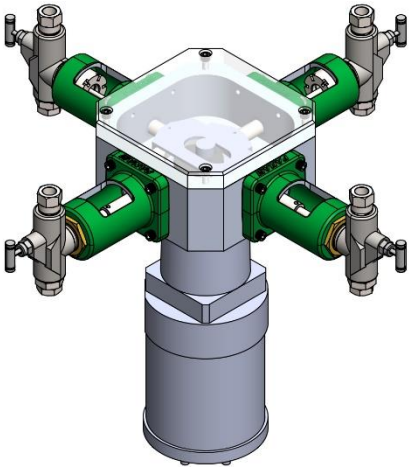
CROSSFIRE Ultra-Low Power Chemical Injection Pump

Introduction

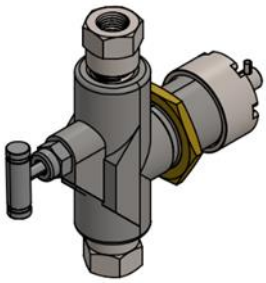


The LCO Technologies *CROSSFIRE* Chemical Injection pump is an ultra-low power device that is designed to reduce chemical costs, maintenance costs and methane emissions. It is a durable, energy-efficient solution like no other that can run for weeks – not days, even in areas with limited sunlight. It can be configured with one to four fluid ends, allowing you to replace up to four pneumatic pumps with one unit.

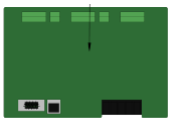
Features

The *CROSSFIRE* chemical injection pump includes the following key features and benefits:

- Eliminates methane venting from chemical injection
- Precise chemical injection
  - Delivers chemical proportionate to flow
  - Consistent chemical dispersion rate
  - Delivers <1L/day to 720 L/day up to 10,000 psi
- High system autonomy
  - Ultra-low power chemical injection pump that can run weeks, not days
  - Most applications use less power than an 8-Watt LED light bulb
- Standard 5100 series fluid ends for field familiarity with proprietary One N' Done packing
  - One N' Done seal has superior chemical compatibility and resiliency in a broad range of applications
  - Multi-purpose, single piece, spring loaded seal eliminates frequent site trips to adjust packing compression and dramatically reduces replacement of packings
  - Industry familiar chevron vee packings also available
- Comes complete with a smart controller that has MODBUS communications built in as a standard
  - Option to upgrade to an advanced controller that has standalone automation capabilities and Ethernet MODBUS communications
  - RS485 or Ethernet
- User friendly operator and technician interface that is password protected
  - Mobile and desktop applications
  - Bluetooth accessories available for wireless connection and control
- CSA Certified Class 1 Division 1 Motor Assembly
  - Efficient, compact, and powerful permanent rare earth magnet motor
  - Variable speed drive
  - Lifetime lubrication, no maintenance required
- Custom designed gearbox with double support mechanism and closed casing
  - Increase durability, contaminant free
  - Lifetime lubrication, no maintenance required



Smart Controller Features



- Sophisticated Field Oriented Control (FOC) scheme used to drive the 3-phase rare earth permanent magnet BLDC motor for maximum performance and power efficiency
- Sensorless design with no Hall Effect sensor
- Only 3 (plus ground) standard conductor flex armour cables required to power the motor
    - Cable length: maximum 60ft long (gauge 10)
- Permanent record of operating data
    - Including total stroke counts, volume injected, system status and operating conditions
    - Time and date stamped
- Onsite firmware updates available for controller version V38 or later
    - Firmware downloadable off the LCO Technologies website
- Built in protection schemes to protect equipment such as: ground-fault, over-voltage, over-current, under-voltage, short-circuit, reverse polarity from power supply, unbalanced loading due to broken / loose motor power lines, and fast logic to shut down and isolate motor in the event of faults
- Direction of motor rotation is reversed automatically every month to minimize natural wear and tear

Process Control and Programmable Logic:

- Specific programmable logic and control algorithm can be developed to meet customer needs
    - Fail-safe motor soft stop feature
    - Freeze protection to automatically increase volume injected based on ambient temperature
- Serial communication to a data modem, RTU or flow computer, Bluetooth module, or HMI
    - Supports standard MODBUS/RTU protocol for remote control and monitoring
- Ethernet MODBUS/TCP communication available on Advanced controllers V38 or later
    - 124 registers per poll for quick, efficient communications
- Built-in process control functions such as toggle switch control and timer control
- Multiple digital and analog IO's to transmitters and final control elements

Software Interface

LCO Technologies' *CROSSFIRE* Software Interface is a tool that allows for easy configuration and monitoring of the controller for the *CROSSFIRE* platform. Operators and technicians can connect to the controller via the RS232 port to either a computer for hardwired connection or use a RS232 Bluetooth LE serial dongle for wireless connection to a laptop or mobile device.

The software is simple and intuitive, while allowing users to configure even the most advanced features. The user experience is the same on both desktop and mobile versions and the software automatically pushes any changes made in the interface to the MODBUS registers.

Software requirements:

- A computer with either Windows 10 or later
    - 512 MB RAM
    - 500 MB hard drive space
- Mobile devices:
    - iOS 12 or later
    - Android 7 or later

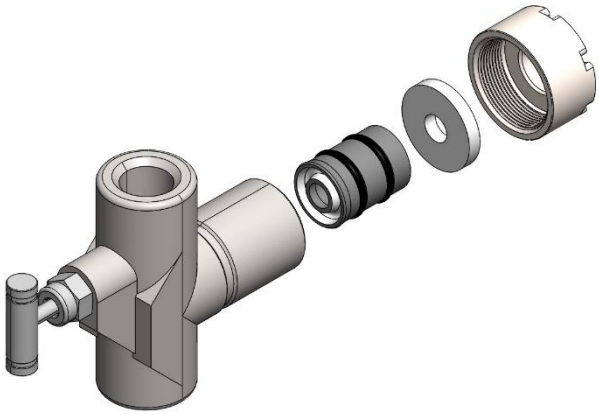
Fluid End Packing and Soft Goods

Proprietary One N' Done Packing

LCO Technologies has developed a proprietary seal compatible with 5100 series fluid ends that provides superior chemical compatibility and resiliency in a broad range of applications. This multi-purpose, single piece, spring loaded seal removes the need to manually adjust jam nut compression and works in both high-and low-pressure applications. The state-of-the-art seal greatly reduces friction on the plunger, reducing wear and increasing electrical efficiency, all while sealing better than a traditional chevron v-packing. The precision manufactured seal is designed to be impervious to dusty environments and dramatically reduces maintenance, service, and replacement of fluid end parts.

Key Features:

- One piece design for long lifespan and superior seal
- Spring loaded
  - No adjustments required with changes in ambient temperature
- No jam nuts or maintenance
- Increases electrical efficiency
- Superior chemical compatibility
  - Kalrez alternative at lower price point
  - Capable of handling aggressive silicone-based inhibitors
- Standard packing for all applications with two O-ring options available
  - Reduce spare parts



Temperature Rating:

O-Ring Material	LCO Part Number Identifier	Min Temperature	Max Temperature
LCO Proprietary Blend	XF1	-65°C	+150°C
High Temperature FFKM	XF2	-7°C	+230°C

Maximum Operating Conditions:

Fluid End Size	Maximum Pressure Rating for Fluid End and One N' Done Packing (psi)	Injection Range for Pump* (L/day)
1/2"	2000 PSI	4.6 L/day - 171.4 L/day
3/8"	3000 PSI	2.6 L/day - 96.4 L/day
1/4"	6000 PSI	1.2 L/day - 42.9 L/day
3/16"	6000 PSI	0.7 L/day - 24.1 L/day

**Note: The pumping volumetric efficiency of the fluid end will decrease with an increase in discharge pressure. Values listed are theoretical and based on one fluid end.*

Comparison: One N' Done Packing vs Chevron V-Packing

Features	One N' Done	V-Packing
Compatible with 5100 Series Fluid End	✓	✓
Lifespan*	6-12 Months	1-6 Months
Pressure Range	100-6,000 psi	0-3,000 psi common 3,000+ limited options
# Of pieces	Single Piece	3+ Pieces
Maintenance	None	Frequent Adjustment Required
Lubrication	None	Required
Chemical Applications	Good for All Applications Including Caustics and Acids	Very Application Specific with a Wide Variety of Expensive Options
Technology	State-of-the-Art Sealing Technology	Decades Old Technology
Resistant to Foreign Particles	✓	-
Low Friction	✓	-
Low Wear	✓	-
Can Survive Dry Operation	✓	-
Set It and Forget It*	✓	-

**Lifespan of One N' Done seal is dependent upon application*

Chevron V-Packing

Standard 5100 series chevron v-packings are also available for the CROSSFIRE fluid ends and pump. Operating conditions for the most common materials are listed below, however more materials are available upon request.

Temperature Rating:

Material	Minimum Temperature	Maximum Temperature
Buna N	-40 °C	+120 °C
Viton	-26 °C	+204 °C
Teflon	-268 °C	+232 °C
Flurosilicone	-56 °C	+204 °C
Rockhard	-40 °C	+120 °C

Maximum Operating Conditions:

Fluid End Size	Maximum Pressure Rating for Packing (psi)						Injection Range for Pump* (L/day)
	Zebra Buna/PTFE	Buna	Teflon	Viton	Flurosilicone	RockHard	
1/2"	2500	2500	3000**	2500	3000**	3000**	4.6 L/day - 171.4
3/8"	4000	3000	3000	3000	3000	6000**	2.6 L/day - 96.4
1/4"	6000	3000	3000	3000	3000	6000**	1.2 L/day - 42.9
3/16"	6000	3000	3000	3000	3000	6000**	0.7 L/day - 24.1

**Note: The pumping volumetric efficiency of the fluid end will decrease with an increase in discharge pressure. Values listed are theoretical and based on one fluid end.*

*** Note: Contact LCO Technologies for specific pump data and special configuration required for high pressure applications.*

Hazardous Area Certifications

The *CROSSFIRE* has the following hazardous certifications:

- The Explosion Proof Motor Assembly (Model **LCOM-1000**)
  - CSA certified to Class 1 Division 1 Groups CD T6
    Rated input 24 VDC, 9.9 Amps, 750 rpm maximum, Class B, Continuous Stall Current 11 A, Rated Output Power 190W
    Ambient Temperature -40°C to +60°C
- The Smart Controller (Model **LCOC-1000-A** and **Model LCOC-1000-B**)
  - CSA certified to Class 1, Division 2, Groups CD T4
    Rated Input 24 VDC, Vac, 9.9 Amps
    Rated Output 24 VDC, 9.9 Amps
    Ambient Temperature: -40°C to +60°C

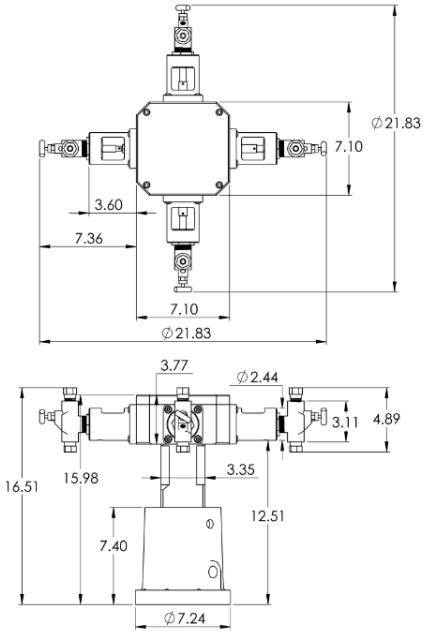
Controller Specifications

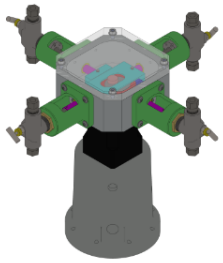
CPU Module		
Processor	Powerful microprocessor (8 nanosecond clock speed)	
Memory	SRAM – 64 KB	
	Flash: 512 KB	
	Onboard flash: 64MB (Advanced Model only)	
Clock	Crystal oscillator: 120 MHz	
	Battery backed Real-Time clock	
	Watchdog timer	
Communications		
Ports	COM 1	3-wire RS232 for data modem or Bluetooth pole-top module Maximum cable length: 130 ft.
	COM 2	RS232 DB9 connector
		Supports operator interface via a serial cable or with a Bluetooth dongle
		Maximum cable length: 25 ft. Maximum Bluetooth range: 50 ft.
	Modbus COM	2 or 3-wire RS485 for RTU, SCADA and HMI Maximum cable length: 4000 ft.
		Ethernet 10/100 - Maximum cable length: 350 ft (Advanced model only) MODBUS/TCP 124 Registers per poll MODBUS/RTU on RS485 = 8 registers per poll
Protocols	Serial Modbus/RTU slave support on the RS485 port	
	Serial communication in ASCII on COM1 and COM2	
LED		
	Advanced	16 LED's to indicate system status, digital IO's and COM port traffic
	Basic	12 LED's to indicate system status, digital IO's and COM port traffic

Reset Button		
	1 reset button to reboot controller. Press with a pin	
IO Specs		
Controller	Advanced	4 Digital Inputs, 4 Digital Outputs, 3 Analog Inputs and 1 Analog Output
	Basic	2 Digital Inputs, 2 Digital Outputs, 3 Analog Inputs
		DI1-DI3 are discrete DI4 is pulse count input (Advanced model only)
		All Digital Outputs are discrete
Digital Inputs	Input Type	DI1-DI3: Discrete level DI4: Pulse count input
	Isolation	Each channel is individually isolated
	Voltage	10-36 Vdc
	Scan Rate	100 ms for discrete level. 400 us interrupt for pulses
	Frequency	Maximum 10 KHz pulse input
	Loop Power	Externally sourced
	Input Resistance	20,000 Ohm
Digital Outputs	Output Type	Dry contact
	Isolation	Each channel ground is individually isolated
	Voltage	10 – 36 Vdc
	Scan Rate	100 ms for discrete level
	Loop Power	Externally sourced
	Output Current	Maximum 1.0 A at 24 Vdc
Analog Inputs	Input Type	4-20 mA on 250 Ohm resistor or 0 - 5 V direct, software selectable
	Isolation	All analog channels share the same ground
	Scan Rate	100 ms
	Loop Power	Externally sourced
Analog Outputs	Output Type	0 – 5 V
	Isolation	All channels share the same ground isolated
	Scan Rate	100 ms
	Loop Power	Internally sourced
Power		
	External DC Power Supply: 24 Vdc, however will function within 18 – 30 Vdc range	
	Controller Power consumption: 35 mA @ 24 Vdc	
	Real-Time Clock battery: 3V Lithium button type CR2032	
Physical		
Controller	Construction	Fibre glass base plate and top cover
	Mounting	Bolt down to panel backplane with 4 screws or mount with 2 DIN-rail clips
	Dimensions	145 mm W by 240 mm L by 27.6 mm
	Weight	470 g

	Wiring	24 Vdc power supply: 10 AWG, Max 60 ft
		Motor power lines: 10 AWG, Max 60 ft
		Digital and Analog I/O: 20 AWG, Max 300 ft
	Wiring Access	Easy access from the top
	Sensor	Onboard temperature sensor for controllers with Firmware V38 and Hardware V2.2 or later
Environmental		
	Operating Temperature: -40 C to +60 C	
	Storage Temperature: -50 C to +85 C	
	Operating Humidity: 5 to 95%, non-condensing	
Regulatory Approvals for Hazardous Locations		
CSA Certification		
	Controller	Class 1, Division 2, Groups CD T4
	Motor Assembly	Class 1, Division 1, Groups CD T6

Dimensional Drawing: LCOD-PUMP





Overall Dimensions:
H: 16.51 in
W: 21.83 in
L: 21.83 in

Dimensional Drawing: LCOD-PUMP-V2