low pressure indicator illuminates when there is insufficient gas pressure to safely operate the dispenser.
- The safe / armed switch is used to prevent trigger signals from activating the dispenser.
- The load switch is used to fill the hopper outlet tube with eggs.
- The speed control varies the cycle speed of launcher when in automatic mode.

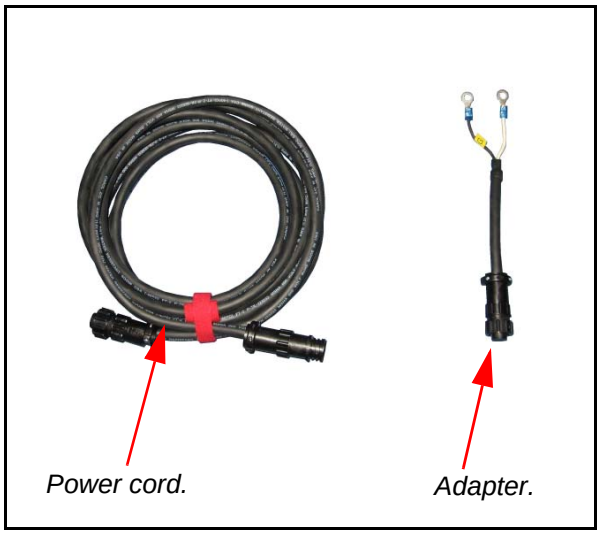
Remote Control

- The trigger switch is used to initiate an operational cycle of the dispenser.
- The auto/manual switch is used to change between automatic and manual modes of operation.



Power Cord

- The power cord connects the main control panel to the power adapter.
- The standard power adapter connects the power cord to a user-supplied power source.



Principles of Operation

The Green Dragon launcher operates on the principle of a single cycle operation. Each time a cycle is initiated, both the hopper and launcher complete one cycle and stop. When the dispenser is stopped between cycles, there are no charged eggs in the dispenser.

Loading Operation

Before the launcher can be operated, the outlet tube connecting the hopper and the launcher must be loaded with five eggs. This can be accomplished by pressing and releasing the load switch on the main control panel. The hopper will operate independently for five cycles to load the outlet tube. During this loading process, the launcher will not respond to trigger signals. If the tube remains loaded from previous use, the load operation is not necessary.

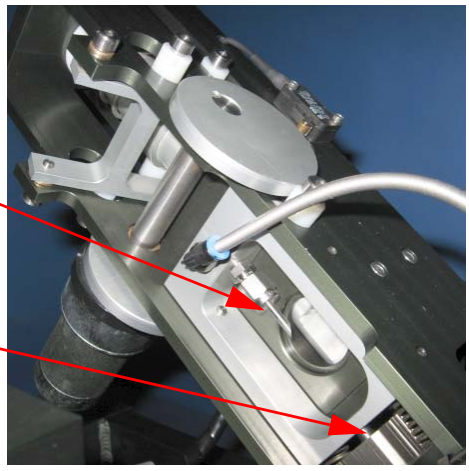
Hopper Operation

At the start of the cycle, the extractor finger strips the egg from the rotor cavity and adds it to the queue of eggs in the outlet tube. Further rotation causes the flexible vanes in the hopper to apply a constant pushing pressure to the eggs in the queue.

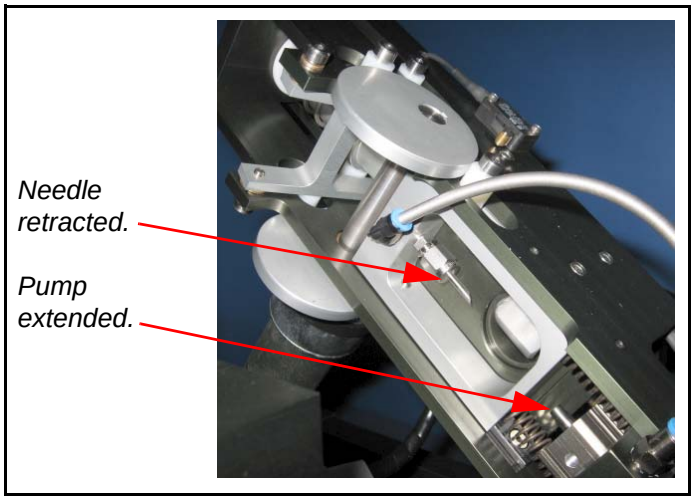
Once the rotor cavity passes by the extractor, the selector plate loads another egg from the hopper into the cavity for the next cycle. At the end of its cycle, the hopper reaches its limit switch and stops rotating.

Launcher Operation

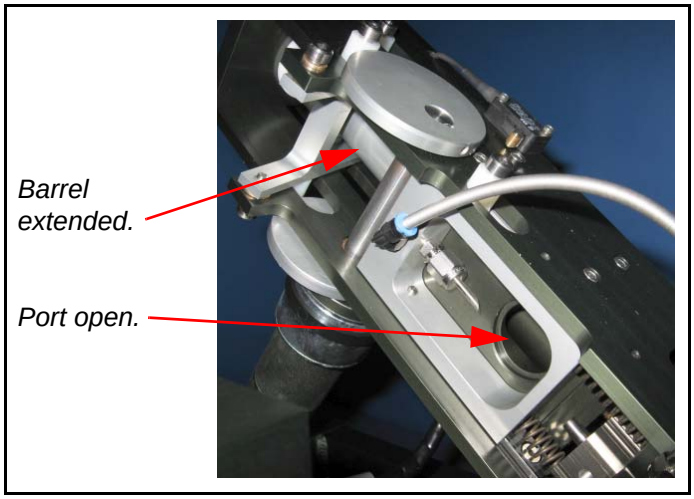
On the first phase of the cycle, the injection needle shuttle is forced downwards by the drive cams. This causes the injection needle to pierce the last egg in the queue. During the final portion of the phase, the injection shuttle pushes down on the piston of the glycol pump, causing it to inject glycol into the egg through the needle.



During the second phase of the cycle, the drive cams allow the injection shuttle springs to push the injection shuttle upwards and retract the needle from the egg. The glycol pump returns to its neutral position and recharges with glycol for the next cycle.

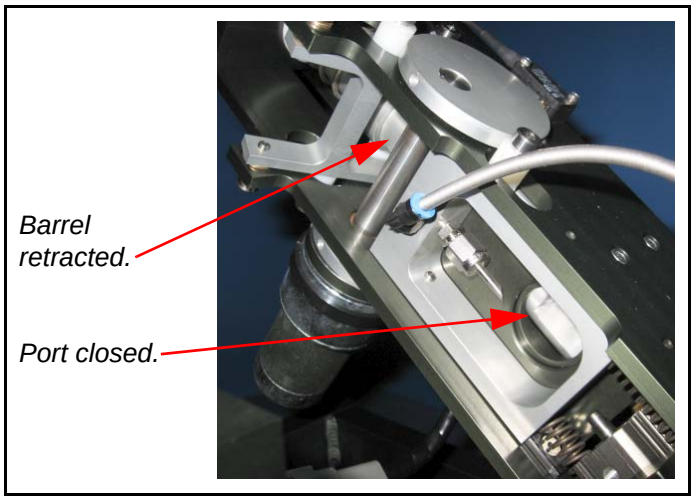


During the third phase of the cycle, the cams push on the barrel actuator, causing the barrel to extend from the receiver. At the end of the stroke, the barrel is fully extended and the side port in the receiver is open. Pressure from the flexible vanes in the hopper pushes the charged egg into the receiver.



During the final phase of the cycle, the barrel spring forces the barrel to retract to its closed position, closing over the charged egg in the receiver. When the barrel is fully retracted, its lower end seals against an O-ring in the breech. When the cams reach the end of their cycle, they trigger the limit switch.

The limit switch stops the drive motor and sends a signal to the controller to open the shot valve momentarily. The gas charge in the shot tank enters the breech of the barrel and propels the charged egg from the barrel.



Modes of Operation

In the manual mode of operation, each time the trigger is pulled and released, the launcher will complete one cycle and stop. Holding down the trigger will cause the dispenser to continue to cycle at the fastest possible speed until the trigger is released. When released, the dispenser completes the cycle that it has started.

In the automatic mode of operation, the dispenser will cycle continuously without holding down the trigger. In this mode, the trigger is used as a toggle to both start and stop operation. During automatic mode, the speed of operation can be controlled with the speed selector which controls the time delay between cycles.

In either mode of operation, if the gas pressure drops below a preset limit, the launcher will complete its current cycle and then stop. It will not initiate a new cycle until the gas pressure has been restored.

Section 2: Installation

Installation

Mounting Options

The launcher is designed to mount to a variety of vehicle platforms. The most important factor to consider when mounting the launcher is the arc of fire. The launcher has a 180° arc of fire that must face away from the operator.

Typical mounting arrangements are as follows:

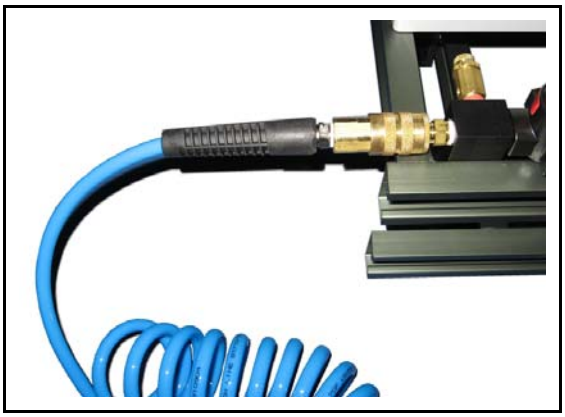
- Truck – mounted to the top of the shipping crate facing to the rear.
- ATV – mounted to the rear utility rack facing to the rear.
- UTV – mounted to the front utility rack facing forwards.

Gas System

If CO_2 gas bottle is used as a propellant, the bottle must be mounted in a vertical position to prevent liquid entering the launcher and causing damage. Mounting brackets are provided to attach a standard 20lb beverage style bottle to the side of the shipping crate.

1. Attach the primary regulator to the gas bottle.
2. Attach the flexible hose to the primary regulator.

3. Connect the flexible hose to the fitting on the manifold.



CAUTION

Carbon Dioxide (CO_2) bottles must be used in a vertical position. Failure to do so may cause permanent damage to the launcher.

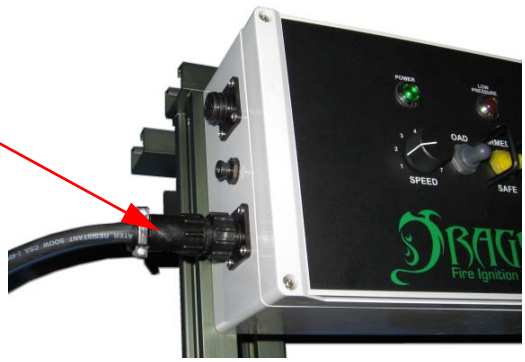
If using compressed air as a propellant, there are no mounting position restrictions.

Electrical System

The Green Dragon operates on a 12VDC system.

1. Attach the power cord to the receptacle on the control enclosure.

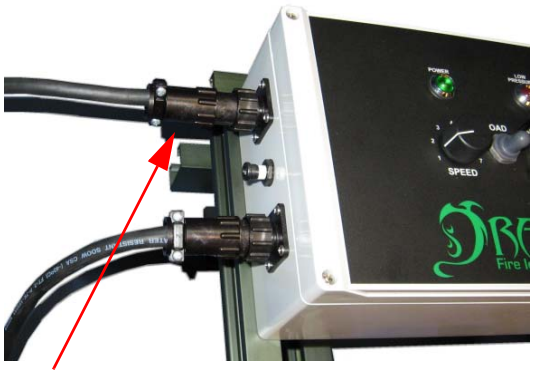
Power cord attached to control enclosure.



2. Attach the power adapter to the power cord.

3. Attach the power adapter to a 12VDC power supply.

4. Attach the remote control to the receptacle on the control panel.



Remote control connected.

Glycol System

Important Note

Use only 100 per cent ethylene glycol to ensure proper ignition. Do not use 50/50 pre-mix or propylene glycol.

The glycol system uses undiluted ethylene glycol (anti-freeze). To fill and prime the system:

1. Disconnect the glycol supply tube from the glycol bottle by pushing up on the blue ring of the disconnect fitting while pulling down on the tubing.
2. Remove the bottle from the dispenser and fill with ethylene glycol. Replace the bottle and tubing.

If the launcher has been allowed to run completely out of glycol, it may require priming of the glycol pump.

To check the pump priming:

1. Squeeze down on the glycol pump piston.
2. Glycol should squirt out of the injection needle.
3. If it does not, the system requires priming.

To prime the glycol system:

1. Remove the glycol supply tubing from the pump inlet check valve and allow the supply tube to fill with glycol.

2. Once the supply tube has filled with glycol, replace the tube into the inlet valve.

3. Squeeze and release the pump piston repeatedly until glycol flows from the injection needle.

4. Wipe up any glycol spills.

Dragon Eggs

Observe safe handling practices for the Dragon Eggs. See *Section 8* for the MSDS information.

1. Fill the hopper with Dragon Eggs.

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Section 3: Operations

Green Dragon Operations

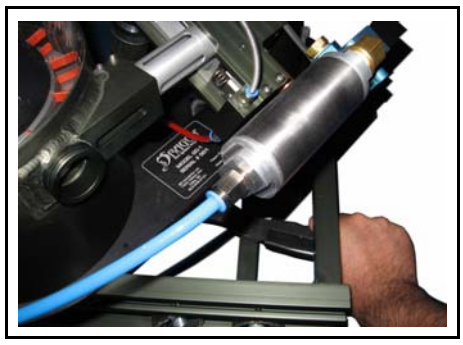
To operate the Green Dragon:

1. Press in the circuit breaker.
   - The POWER indicator will illuminate.
   - The LOW PRESSURE indicator will illuminate.

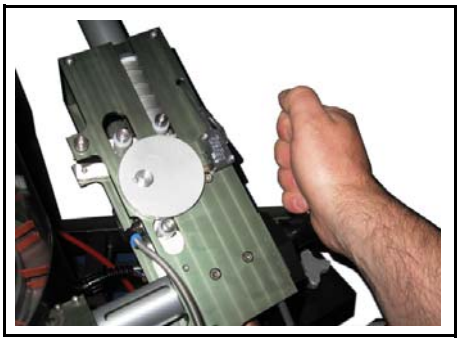
2. Open the valve on the gas bottle or air system, as applicable.
   - The LOW PRESSURE indicator should extinguish.

3. If the outlet tube is empty, press and release the load switch.

4. Adjust the azimuth of the launcher.



5. Adjust the elevation of the launcher.

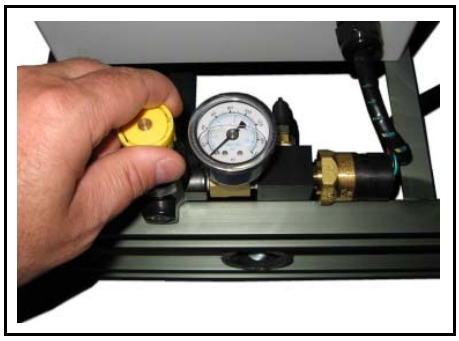


6. Select the operational mode using the switch on the remote control.

MAN	• pull and release the trigger to shoot single eggs. • pull and hold the trigger to shoot continuously.
AUTO	• pull and release the trigger to start shooting. • pull and release the trigger to stop shooting.

7. If in AUTO mode, select the launch speed to get the desired ground spacing.

8. Adjust the pressure regulator to give the desired range. Pull up on the locking ring of the pressure regulator before attempting to rotate.



9. Set the safety switch to the ARMED position.

10. Pull the trigger to initiate operation.

CAUTION

The projectiles from the launcher are moving at a high speed and can cause personal injury.

CAUTION

Whenever leaving the dispenser unattended, ensure the safety switch is in the SAFE position.

11. Add more eggs as required.

CAUTION

Do not allow the hopper to run out of eggs. If this occurs, the vanes cannot push the primed egg into the launcher and a fire will result.

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Section 4: Emergency Procedures

Launcher Jams

Important Note

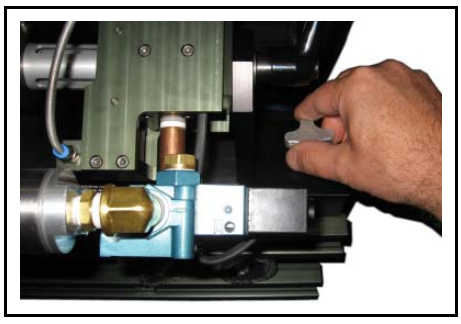
If a jam occurs in the launcher feed mechanism, it can lead to a fire in the dispenser. If this occurs, extinguish the fire using the supplied water bottle.

Clearing a Jam

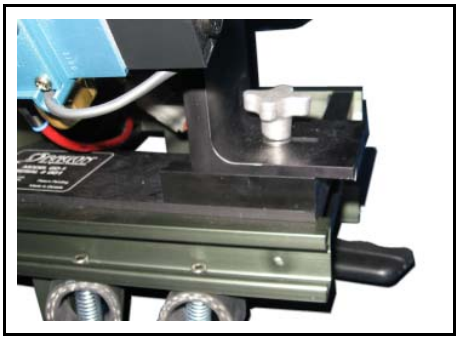
To facilitate cleaning or clearing a jam, the launcher can be separated from the hopper. The process is as follows:

1. Set the ARMED / SAFE switch to the SAFE position.

2. Turn the slide block knob counter clockwise.



3. Slide the launcher and slide angle away from the hopper.



4. Remove the hopper outlet tube.

5. Clean as required.

6. On reassembly, note that there is a slot in the hopper outlet tube which ensures proper alignment with the hopper.

Section 5: Troubleshooting

These remedial actions are limited to those which can be performed in the field by an operator with limited tools.

Won't Power On

Dispenser will not power on and the "POWER" indicator is not illuminated.

Circuit Breaker

- Check that the circuit breaker is pushed in.

Faulty Electrical Connection

- Check that the power supply is properly connected to the power adapter.
- Check that the power adapter is properly connected to the power cord.
- Check that the power cord is properly connected to the receptacle on the control panel.

Power Supply

- Check that the power supply is 12VDC.
- Check that the power adapter has been attached with the correct polarity.
    - White – Positive
    - Black – Ground

Won't Load

Load switch is pushed but hopper does not operate.

PLC Startup

When the dispenser first powers on, the internal PLC takes several seconds before it can respond to any inputs.

- Wait five seconds then push load switch again.

Already Loaded

The load operation can only be completed once each power cycle.

- Check that the dispenser has not been loaded.
- Pull out the circuit breaker.
- Push in the circuit breaker and wait five seconds.
- Press the load switch.

Won't Cycle

Trigger switch is pulled but dispenser does not respond.

PLC Startup

When the dispenser first powers on, the internal PLC takes several seconds before it can respond to any inputs.

- Wait for five seconds, then pull trigger.

Load Cycle

During the load cycle, the dispenser will not respond to trigger signals.

- Wait for loading to complete, then pull trigger.

Low Gas Pressure

If the gas pressure is below 30 psi, the dispenser will not cycle and the "LOW PRESSURE" indicator will illuminate.

- Adjust the regulator to increase the pressure above 30 psi.
- Check gas supply.

Safety On

If the "SAFE / ARMED" switch is in the "SAFE" position, the dispenser will not respond to trigger signals.

- Set the "SAFE / ARMED" switch to the "ARMED" position.

Intermittent Operation

Dispenser shuts down randomly and then restarts.

Power Supply Voltage.

A low power supply voltage will cause the dispenser to shut down and restart.

- Check that the power supply voltage does not drop below 12VDC during operation.

Faulty Electrical Connection

- Check that the power supply is properly connected to the power adapter.
- Check that the power adapter is properly connected to the power cord.
- Check that the power cord is properly connected to the receptacle on the control panel.

Egg Jamming

When dispenser is cycled, eggs do not get loaded into the barrel properly.

Outlet Tube Position

Incorrect location of the outlet tube will change the position of the eggs in the tube and cause sphere jamming.

- Check that the outlet tube is fully seated into the hopper.
- Check that the outlet tube is fully seated in the counterbore in the receiver.

Dirty Outlet Tube

A dirty outlet tube can cause the eggs to drag in the outlet tube leading to a jam.

- Remove the outlet tube and clean.

Loss of Range

When dispenser is cycled, eggs are not propelled the normal distance for that pressure setting.

Breech Seal Leakage

Gas leaking past the o-ring seal in the breech plug will reduce the effective range of the launcher.

- Remove the four socket head cap screws which secure the breech plug to the receiver.
- Remove the breech plug and valve assembly.
- Check breech plug for debris and clean as required.
- Check for damaged or missing o-ring and replace as required.
- Check for damage to the breech end of the barrel and clean as required.

Launcher Limit Switch Adjustment

An improperly adjusted limit switch can cause the cycle to stop too soon and the valve will activate before the barrel is fully seated against the o-ring.

- Cycle the launcher once.
- Check that there is freedom of movement between the barrel actuator frame and the two barrel rollers. This indicates that the barrel is fully seated.
- If required, adjust the launcher limit switch away from the cam to allow the cam to advance further before stopping.

Ignition Failure

Eggs are not igniting properly.

Glycol Composition

Using the wrong type of glycol can cause ignition failure.

- Check that glycol is ethylene glycol and not propylene glycol.
- Check that the glycol has not been diluted with water (automotive antifreeze is often sold as a 50/50 mix of glycol and water).

Ambient Temperature

The ambient air temperature changes the effect of the reaction.

- Burning, when the ambient air temperature is less than 32°F / 0°C, can cause delayed or poor ignition.

Injection Needle

A plugged or damaged injection needle will prevent glycol from entering the eggs.

- Disconnect the glycol outlet line that connects the outlet check valve to the elbow on the needle shuttle.
- Press the needle shuttle to cycle the glycol pump.
- If glycol comes out of the outlet line, then the problem is with the needle.
- Check the needle for blockage and clean as required.

Glycol Pump System

Faulty inlet or outlet check valves on the glycol pump will prevent it from pumping glycol.

- Disconnect the glycol inlet line from the bottom of the glycol reservoir (the fitting on the reservoir is self-sealing and will not leak).
- Press the needle shuttle to cycle the glycol pump.
- If the glycol comes out of the inlet line, the inlet check valve is stuck open and needs cleaning or replacing.
- Re-attach the glycol inlet line to the bottom of the glycol reservoir.
- Disconnect the glycol outlet line that connects the outlet check valve to the elbow on the needle shuttle. Seal the end of the glycol outlet line with your thumb.
- Press and release the needle shuttle once to cycle the glycol pump.
- Remove your thumb from the glycol outlet and cycle the pump again.
- If glycol comes out of the outlet line, the outlet check valve is stuck open and needs cleaning or replacing.

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Section 6: Service

Cleaning and Storage

Regular cleaning of the Green Dragon is the most important maintenance function. During each operational cycle, a small amount of potassium permanganate powder and glycol can leak out of the punctured hole in the sphere and be deposited in the launcher.

Over the course of thousands of eggs, this can build up and cause feeding problems between the hopper and launcher. Daily and weekly cleaning routines need to be performed to keep the launcher operating reliably.

The recommended cleaners are citrus based solvents such as Simple Green all purpose cleaner. These cleaners do not contain any oils which can cause dust and debris to accumulate in the moving parts of the launcher.

All of the bearing surfaces in the launcher are made from self-lubricating materials. There is no need to lubricate them.

Daily Cleaning Routine

- Loosen the slide locking knob and slide the launcher to the right.
- Remove the hopper outlet tube.
- Spray the inside of the outlet tube with cleaner and wipe it as clean as possible. This is the most critical part in the dispenser to be kept clean.
- Pull the barrel outward and spray cleaner into the side port of the receiver. Wipe out as much of the receiver and barrel as is accessible.
- Wipe the needle shuttle and shuttle guides.
- Inspect the injection needle to ensure that it is sharp and straight.
- Wipe up any glycol which has dripped from the breech plug drain port.
- Wipe out the hopper.
- Replace the outlet tube.
- Slide the launcher back to its correct position and lock in place.

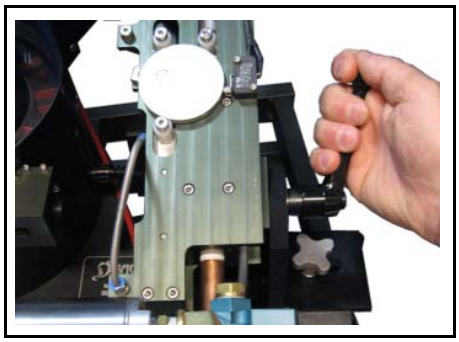
Weekly Cleaning Routine

- Disconnect the air line to the shot tank.

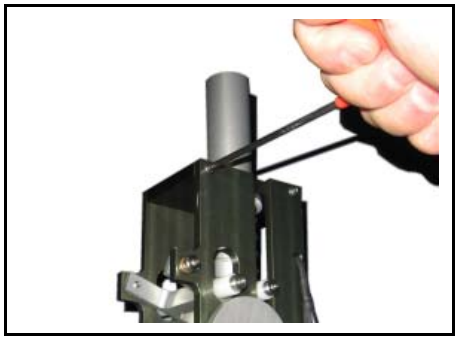
- Disconnect the glycol line to the glycol pump inlet valve.

- Disconnect the electrical connection to the launcher.

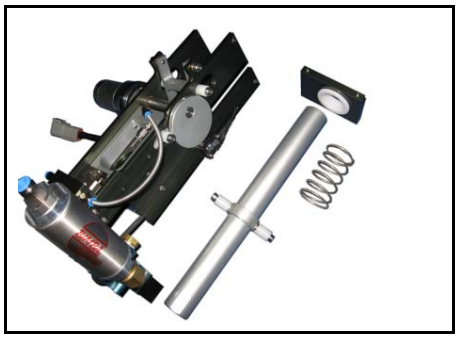
- Unscrew the elevation lock handle completely and remove the launcher.



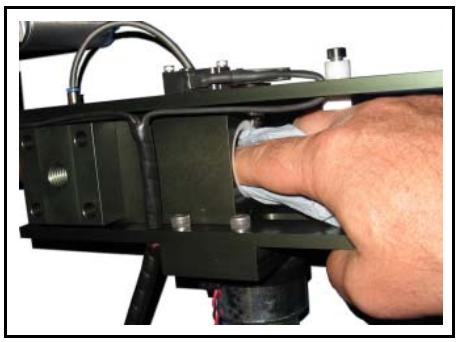
- Remove the four socket head cap screws which secure the front plate to the side plates of the launcher.



- Remove the front plate, front bearing, barrel and barrel spring.

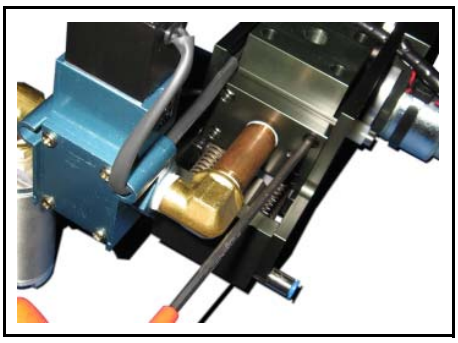


- Wipe out the inside of the front bearing and receiver bearing with a cloth. The bearings are self-lubricating and should not be oiled.

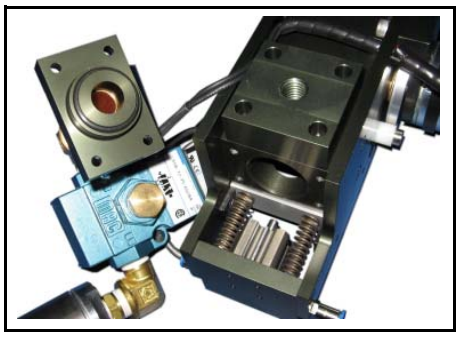


- Spray the inside of the barrel with cleaner and swab out using a cloth.

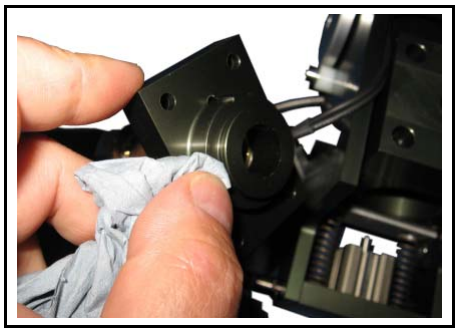
- Remove the four socket head cap screws which secure the breech plug to the receiver.



- Remove the breech plug and valve assembly and set aside being careful not to damage the valve wires.

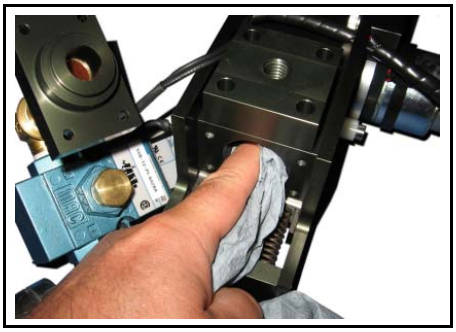


- Remove the o-ring and clean the breech plug paying particular attention to the o-ring groove.

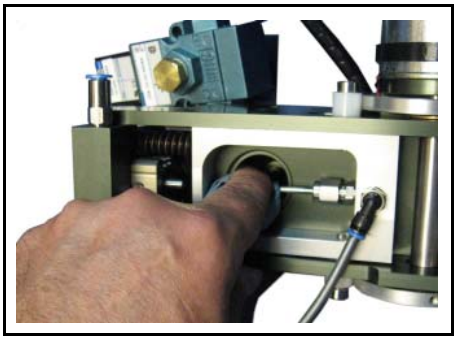


- Clean the o-ring and examine it for signs of damage. It should be soft and pliable. Replace if necessary.

- Spray the bore of the receiver with cleaner and swab it out with a cloth.



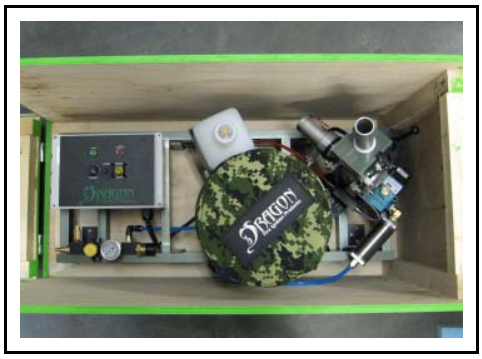
- Clean the port in the side of the receiver where the hopper outlet tube mates.



- Wipe the running surfaces of all the nylon bushings on the needle shuttle, barrel actuator and barrel.
- Replace the breech plug and valve assembly into the receiver ensuring the correct orientation. Secure using the four socket head cap screws.
- Install the barrel into the receiver bearing ensuring that the end with the flats is inside of the receiver.
- Install the barrel spring onto the barrel.
- Install the front bearing and front plate into the side plates, ensuring that the flange on the bearing is contacting the barrel spring. Secure using the four socket head cap screws.
- Check the barrel alignment by pulling out the barrel and releasing. If necessary, loosen the cap screws and adjust the front plate to get the optimum alignment.
- Check for damaged vanes in the hopper.

Storage

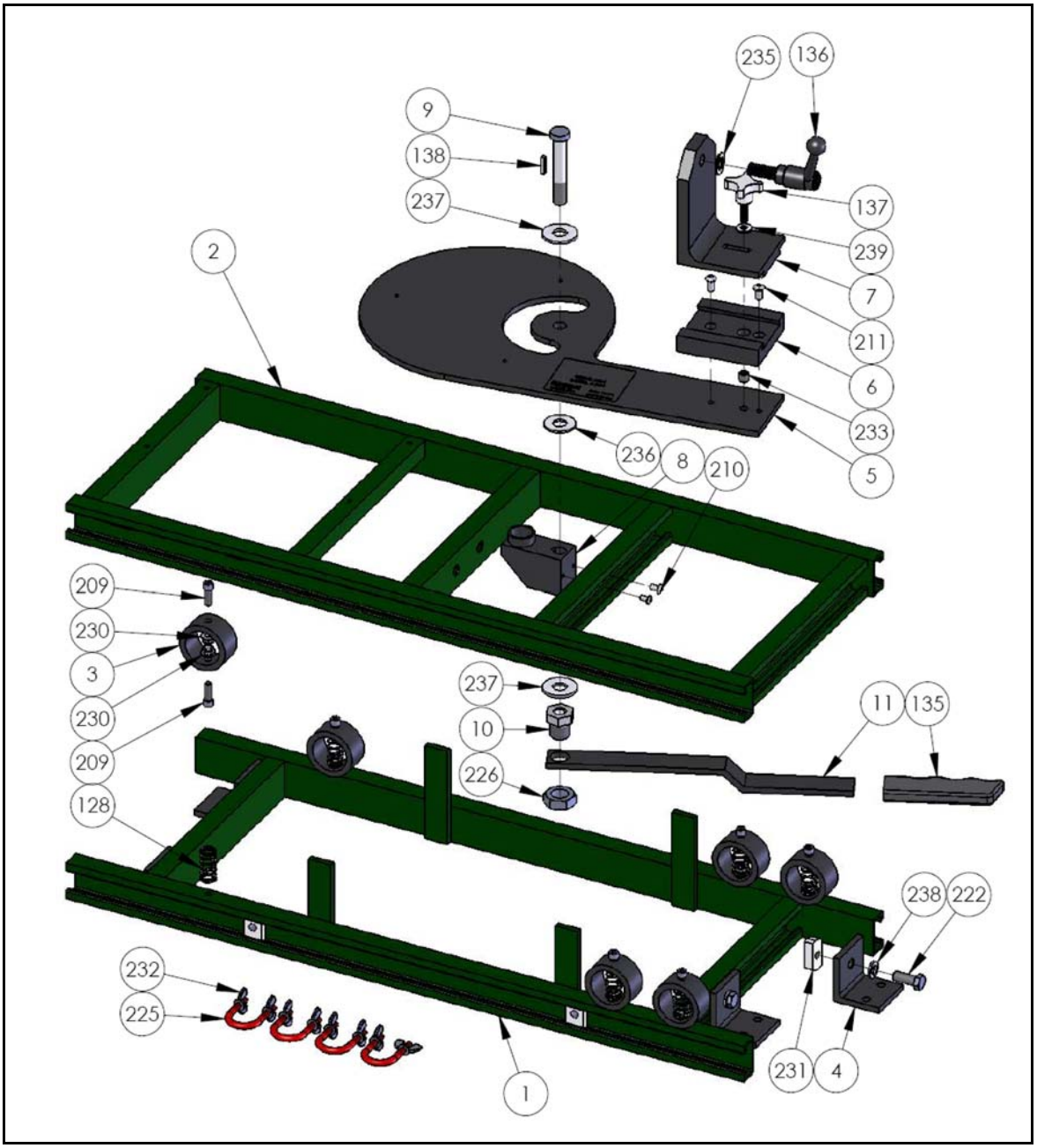
Proper packing of the Green Dragon will ensure that no damage occurs to the dispenser during shipping or long term storage.



- Ensure that the dispenser is clean and dry.
- Remove the remote control and place in the hopper.
- Remove the power cord and place in the tool bag.
- Remove the gas hose and place in the tool bag.
- Remove the tank regulator and place in the tool bag.
- Adjust the elevation of the launcher to its highest angle.
- Rotate the hopper and launcher assembly to the position shown.
- Place the dispenser in the crate as shown.
- Close the end of the crate.
- Place the tank hoops in the outer pocket.
- Place the manual in the inner pocket.
- Place the tool bag on the shelf.
- Close the lid and latch the crate.
- Store the crate in a dry location.

System Components and Parts Lists

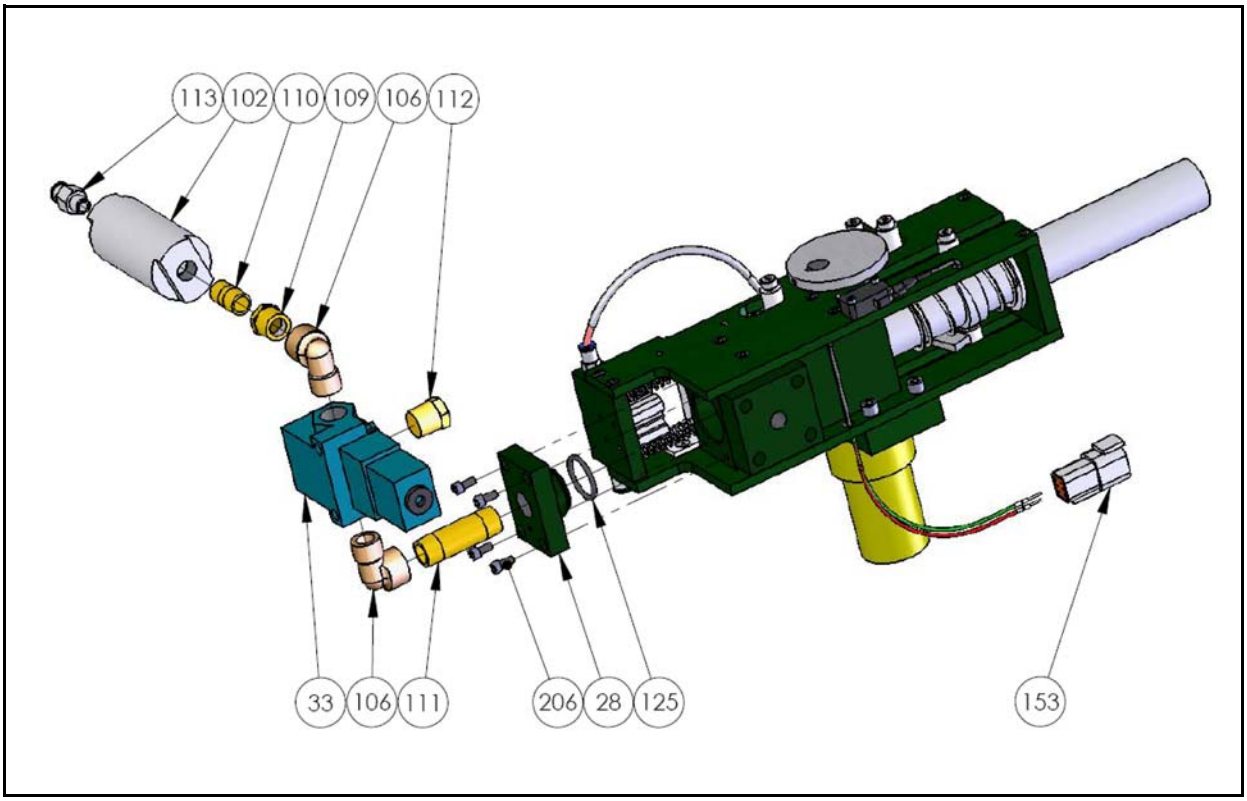
Base Drawing



Base Parts List

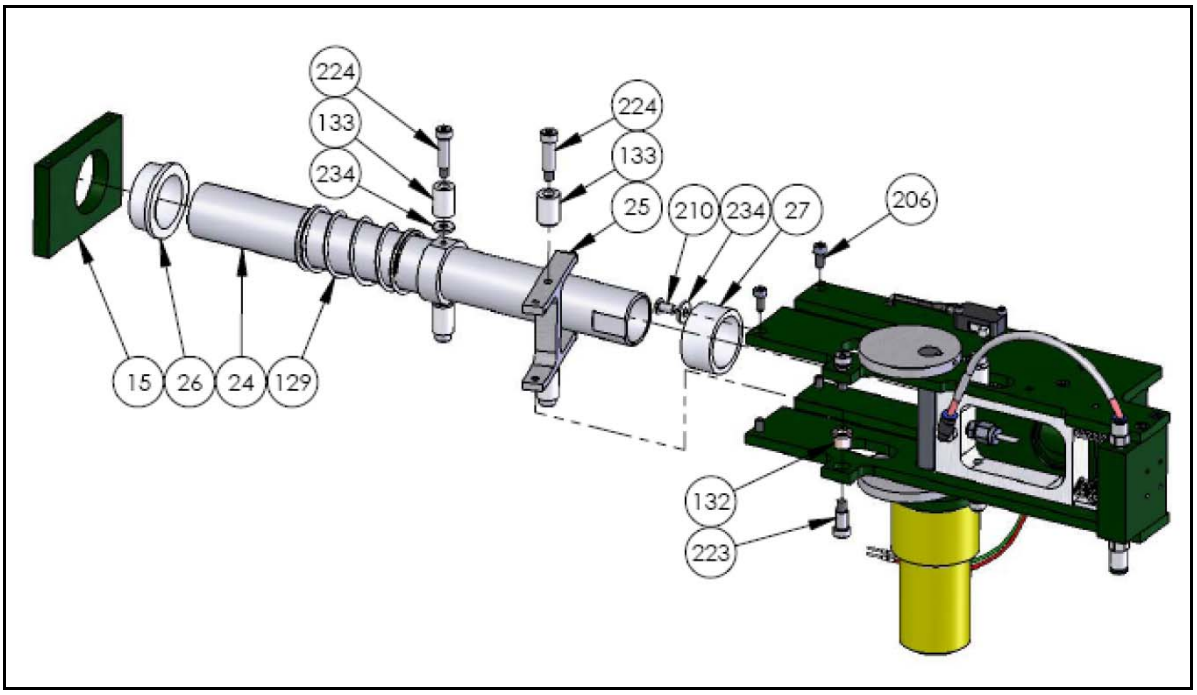
ITEM	PART NUMBER	DESCRIPTION	QTY
1	DE14101	BASE FRAME, LOWER	1
2	DE14102	BASE FRAME, UPPER	1
3	DE14103	VIBRATION ISOLATOR	6
4	DE14104	MOUNT ANGLE, BASE	4
5	DE14110	BASE PLATE	1
6	DE14111	SLIDE BLOCK	1
7	DE14112	SLIDE ANGLE	1
8	DE14113	PIVOT BLOCK	1
9	DE14114	PIVOT PIN	1
10	DE14115	PIVOT NUT	1
11	DE14116	HANDLE, AZIMUTH	1
128	005085	SPRING, COMP, 0.625 x 0.054 x 2.75	6
135	005084	GRIP, 1/4 x 1 x 4, RBR, BLK	1
136	005081	HANDLE, ADJ, MALE, 1/2-13 x 1-3/16	1
137	005082	KNOB, MALE, 1/4-20 x 1-3/4	1
138	005083	KEY, MACHINE, C1018, SQ, 1/8 x 3/4	1
209	000428	SCREW, 1/4-20 x 3/4, SC, SS	12
210	000513	SCREW, 10-24 x 3/8, BC, SS	2
211	000514	SCREW, 1/4-20 x 1/2, BC, SS	2
222	000391	BOLT, 3/8-16 x 1, HX, SS	4
225	000526	U-BOLT, 1/4-20 x 1, PL	4
226	005087	NUT, JAM, 3/4-16, HX, SS	1
230	001647	NUT, FLNG, NYL, 1/4-20, PL	12
231	001648	NUT, CHNL, 3/8-16, PL	8
232	001674	NUT, WING, 1/4-20, SS	8
233	001677	INSERT, THREAD, 1/4-20 x 3/8-24	1
235	001842	WASHER, FLAT, 0.51 x 0.88 x 0.06, SS	1
236	005086	WASHER, FLAT, 0.56 x 1.25 x 0.06, PVC	1
237	001847	WASHER, FLAT, 0.56 x 1.38 x 0.11, SS	2
238	001853	WASHER, LOCK, 3/8, SS	4
239	001819	WASHER, FLAT, 0.28 x 0.63 x 0.06, SS	1

Launcher Drawings and Parts Lists



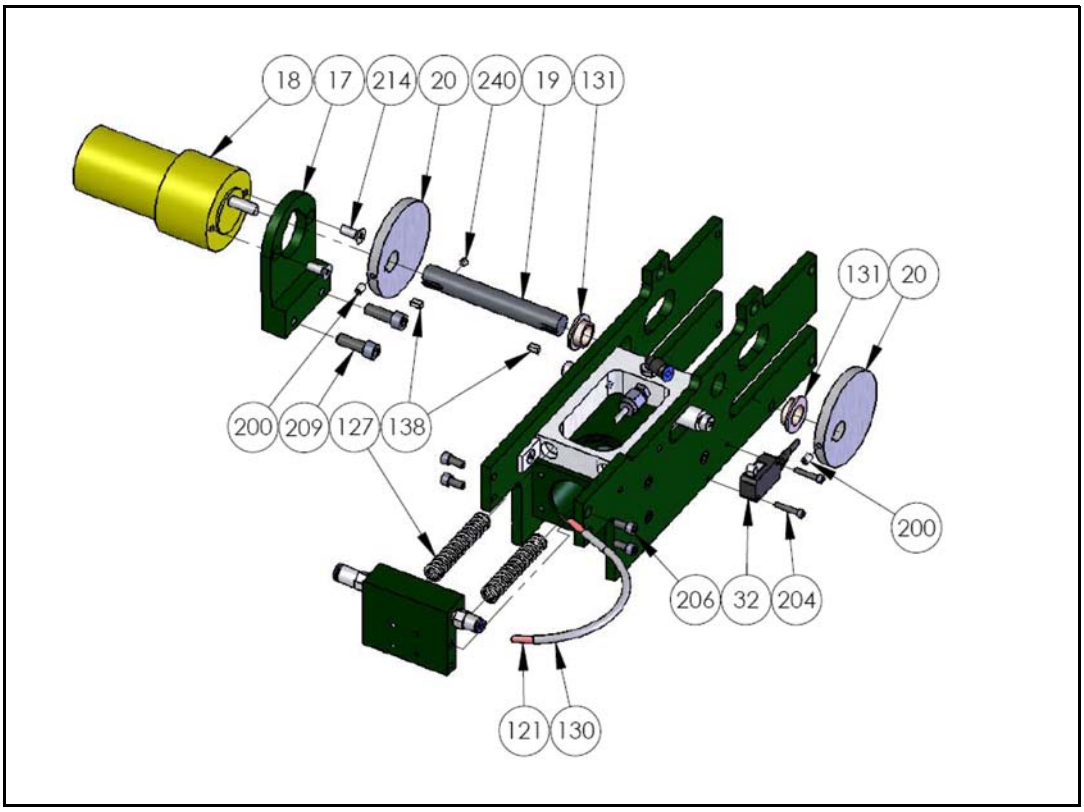
ITEM	PART NUMBER	DESCRIPTION	QTY
28	DE14250	BREECH PLUG	1
33	DE14280	SHOT VALVE	1
102	DE14281	SHOT TANK	1
106	003646	ELBOW, STR90, 3/8NPT, BR	2
109	003632	BUSHING, 3/8MNPT x 1/4FNPT, BR	1
110	003636	NIPPLE, 1/4NPT x CLS, BR	1
111	003637	NIPPLE, 3/8NPT x 2, BR	1
112	005106	PLUG, 3/8 MNPT, HXHD, BR	1
113	003651	ADAPTER, 1/8NPT x 8MM	1
125	005113	O-RING, BUNA N, #119	1
153	001190	RECEPTACLE, FH, 6 PIN	1
206	000418	SCREW, 8-32 x 3/8, SC, SS	4

Launcher Drawings and Parts Lists (continued)



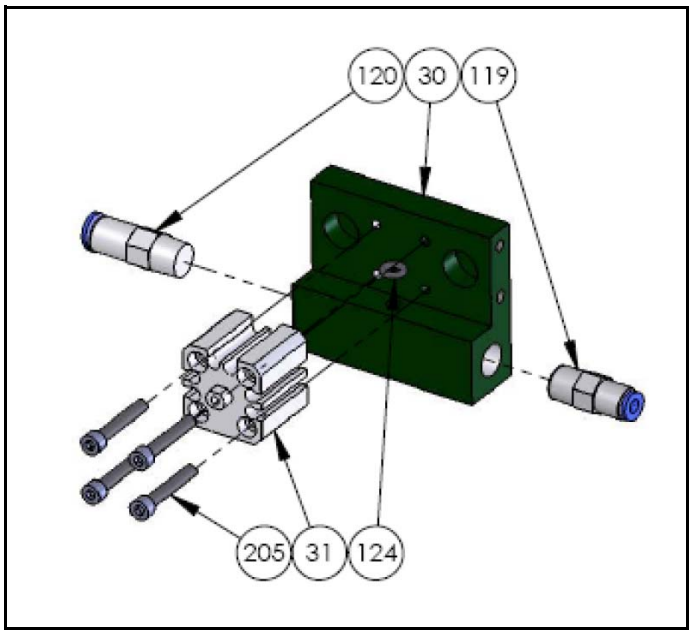
ITEM	PART NUMBER	DESCRIPTION	QTY
15	DE14204	FRONT PLATE	1
24	DE14240	BARREL	1
25	DE14241	BARREL ACTUATOR	1
26	DE14242	BEARING, FRONT	1
27	DE14243	BEARING, RECEIVER	1
129	005111	SPRING, COMP, 1.500 x 0.091 x 2.63	1
132	005108	BUSHING, FL, BRZ, 1/4 x 3/8 x 3/8	2
133	005104	BUSHING, ST, NY, 1/4 x 1/2 x 11/16	4
206	000418	SCREW, 8-32 x 3/8, SC, SS	4
210	000513	SCREW, 10-24 x 3/8, BC, SS	1
223	003685	BOLT, 1/4 x 7/16 x 10-32, SH, HX, SS	2
224	000557	BOLT, 1/4 x 3/4 x 10-32, SH, HX, SS	4
234	001843	WASHER, FLAT, 0.20 x 0.50 x 0.06, SS	3

Launcher Drawings and Parts Lists (continued)



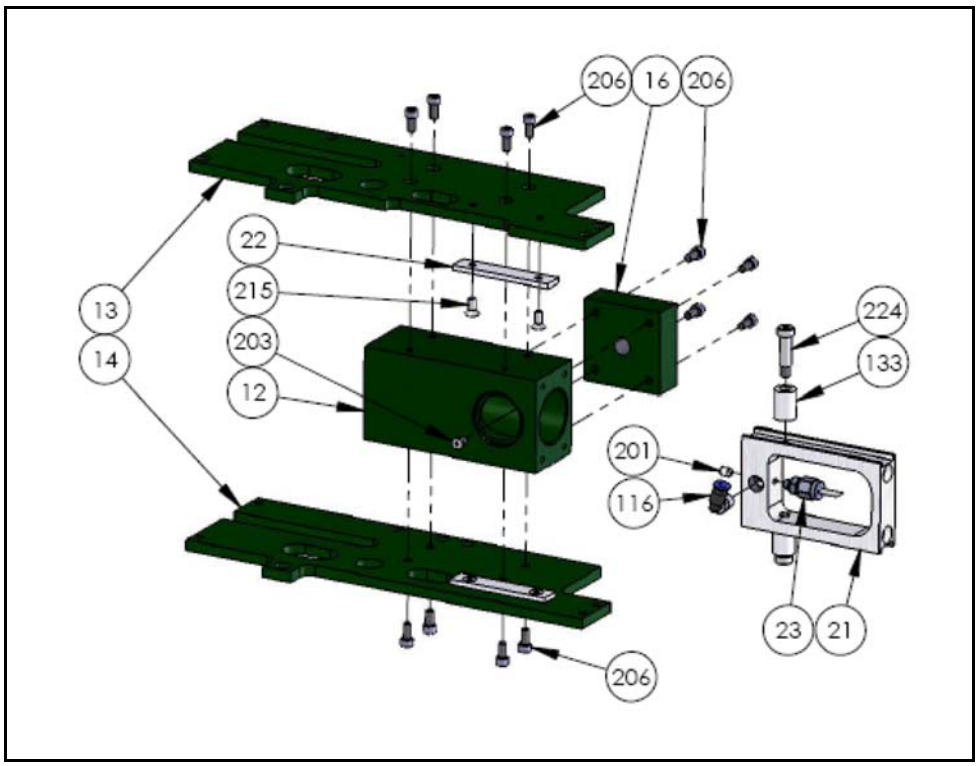
ITEM	PART NUMBER	DESCRIPTION	QTY
17	DE14220	MOTOR MOUNT	1
18	DE14221	MOTOR, LAUNCHER	1
19	DE14222	DRIVE SHAFT	1
20	DE14223	CAM	2
32	DE14270	LIMIT SWITCH, LAUNCHER	1
121	004217	TUBE, PUN, 4MM x 0.75MM, RED	8 IN
127	005110	SPRING, COMP, 0.420 x 0.051 x 2.25	2
130	006072	SPRING, EXT, 0.188 x 0.015 x 20.0	7 IN
131	005109	BUSHING, FL, BRZ, 1/2 x 5/8 x 1/4	2
138	005083	KEY, MACHINE, C1018, SQ, 1/8 x 3/4	2
200	000364	SETSCREW, 8-32 x 1/4, CUP, SS	2
204	000405	SCREW, 4-40 x 5/8, SC, SS	2
206	000418	SCREW, 8-32 x 3/8, SC, SS	4
209	000428	SCREW, 1/4-20 x 3/4, SC, SS	2
214	000538	SCREW, 10-32 x 1/2, MS, FHPH, SS	2
240	000363	SETSCREW, 8-32 x 1/8, CUP, SS	1

Launcher Drawings and Parts Lists (continued)



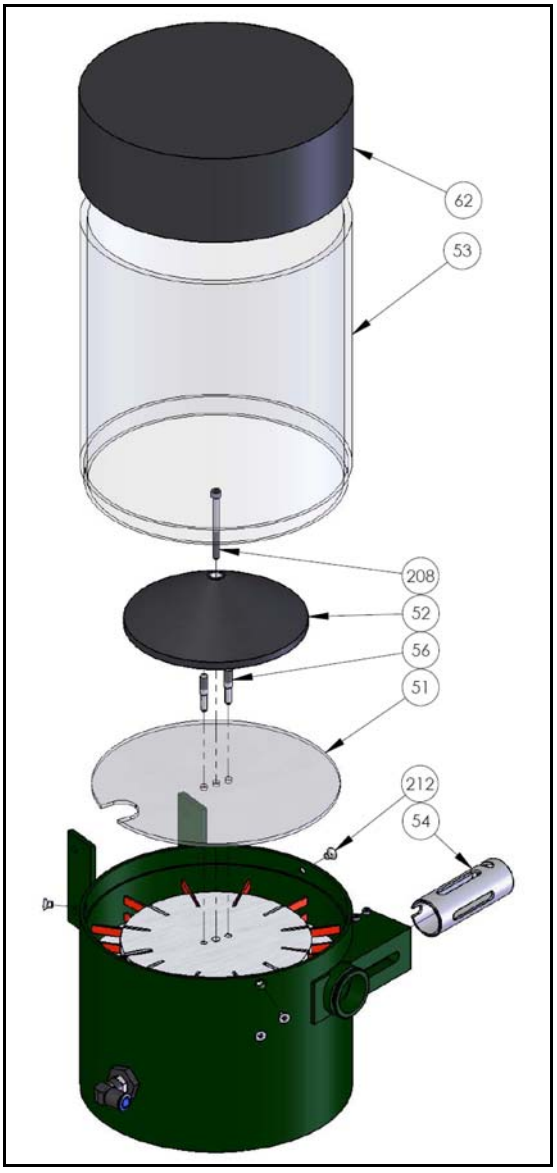
ITEM	PART NUMBER	DESCRIPTION	QTY
30	DE14261	PUMP MANIFOLD	1
31	DE13223	GLYCOL PUMP	1
119	004228	VALVE, NON-RETURN, 1/8MNPT -> 4MM	1
120	004230	VALVE, NON-RETURN, 6MM -> 1/8MNPT	1
124	005112	O-RING, BUNA N, #007	1

Launcher Drawings and Parts Lists (continued)



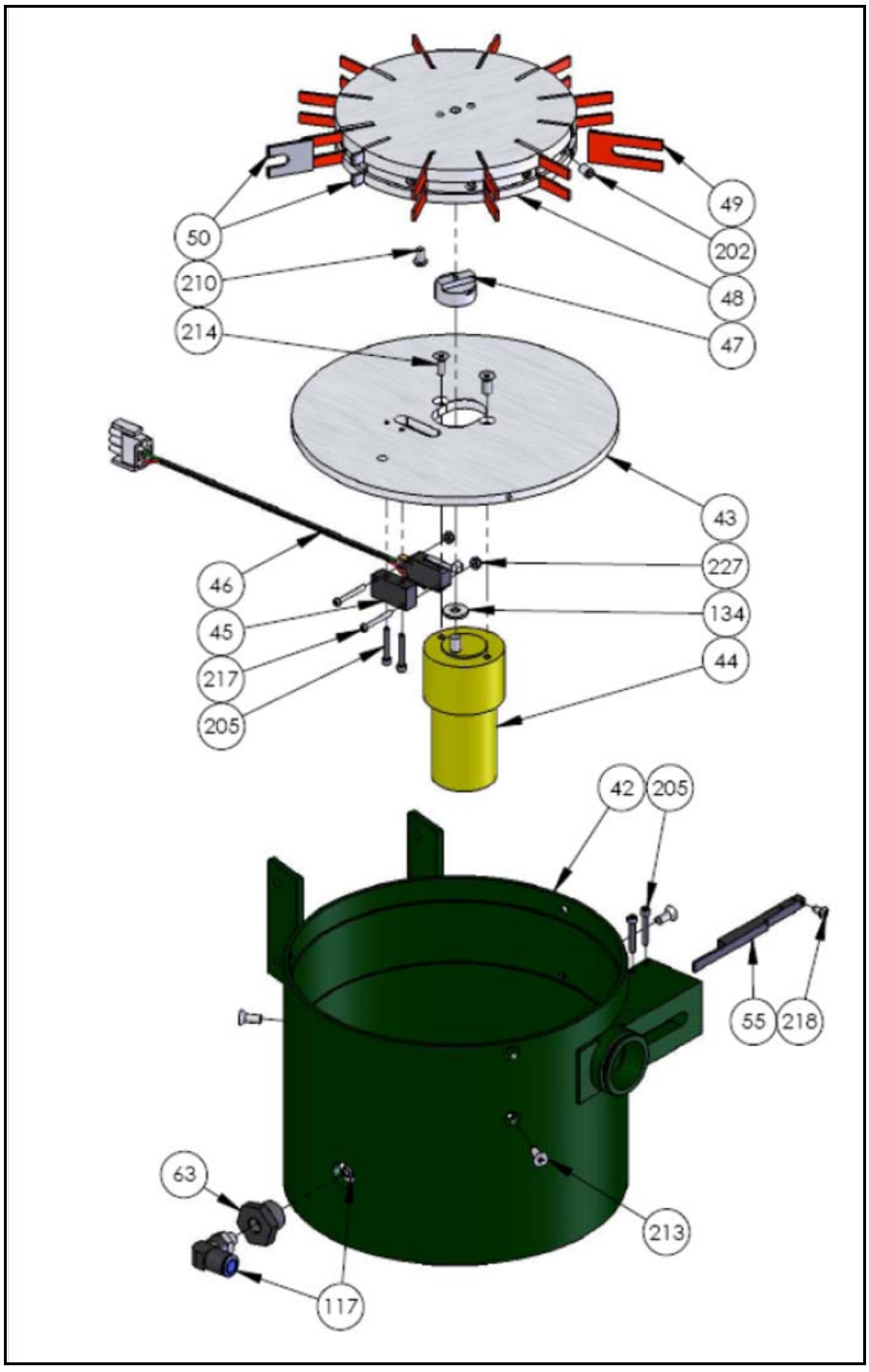
ITEM	PART NUMBER	DESCRIPTION	QTY
12	DE14201	RECEIVER	1
13	DE14202	UPPER FRAME	1
14	DE14203	LOWER FRAME	1
16	DE14210	TRUNNION BLOCK	1
21	DE14230	NEEDLE SHUTTLE	1
22	DE14231	SHUTTLE GUIDE	2
23	DE14232	NEEDLE ASSEMBLY	1
116	003643	ELBOW, STR90, 1/8NPT x 4MM	1
133	005104	BUSHING, ST, NY, 1/4 x 1/2 x 11/16	2
201	000525	SETSCREW, 10-32 x 1/4, CUP, SS	1
203	005238	SCREW, 8-32 x 1/4, LSC, SS	1
206	000418	SCREW, 8-32 x 3/8, SC, SS	12
215	000444	SCREW, 8-32 x 3/8, FSC, SS	4
224	000557	BOLT, 1/4 x 3/4 x 10-32, SH, HX, SS	2

Hopper Drawings and Parts Lists



ITEM	PART NUMBER	DESCRIPTION	QTY
51	DE14533	SELECTOR PLATE	1
52	DE14534	CONICAL DEFLECTOR	1
53	DE14540	HOPPER TUBE	1
54	DE14541	OUTLET TUBE	1
56	DE13526	LOCATE PIN, HOPPER	2
62	DE14970	COVER, HOPPER	1
208	000552	SCREW, 10-24 x 2-1/4, SC, SS	1
212	000448	SCREW, 10-24 x 1/4, MS, FHPH, SS	3

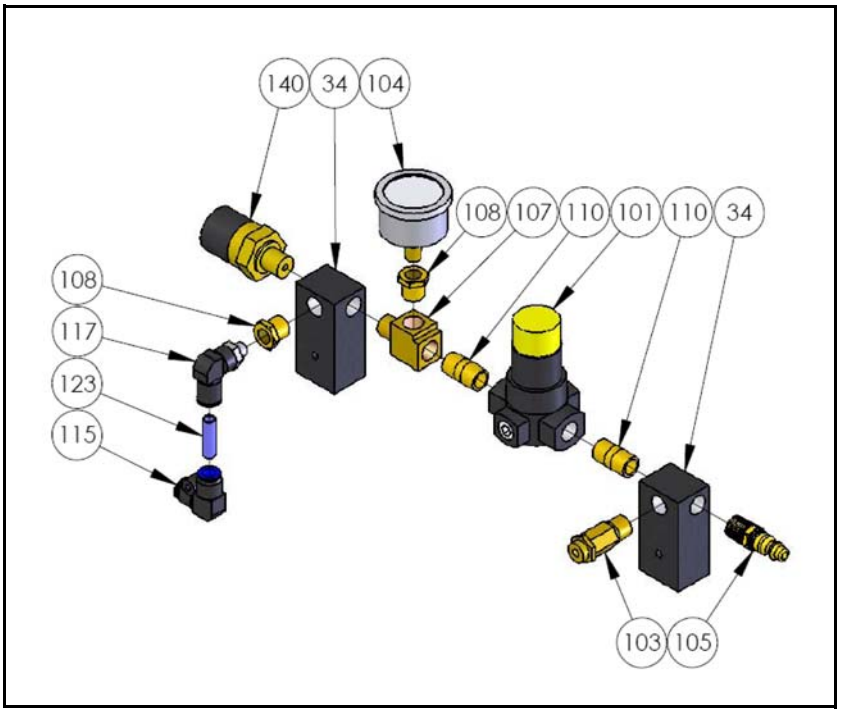
Hopper Drawings and Parts Lists (continued)



Hopper Parts List (2)

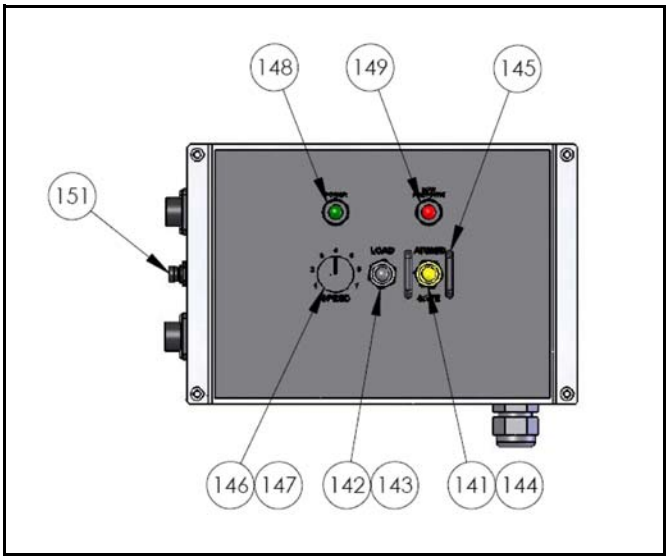
ITEM	PART NUMBER	DESCRIPTION	QTY
42	DE14510	HOPPER BASE	1
43	DE14520	MOTOR PLATE	1
44	DE14521	MOTOR, HOPPER	1
45	DE14522	BLOCK,MICROSWITCH	1
46	DE14523	LIMIT SWITCH, HOPPER	1
47	DE14524	MOTOR COUPLING	1
48	DE14530	ROTOR	1
49	DE14531	VANE, FLEXIBLE	12
50	DE14532	VANE, RIGID	2
55	DE14542	EXTRACTOR	1
63	DE14302	ADAPTER, HOPPER	1
117	003649	ELBOW, STR90, 1/8NPT x 8MM	2
134	005138	BUSHING, ST, NY, 1/4 x 5/8 x 1/16	1
202	005151	SCREW, 1/4-20 x 3/8, SET, CUP, SS	12
205	000414	SCREW, 6-32 x 7/8, SC, SS	4
210	000513	SCREW, 10-24 x 3/8, BC, SS	1
213	000446	SCREW, 10-24 x 1/2, MS, FHPH, SS	3
214	000538	SCREW, 10-32 x 1/2, MS, FHPH, SS	2
217	000477	SCREW, 4-40 x 1, MS, PNPH, SS	2
218	000481	SCREW, 6-32 x 1/4, MS, PNPH, SS	1
227	001657	NUT, NYL, 4-40, HX, SS	2

Gas Manifold Drawing and Parts List



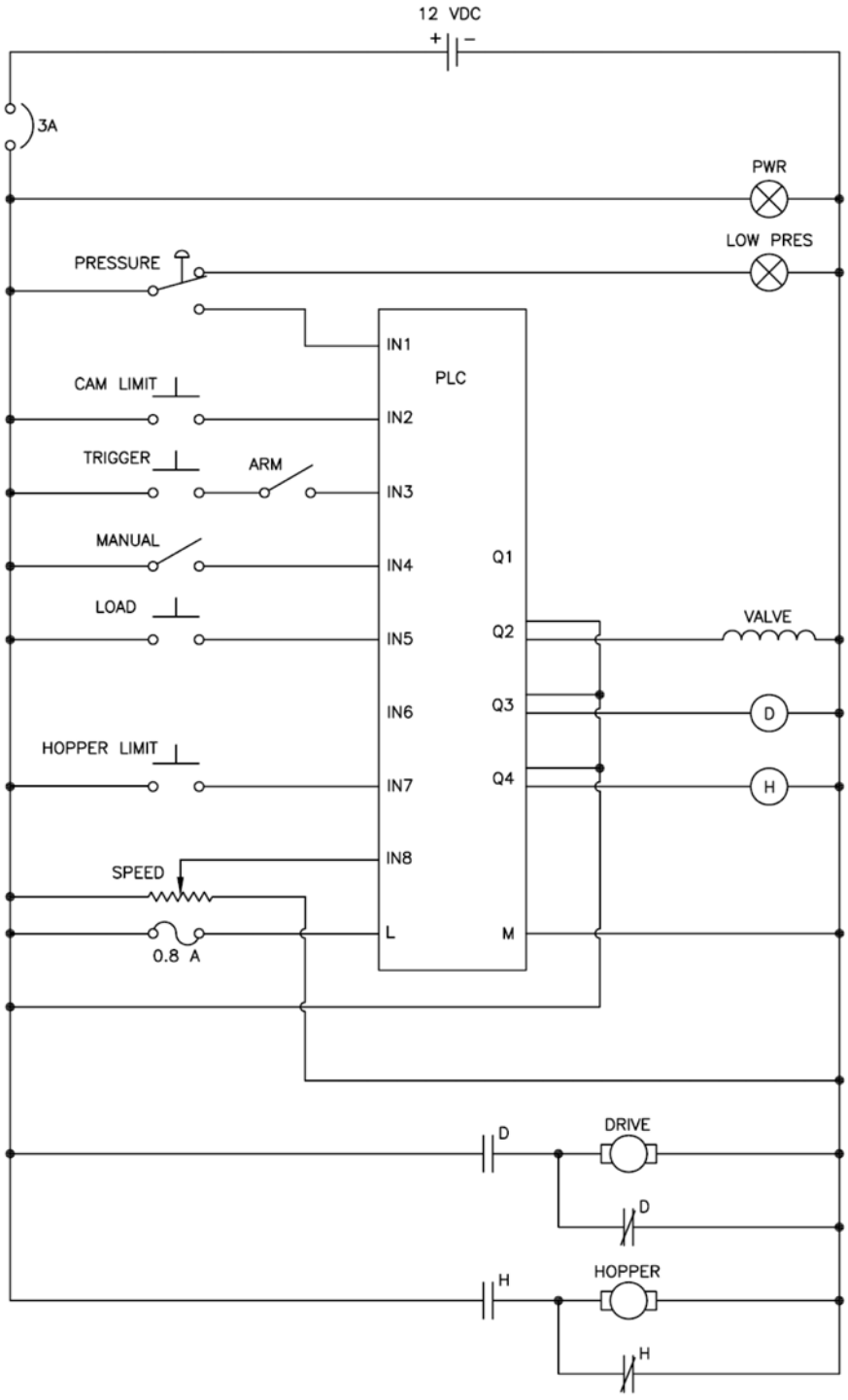
ITEM	PART NUMBER	DESCRIPTION	QTY
34	DE14301	GAS MANIFOLD	1
101	005131	REGULATOR, GAS, 2-125PSI, 1/4 NPT	1
103	005133	VALVE, RELIEF, 25-200PSI, 1/4NPT	1
104	005132	GAUGE, PRES, 0-160PSI, 1/8 NPT	1
105	003639	ADAPTER, QUICK x 1/4MNPT	1
107	003640	TEE, STR, 1/4MNPT x 1/4FNPT	1
108	003631	BUSHING, 1/4MNPT x 1/8FNPT, BR	2
110	003636	NIPPLE, 1/4NPT x CLS, BR	2
115	003642	ELBOW, 8MM	1
117	003649	ELBOW, STR90, 1/8NPT x 8MM	1
123	004220	TUBE, PUN, 8MM x 1.25MM, BLU	1 IN
140	001310	PRES SWITCH, SPDT, 0-30PSI, 1/4 NPT	1

Control Panel Drawing and Parts List

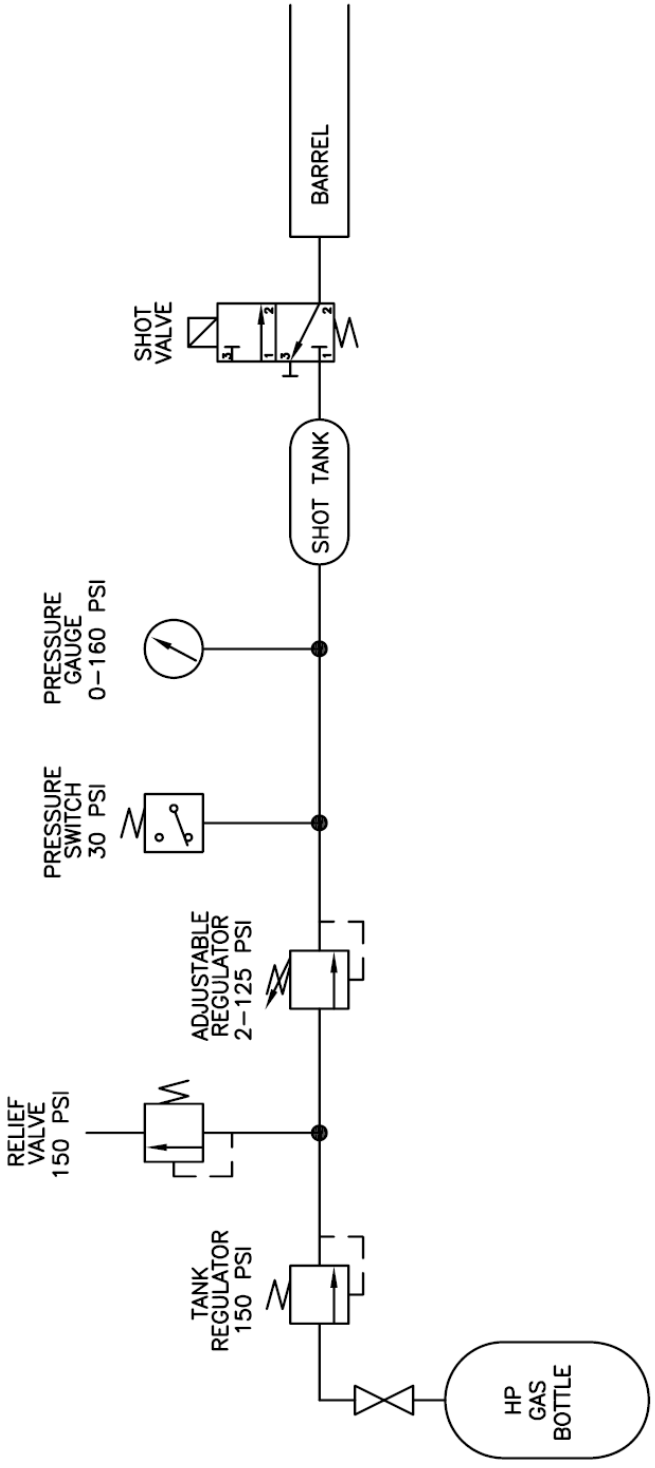


ITEM	PART NUMBER	DESCRIPTION	QTY
141	001369	SWITCH, TOGGLE, SPST, 15A, 125VAC	1
142	005095	SWITCH, TOGGLE, SPST, 20A, 125VAC	1
143	001355	BOOT, TOGGLE SWITCH, 15/32, GRY	1
144	006022	BOOT, TOGGLE SWITCH, 15/32, YEL	1
145	005139	SWITCH GUARD, 1 x 1, 4-40	2
146	005094	POTENTIOMETER, 5K OHM, 1/2 W	1
147	001368	KNOB, ABS, 0.85 DIA, 1/4 SHAFT	1
148	001303	LED, 12VDC, 700MCD, GRN	1
149	001302	LED, 12VDC, 700MCD,RED	1
151	000896	BREAKER, CIRCUIT, 3A	1

Simplified Electrical Schematic



Simplified Pneumatic Schematic



Parts Cross Reference List

The purpose of this section is to provide a cross reference to alternate parts suppliers for the non-proprietary components used in the dispenser. The item number in the table corresponds to the item number used in the expanded drawings in this section of the manual.

Item	Description	Supplier	Part Number
101	REGULATOR, GAS, 2-125PSI, 1/4 NPT	McMaster Carr	41735K11
103	VALVE, RELIEF, 25-200PSI, 1/4NPT	McMaster Carr	50265K23
104	GAUGE, PRES, 0-160PSI, 1/8 NPT	McMaster Carr	9780T11
105	ADAPTER, QUICK x 1/4MNPT	Greenline	CP21B
106	ELBOW, STR90, 3/8NPT, BR	Greenline	G1698B-06-06
107	TEE, STR, 1/4MNPT x 1/4FNPT	Greenline	G16T88B-04-04
108	BUSHING, 1/4MNPT x 1/8FNPT, BR	Greenline	G0816B-04-02
109	BUSHING, 3/8MNPT x 1/4FNPT, BR	Greenline	G0816B-06-04
110	NIPPLE, 1/4NPT x CLS, BR	Greenline	G1616BC-04
111	NIPPLE, 3/8NPT x 2, BR	Greenline	G1616B-06X2
112	PLUG, 3/8 MNPT, HXHD, BR	Greenline	G1600B-06
113	ADAPTER, 1/8NPT x 8MM	Festo	153004
114	ADAPTER, QUICK, 1/8MNPT x 6MM	Festo	153420
115	ELBOW, 8MM	Festo	153072
116	ELBOW, STR90, 1/8NPT x 4MM	Festo	153334
117	ELBOW, STR90, 1/8NPT x 8MM	Festo	153048
119	VALVE, NON-RETURN, 1/8MNPT -> 4MM	Festo	153446
120	VALVE, NON-RETURN, 6MM -> 1/8MNPT	Festo	153449
121	TUBE, PUN, 4MM x 0.75MM, RED	Festo	178410
122	TUBE, PUN, 6MM x 1MM, RED	Festo	178411
123	TUBE, PUN, 8MM x 1.25MM, BLU	Festo	159666
124	O-RING, BUNA N, #007	McMaster-Carr	2418T113
125	O-RING, BUNA N, #119	McMaster-Carr	2418T144
126	VENT, 1/8MNPT,BR	McMaster-Carr	9833K21
127	SPRING, COMP, 0.420 x 0.051 x 2.25	Century Spring	71395
128	SPRING, COMP, 0.625 x 0.054 x 2.75	McMaster-Carr	9657K127
129	SPRING, COMP, 1.500 x 0.091 x 2.63	Century Spring	S-1263
130	SPRING, EXT, 0.188 x 0.015 x 20.0	McMaster Carr	9665K53
132	BUSHING, FL, BRZ, 1/4 x 3/8 x 3/8	McMaster-Carr	6338K412
133	BUSHING, ST, NY, 1/4 x 1/2 x 11/16	McMaster-Carr	94638A251
134	BUSHING, ST, NY, 1/4 x 5/8 x 1/16	McMaster-Carr	96371A202
135	GRIP, 1/4 x 1 x 4, RBR, BLK	McMaster-Carr	9692K15
136	HANDLE, ADJ, MALE, 1/2-13 x 1-3/16	McMaster-Carr	6271K46
137	KNOB, MALE, 1/4-20 x 1-3/4	McMaster-Carr	6085K310
138	KEY, MACHINE, C1018, SQ, 1/8 x 3/4	McMaster-Carr	98870A100
140	PRES SWITCH, SPDT, 0-30PSI, 1/4 NPT	Newark	42M0461
141	SWITCH, TOGGLE, SPST, 15A, 125VAC	Newark	04M4765
142	SWITCH, TOGGLE, SPST, 20A, 125VAC	Digikey	480-3068-ND
143	BOOT, TOGGLE SWITCH, 15/32, GRY	Newark	30F000
144	BOOT, TOGGLE SWITCH, 15/32, YEL	Newark	95B1098
145	SWITCH GUARD, 1 x 1, 4-40	McMaster Carr	1568A41

Parts Cross Reference List (continued)

146	POTENTIOMETER, 5K OHM, 1/2 W	Digikey	CT3012-ND
147	KNOB, ABS, 0.85 DIA, 1/4 SHAFT	Newark	91F2244
148	LED, 12VDC, 700MCD, GRN	Newark	93K6718
149	LED, 12VDC, 700MCD,RED	Newark	93K6719
150	RELAY, SPDT, 12VDC, 40A	Newark	30M9185
151	BREAKER, CIRCUIT, 3A	Flame	2TC2-3
152	FUSE, 1/4 x 1-1/4, 0.8A, 250V	Newark	48K9415
200	SETSCREW, 8-32 x 1/4, CUP, SS	Fastenal	73225
201	SETSCREW, 10-32 x 1/4, CUP, SS	Fastenal	73245
202	SCREW, 1/4-20 x 3/8, SET, CUP, SS	Fastenal	73258
203	SCREW, 8-32 x 1/4, LSC, SS	Fastenal	171396
204	SCREW, 4-40 x 5/8, SC, SS	Fastenal	73405
205	SCREW, 6-32 x 7/8, SC, SS	Fastenal	73417
206	SCREW, 8-32 x 3/8, SC, SS	Fastenal	73421
207	SCREW, 8-32 x 1/2, SC, SS	Fastenal	73422
208	SCREW, 10-24 x 2-1/4, SC, SS	Fastenal	73433
209	SCREW, 1/4-20 x 3/4, SC, SS	Fastenal	73480
210	SCREW, 10-24 x 3/8, BC, SS	Fastenal	73742
211	SCREW, 1/4-20 x 1/2, BC, SS	Fastenal	73767
212	SCREW, 10-24 x 1/4, MS, FHPH, SS	Fastenal	72660
213	SCREW, 10-24 x 1/2, MS, FHPH, SS	Fastenal	72662
214	SCREW, 10-32 x 1/2, MS, FHPH, SS	Fastenal	72682
215	SCREW, 8-32 x 3/8, FSC, SS	Fastenal	73851
216	SCREW, 4-40 X 3/8, MS, PNPH, SS	Fastenal	72482
217	SCREW, 4-40 x 1, MS, PNPH, SS	Fastenal	72494
218	SCREW, 6-32 x 1/4, MS, PNPH, SS	Fastenal	72383
219	SCREW, 8-32 X 3/8, MS, PNPH, SS	Fastenal	72396
220	SCREW, 10-24 X 3/8, MS, PNPH, SS	Fastenal	72438
221	SCREW, 10-24 x 3/4, MS, PNPH, SS	Fastenal	72442
222	BOLT, 3/8-16 x 1, HX, SS	Fastenal	77105
223	BOLT, 1/4 x 7/16 x 10-32, SH, HX, SS	McMaster Carr	93996A845
224	BOLT, 1/4 x 3/4 x 10-32, SH, HX, SS	McMaster Carr	94035A540
225	U-BOLT, 1/4-20 x 1, PL	Fastenal	42004
226	NUT, JAM, 3/4-16, HX, SS	Fastenal	70837
227	NUT, NYL, 4-40, HX, SS	Fastenal	70854
228	NUT, NYL, 8-32, HX, SS	Fastenal	70856
229	NUT, JAM, NYL, 10-24, HX, SS	Fastenal	129154
230	NUT, FLNG, NYL, 1/4-20, PL	Fastenal	37337
231	NUT, CHNL, 3/8-16, PL	McMaster-Carr	3259T32
232	NUT, WING, 1/4-20, SS	Fastenal	70910
233	INSERT, THREAD, 1/4-20 x 3/8-24	McMaster-Carr	94165A435
234	WASHER, FLAT, 0.20 x 0.50 x 0.06, SS	Fastenal	71010
235	WASHER, FLAT, 0.51 x 0.88 x 0.06, SS	McMaster-Carr	98017A210
236	WASHER, FLAT, 0.56 x 1.25 x 0.06, PVC	McMaster-Carr	95611A033
237	WASHER, FLAT, 0.56 x 1.38 x 0.11, SS	Fastenal	71022
238	WASHER, LOCK, 3/8, SS	Fastenal	71067

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Section 7: Specifications

Dispenser Specifications

Min. launch rate	12 eggs per min.
Max. launch rate	40 eggs per min.
Range	75 yds. 70 m
Hopper capacity	450 eggs
Power Supply	12 VDC
Operational weight	49.0 lbs 22 kg
Glycol Volume	0.26 US gal 1.0 liter

Dragon Egg Specifications

Dragon Egg Weight	.17 oz 4.8 g
Box of 1,000 Dragon Eggs	12.1 lbs 5.5 kg
Injection to the first combustion (smoke)	25 seconds @ 55^{o} F (13^{o} C)
Injection to full combustion (flame)	35 seconds @ 55^{o} F (13^{o} C)
Total useful combustion time	80 seconds @ 55^{o} F (13^{o} C)

Important Note

Increasing ambient temperatures will decrease the ignition delay time.

Safety

Although stable, prior to priming with ethylene glycol, the material within the sealed Dragon Egg is classified as a hazardous substance and, as such, must be handled and transported in the correct manner. Potassium permanganate ($KMnO_4$) is a strong oxidizer and will react violently with certain chemicals as indicated below. In addition, potassium permanganate should not be inhaled or otherwise absorbed or come in contact with the skin.

WARNING

There are dangerous compounds that must be isolated from the potassium permanganate in Dragon Eggs during shipping and storage. These compounds include:

Antimony	Aluminium Carbide
Arsenic	Ethylene Glycol
Glycerol	Hydrogen Trisulphide
Hydrogen Peroxide	Phosphorous
Sulphur	Sulphuric Acid
Titanium	

A full MSDS sheet for the chemical is included in Appendix A.

Dragon Egg Shipping Box Certifications

- The complete package has been tested to meet the requirements of ISTA procedure 1A.
- The complete package has been tested to meet the requirements of UN 4G combination packaging.

Section 8: MSDS Sheets

Potassium Permanganate

ClearTech Potassium Permanganate MSDS

PRODUCT INFORMATION

Product Identifier	Potassium permanganate
Chemical Name	Potassium permanganate
Synonym(s)	Permanganic acid, potassium salt; Condy's crystals; Cairox; chameleon mineral; permanganate of potash.
Chemical Family	Manganese compound
Molecular Formula	$KMnO_4$
Product Use	Oxidizing and bleaching, disinfectant, deodorizer, remove iron and manganese from water, tanning, algicide, dye ingredient.

Supplier/Manufacturer	Address	Emergency Telephone
ClearTech	2302 Hanselman Ave., Saskatoon, SK S7L 5Z3 Canada *See "Preparation Information" for a list of regional offices.*	(306) 664-2522

TDG/WHMIS INFORMATION

Shipping Name: Potassium Permanganate

PIN	Class	Group	WHMIS
UN1490	5.1(9.2)	II	C, E

MAIN/HAZARDOUS INGREDIENTS

Ingredients	Weight %	CAS #
Potassium Permanganate	99	7722-64-7

PHYSICAL DATA

State	Solid
Odour and Appearance	Odourless dark purple to bronze crystals
Odour Threshold	Not applicable
Molecular Weight	158.04
Boiling Point	Not applicable
Freeze/Melting Point	~240°C decomposes
Specific Gravity (water=1)	2.703
Bulk Density	166.8 lb/ft^3
Vapour Density (air=1)	5.40
Vapour Pressure	Data not available
Evaporation Rate	Data not available
% Volatiles by Volume	0% at 21°C
pH	Data not available
Solubility in Water	70 g/L
Water/Oil Distribution Coefficient	Data not available

FIRE AND EXPLOSION DATA

Conditions of Flammability

Not applicable

Explosion Hazards

Strong oxidizer. Contact with other material may cause fire or explosion.

Flash Point and its Method of Determination

Not applicable

Auto-Ignition Temperature

Not applicable

Upper Flammable Limit (% by vol)

Not applicable

Lower Flammable Limit (% by vol)

Not applicable

Hazardous Combustion Products

Thermal decomposition yields toxic fumes of manganese oxides.

Means of Extinction

Use water spray.

Special Fire Fighting Procedures

Fire fighters should wear appropriate PPE and SCBA. Move containers from fire area if it can be done without risk. Use water to keep fire exposed containers cool.

REACTIVITY DATA

Stability

Stable under normal conditions.

Incompatibility

Organic materials, combustible materials, reducing agents, strong acids, peroxides, alcohols, ammonium nitrate, ammonium perchlorate, dichloromethylsilane, antimony, arsenic, phosphorous, sulphur, titanium, carbon, iron salts, mercury salts, hypophosphites, hyposulphites, sulphites, oxalates, halides, hydrides, arsenites, and heat.

Reactions

Contact with hydrochloric acid liberates chlorine. Explodes when in contact with sulphuric acid, peroxides, nitric acid, alcohols, arsenic, phosphorous, sulphur, titanium, and anhydrides. Contact with other incompatibles results in ignition and rapid burning.

Polymerization

Will not occur

HEALTH HAZARD DATA

Inhalation

Excessive inhalation is irritating to the nose, throat, and upper respiratory tract. It may cause central nervous system depression, spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of over-exposure include burning, coughing, laryngitis, shortness of breathe, headache, nausea, and vomiting.

Skin Contact/Absorption

Severe irritation or burns.

Eye Contact

Severe irritation or burns. Usually where the chemical touches the eye a hardened, ulcer-like dark-brown injury develops. Swelling of the eyelid and conjunctiva as well as bleeding can occur. Permanent eye damage is possible.

Ingestion

Ingestion causes burns to the mouth and throat and severe gastro-intestinal distress. Symptoms include nausea, vomiting, abdominal pain, a slowing of the pulse, and shock with a fall in blood pressure. Generally ingestion of concentrations up to 1% cause burning of the throat, nausea, vomiting, and abdominal pain. Ingestion of concentrations from 1% to 3% cause anemia and swelling of the throat with possible suffocation. Ingestion of concentration from 3% to 5% may cause kidney damage.

Chronic/Acute Effects

Repeated intake of manganese compounds by ingestion & inhalation can result in chronic manganese poisoning characterized by impairment of the central nervous system. Early symptoms include sluggishness, sleepiness, and weakness of the legs. Advances cases show uncontrollable laughter, spastic gait, emotional disturbances, fixed facial expressions, and falling down while walking. A higher incidence of pneumonia has been found in workers exposed to some airborne manganese compounds. Men exposed to manganese dusts showed a decrease in fertility. Target organs: respiratory system, central nervous system, blood, and kidneys.

Exposure Limits

ACGIH TLV = 0.5 mg/m^3

ACGIH TLV = 0.2 mg/m^3 as manganese

OSHA PEL = 5 mg/m^3 as manganese

Irritancy

Strong irritant or corrosive.

Carcinogenicity

Not considered to be carcinogenic by IARC or ACGIH.

Reproductive Toxicity

May have adverse reproductive effects.

Teratogenicity

Not considered a teratogen in "Dangerous Properties of Industrial Materials" 7th edition.

Sensitization

Repeated contact may cause sensitization in some individuals.

Mutagenicity

Failed tests for mutagenicity by EPA Genetox program in 1988. RTECS cites it has having possible mutagenic effects.

Synergistic Materials

Data not available

Animal Toxicity Data

LD_{50} (oral, rat) = 1090 mg/kg

LD_{50} (oral, mouse) = 2157 mg/kg

LD_{50} (oral, guinea pig) = 1151 mg/kg

LD_{lo} (oral, human) = 100 mg/kg

PREVENTATIVE MEASURES

Respiratory Protection

None required where adequate ventilation exists. If airborne concentration exceeds the TLV by up to 10 times a half face particulate respirator is required. For airborne concentrations up to 50 times the TLV, a full face NIOSH approved dust/mist respirator is required. For higher levels or where the concentration is unknown a self-contained breathing apparatus is recommended.

Skin Protection

Wear impervious protective clothing including boots, gloves, lab coat, apron, or coveralls as appropriate to prevent contact.

Eye/Face Protection

Chemical goggles are to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.

Special Handling Procedures

Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid situations that could lead to harmful exposure.

Storage Requirements

Keep container tightly closed. Store separately and away from flammable and combustible materials.

Engineering Controls

Mechanical ventilation (dilution or local exhaust), process or personnel enclosure, and control of process conditions. Supply sufficient replacement air to make up for air removed by exhaust systems.

FIRST AID MEASURES

Inhalation

Remove to fresh air. If not breathing give artificial respiration. If breathing is difficult give oxygen. Contact physician.

Skin Contact

Flush with plenty of water for 20 minutes. Remove contaminated clothes and wash thoroughly before reuse. If irritation persists, flush again. Obtain medical attention.

Eye Contact

Flush eyes with water for at least 20 minutes. If irritation persists, flush repeatedly. Obtain medical attention.

Ingestion

Call physician. If swallowed do not induce vomiting. If conscious give large amounts of water. Follow with diluted vinegar, fruit juice or whites of eggs beaten with water.

Other Information

None

ENVIRONMENTAL PROTECTION DATA

Steps in the Event of a Leak or Spill

Wear appropriate respirator or SCBA and full protective clothing. Remove all sources of ignition. Keep combustibles away from spilled material. With a clean shovel, carefully place material into clean dry containers and remove from area. Flush area with plenty of water.

Environmental Effects

May be harmful to aquatic life.

LC_{50} (goldfish, 96 hours)=3.6mg/L

LC_{50} (channel catfish, 96 hours)=0.75mg/L

Deactivating Chemicals

Neutralize with dilute solutions of sodium sulphite, sodium metabisulphite, sodium bisulphite, or sodium thiosulphate.

Waste Disposal Methods

Dispose in accordance with all federal, provincial, and local regulations.

PREPARATION INFORMATION

References

Various Manufacturers' MSDS

Date Prepared/Revised

May 14, 2001

Please obtain **MSDS updates** for this product from your regional ClearTech office.

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The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment.

The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

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