

Operations Manual R3

Model C1 V2.0 Electric Chemical Injection System



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1 General Safety

Symbol Usage

A DANGER!

A CAUTION!





Designates an imminent danger. In case of non-observance of this information, death or severe injuries are an imminent risk.

Designates possibility of a dangerous situation. In case of non-observance of this information, death or severe injuries can occur.

Designates areas where the potential for severe crush injury exists. These crush injuries can result in serious bodily injury.

Electrical Shock Hazard Warning indicates a potential injury hazard that can result in serious bodily injury or death.

Designates important user tips and other useful information.

Designates important installation information that if not followed could cause System failure.

The C1 Electric Chemical Injection System has been subjected to a safety test and quality acceptance inspection. Please ensure all safety instructions in this manual are clearly understood. Misuse or incorrect operation of the System may cause serious injury or death.

Only properly trained personnel should be involved in the setting up, putting into service, inspecting, servicing and repairing of this equipment.

Read and understand all instructions. Failure to follow the Dangers, Cautions and Warnings contained in this owners manual may result in electric shock, fire, serious bodily injury or death.

Notice to Installer: This manual must be left with the owner/operator of the System and kept for future reference.

Proper Use

This System uses a reciprocating positive displacement pump. It serves the purpose of conveying and circulating liquids. The System and these operating instructions are intended for commercial use exclusively.

A CAUTION! Severe skin injury can result from dangerous media used with this System. (i.e. Aggressive, toxic and caustic media)

Unsuitable media can damage the pump and then escape into the surrounding area.

If you intend to use dangerous media, the materials used for the pump parts must be designed and compatible for this use.

A CAUTION! Any form of liability on the part of the manufacturer shall be null and void if the System has been modified by others without authorization from MCI.

When replacing parts in the System, use only spare parts approved by MCI. (Refer to the Bill of Materials section in this manual for more information)

Always Disconnect power to the System before performing <u>ANY</u> maintenance or repair activities.

Sources of Danger

The System has been manufactured in compliance with CSA standards and complies with all applicable safety requirements.

Although most safety risks have been reduced through design and construction measures, residual risks (i.e. explosive atmospheres, electrical, mechanical or thermal) cannot be excluded entirely during either transport, maintenance and repair work, or regular operation.

Authorized Operators

Only persons who have been properly authorized and trained by MCI or its authorized agent may work on or with this equipment.

The owner must:

- Clearly define and ensure the observance of the responsibilities for all tasks performed in connection with the System.
- Make this manual accessible to all operations staff.
- · Make sure operations have read and understood all operating instruction.



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Or, scan the following QR code with your smart phone for a direct link to digital copies of all MCI Operation Manuals:



Maintenance, upkeep and electrical tasks should only be performed by technically competent, trained and/or qualified personnel.

Technically competent, trained and qualified personnel are defined as individuals who:

- · Possess sufficient knowledge in a specific field based on their specialized training and experience; and
- Are familiar with all applicable work safety and accident prevention regulations. (i.e. lock-out or tag-out safety procedures)

Personal Protective Equipment

A CAUTION! Wear appropriate protective equipment especially when performing any maintenance, inspection or cleaning task on the System.

Oils, lubricants and cleaning agents can cause skin reactions and irritation. Avoid skin contact with all chemical used in connection with the System.

In Case of Emergency

In case of emergency originating from the System or from conditions in the surrounding area, the System must be switched off immediately.

The System cannot be put back into operation until the emergency has been identified and corrected. Ensure corrective actions are taken to prevent future occurrence. In case of fires, use only suitable fire-extinguishing agents.

A CAUTION!

If the instructions in this manual are not adhered to or are inadequately adhered to, the warranty shall become null and void and the CSA declaration of conformity shall immediately cease to be valid.

MCI makes no other warranty, including without limitation, any warranties or merchantability or of fitness for a particular purpose, whether express or implied. MCI will not be liable under any circumstances whatsoever to the purchaser for any damages relating to loss of production, loss of product, environment damage, or any incidental, consequential, special or punitive damages regardless of whether arising in contract, strict liability, other tort or otherwise. The exclusive remedy of the purchaser for any and all losses, injuries or damages resulting from the sale, use or handling of any product whether in contract, warranty tort, negligence, strict liability or otherwise, will not exceed the purchase price paid, or at MCI's sole election, the repair or replacement of the product.

2 System Specifications

Physical Dimensions



Mounting Layout



Static Head Requirements



Electrical Specifications

Specifications	Description
Electrical Rating	12V DC or 24V DC
Classification	CSA Class I, Division 2, Groups A, B, C and D
Enclosure Rating	Nema 3R
Temperature Code	T4A
Motor Type	4 Pole Stepper Motor, 1.8 Degree Step
Startup Power Consumption (Cold Start)	240mA - 750mA Max (6 Min. Duration @ Initial Startup Only)
Average Power Consumption	<= 450 mA мах.
Reverse Polarity Protection	Standard
Analog Input (4-20 mA)	Activation Required (Injection rate control and remote
	ON/OFF capability)
Modbus Over RS-485 Link (2-Wire)	Activation Required
Integrated Low Voltage Disconnect / Reconnect	Setpoints adjustable via Graphical User Interface
Graphical User Interface	Standard (USB A to USB Mini B Interface)

General Specifications

Specifications	Description
FMT Leak Containment Technology	Standard
Variable Speed Controller	Electronic / MOSFET
Electro-mechanical Contactors / Relays	None
Electro-mechanical Timers	None
Dip Switch	None
Fluid End	Carbon Steel Standard (316L S.S. Upgrade Available)
Fluid end Suction and Discharge Seals	FFKM Perfluoroelastomer [Kalrez® Equivalent]
Secondary Containment Static Seals	Teflon®
Energized Plunger Seals	UHMW Polyethyle [Teflon® Option Available]
Plunger Material	Tungsten Carbide
Operating Temperature	-40 °C to +40 °C / -40 °F to 104 °F
Storage Temperature	-40 °C to +40 °C / -40 °F to 104 °F

Output Performance

			Plunger Diameter (Inch)			
			1/4"	3/8"	1/2"	11/16"
	psi	Default	3000	1500	750	400
Maximum Displacement Pressure		GUI Optimized*		2500	1300	650
	kPa	Default	20684	10342	5171	2758
		GUI Optimized*		17237	8963	4482
Maximum Output Volume [Litres/day]		10	26.7	48.8	93.5	
Minimum Output Volume [Litres/Day]		0.1	0.1	0.1	0.1	

*MCI's graphical user interface (GUI) allows for increased discharge pressure settings with limited volume outputs without increasing avg. power draw requirements. Contact customer service for more information: +1.888.263.4565

3 Installation

General

Congratulations. You have chosen the finest, most accurate electrically powered chemical injection System available. Before installation, please inspect the pump carefully for any possible in-transit damage. If the pump appears damaged, call your local distributor or call MCI customer service direct at +1.888.263.4565.

A CAUTION!

Please ensure you have fully read and understood the general safety section of this manual before proceeding with the System installation.

The System is CSA approved for use in CSA Class I, Division 2, Groups A, B, C and D areas. It is the responsibility of the owner to determine the classification of the area where the System is to be installed.

Standard Package Contents



C1 Electric Drive (x1)



Manual (x1)

The System is to be mounted securely on a horizontal surface in a safe location that satisfies the classification requirements. The System's Fluid End (Pump) must be oriented in a vertical position for proper check valve operation.

Allow a minimum distance of 10 in. from the center line of the pump head to the lowest point on the chemical storage container bulkhead to ensure adequate (positive) static head pressure is available. The System relies on a positive supply pressure to function correctly.

Initial Setup (Tie-In)

A CAUTION! Only properly qualified and trained personnel should be involved in the setting up , putting into service, inspecting, servicing and repairing of the plumbing for the fluid end.

Ensure all National, Provincial/State and local codes are followed when plumbing equipment. Failure to follow these codes can result in serious bodily injury or death.

The following tie-in suggestions are examples of typical installations only and may not be the best suited method for your custom installation.

Ensure all process valves are closed prior to disconnecting or re-installing any chemical injection System.

To avoid over-pressuring chemical discharge lines MCI requires placing a properly tested and calibrated Pressure Relief Valve (PRV) between the discharge port of the fluid end and the process injection point. The set point must not exceed the pumps maximum discharge pressure.



Failure to add a CERTIFIED and CALIBRATED Pressure Relief Valve (PRV) to the System is inherently unsafe. It can cause catastrophic System damage and voids the System warranty. MCI is not responsible for any damage caused by exceeding maximum System pressure. MCI offers complete PRV solutions for all System's. Please contact customer service for the latest pricing and availability: +1.888.263.4565.

Standard Connection Points



- 1. Fluid End Discharge Point 1/4" Fem. NPT
- 2. Pressure Transducer Port 1/8" NPT
- 3. Fluid End Suction Point 3/8" Tube

Removing foreign debris from suction lines and chemical storage containers will greatly extend the life of all dynamic seals used in the System. It is highly recommended to use a pre-suction in-line filter on all System's. MCI offers in-line filter kits for all pump models. Please contact customer service for the latest pricing and availability: +1.888.263.4565

Secondary Containment Line



1. Secondary containment line - 1/4" Tube

Pressure Relief Valve Tie-In (SUGGESTED ARRANGEMENT SHOWN)



- 1. Pressure Relief Valve
- 2. Male Connector 1/4" NPT x 3/8" Tube
- 3. Run Tee 1/4" NPT [Main Discharge Point]
- 4. Stainless Steel Tubing [.035] 3/8"
- 5. Tube Connector 3/8"
- 6. Union Tee 3/8"



Pressure relief valve kits are available directly from MCI. Kits include all tubing (where applicable) and fittings required to complete the installation. Contact customer service for more information: +1.888.263.4565.

Suggested in-Line Filter [TYPICAL ARRANGEMENT SHOWN]



- 1. In-line filter 440 Micron
- 2. Tube connector 3/8"



In-line filter assemblies are available directly from MCI. Kits include all tubing (where applicable) and fittings required to complete the installation. Contact customer service for more information: +1.888.263.4565.

DO NOT PLUG OFF DRAIN PORT



System Nomenclature

The drain port shown (Arrow) is a general System drain port DO NOT PLUG OFF. This port MUST remain open ended.

It can be redirected with instrumentation tubing to a designated containment area.

Without routine maintenance it is possible for seal bypass from the low pressure side to exit this port. Ensure proper containment areas are in place and suggested routine seal maintenance procedures are followed to prevent spills.





- 1. USB Mini B Receptacle Graphical User Interface (GUI) port
- 2. FuseHolder Accepts 5mm x 20mm time-delay 2.5A glass fuse
- 3. 12 Pin Connector (20 12 AWG)
- 4. 0.850" +/- .020 Diam. knockout to accept 1/2" liquidtight conduit connector

Power Supply



When wiring the System follow cable orientation labels found on the inside of the enclosure lid. Failure to orientate wiring properly may result in damage to the on-board electronics and could cause serious bodily injury or death.

To protect the System and associated components the pump box must be connected to ground. All electrical connections must satisfy National, Provincial/State and local electrical codes.



SYSTEM CAN START AUTOMATICALLY - Before connecting power to the control board ensure that you and all tools used in setup are clear of moving parts. Serious bodily injuries can occur.

When connecting cables ensure all connections are tight. Loose connections can cause arcing and erosion which destroy the integrity of the connections.



To ensure safe and proper System operation DO NOT exceed maximum recommended injection pressures. Maximum System pressures can be found under the 'SYSTEM SPECIFICATIONS' section of this manual.

Do not connect or disconnect motor leads while the controller is powered on or damage to the controller can result.

Wiring / Terminal Block Pinout Schedule



System's are available in both 12V and 24V DC supply input Refer to pump ID decals found on enclosure for input power supply specification.

A CAUTION!

12V DC Models: Power supply cannot exceed15.4V or damage to electrical components can result. [Range: 9.6 - 15.4 V]

24V DC Models:Power supply cannot exceed 30V or damage to electrical components can result. [Range 19.2V to 30V]



System Startup

Ensure you have fully read and understood all sections of this manual before operating this equipment.



FIG 3.1

Depending on System purchased connect 12V DC or 24V DC power supply out to the appropriate pins on the 12-Pin Connector (Fig 3.1) ensure wiring polarity is correct to prevent system damage.

A CAUTION! The System's default configuration is set to run automatically when power is first applied.

Model C1 pumps are equipped with 'Coldstart' technology. This technology ensures proper operation during cold weather startup conditions by temporarily increasing the motors maximum available current at startup. When the system is in 'Coldstart' mode 'CS' will appear on the digital display. The System will automatically revert to normal operating conditions when its' warm up routine is complete. (6 minute cycle)



If the ambient temperature is warmer than -15°C the 'Coldstart' routine is not required and will be bypassed automatically. To bypass the routine early, press the 'UP' or 'DOWN' arrow button once to resume normal operation. When the system is exiting the 'Coldstart' routine 'ECS' will be displayed for one complete stroke.

Setting Pump Flow Rate

To set flow rate in litres per day (LPD), press either the 'UP/DOWN' stroke rate keys on the control module until the desired LPD flow rate is displayed.

Note: If you click and hold the 'UP/DOWN' stroke rate keys the system will auto scroll at an increased rate.

If the 4-20mA interface is activated and a valid source signal (4-20mA) is available this will override the manual interface control. When the 'UP/DOWN' buttons are pressed under this condition 'A.IN' will display on screen. To enable manual control remove the 4-20 mA source or disable the 4-20mA routine via the graphical user interface.

Note:

[•] For operators safety the 'OFF' button will remain active when the 4-20mA input is active.

If the pump is left in the off condition while controlled via the 4-20mA interface it can be started remotely by cycling the 4-20mA source signal.



Due to System layout variation such as restrictions and media variation it is important to always confirm injection rates using a calibrated tank or barrel gauge and adjust as required.

Controller Interface



LED Display Definitions



FLOW RATE (LITRES PER DAY):

When the 'UP/DOWN' buttons are pressed the current LPD rate for the pump is displayed momentarily in Litres Per Day (LPD). Note: Click and hold the stroke rate keys the system will auto scroll at an increased rate



OFF STATUS 'STANDBY':

When power is applied to the System and the drive is in the OFF 'Standby' condition (plunger not cycling), the lower left (round) LED decimal point will blink indicating OFF 'standby' status.



ON STATUS:

When power is applied to the System and the drive is ON (plunger cycling) the 3 center horizontal LED diodes blink in linear back and forth sequence.



OFF BLINK:

When the pump is in the OFF 'Standby' status and the UP/DOWN arrow is pressed the display will read 'OFF' to confirm status. If the pump is ON and the 'ON/OFF' buttons are pressed the display will read 'OFF' while the drive completes its last stroke.

LED Display Definitions (Continued)



PLUNGER SELECTION:

When the System is first powered or when the pump is cycled ON from the standby condition the system will momentarily flash the System's current software plunger size setting. *Note: To ensure LPD output display is correct ensure the software plunger setting (display) always matches the physical plunger installed on System (marked on front face of pump)*



Coldstart Routine:

Coldstart technology ensures proper operation during cold startup conditions by temporarily increasing the motors supply current at startup. When the system is in Coldstart mode 'CS' will appear on the digital display. The System will automatically revert to its normal operating conditions when the routine is complete. (6 MINUTE CYCLE)



EXITING COLD START:

Although not recommended, the cold start routine can be bypassed by pressing either the UP or DOWN arrow buttons when the Coldstart routine is active. The pump requires a full extend and retract cycle to exit the Cold start routine and during this time the display will read 'ECS' and normal pump operations will resume when the 'ECS' routine is complete.



LOW POWER:

The 'LP' display indicates the pump has been forced to the OFF 'Standby' condition because the System's battery voltage has dropped below the disconnect set point. The System will automatically resume pumping operations when the System reconnect value is reached.



4-20mA CONTROL 'ANALOGUE IN':

When a valid 4-20mA source signal is provided to the System it will display 'A.in' when either the UP or DOWN arrow is pressed to inform the operator the pumps flow rate is being controlled remotely via 4-20mA input.



TEMPERATURE OFF: (Optional Temperature Based Pump Control)

If 'AL.2' is displayed this indicates the pump has been forced to the OFF 'Standby' condition because the optional temperature disconnect 'OFF' set point is true. When the reconnect 'ON' value set point is true the pump will automatically resume operation.



LOGIC (PUMP) 'OFF':

When Digital Input (PIN 11) is pulled to ground (Pin 3) with the use of a switch closure contact the pump will be forced to the OFF 'Standby' condition. The pump will remain in this condition as long as PIN 11 is pulled LOW (to ground).

Plunger Selection Update

The System's output display is in Litres Per Day. This requires the System's plunger setting to match the physical plunger installed on the system. If they do not match the display will not output the correct rates.

STEP 1



Confirm what physical plunger size is (or will be) installed on the drives pump. The plunger size is etched on the front face of all MCI Fluid End Castings. (as shown)

STEP 2

When power is first applied to the pump, or when the pump is turned 'ON' from the standby condition the display will flash the active software plunger size. Confirm this value matches the installed (physical) pump size found in STEP 1.

261/4" **3615** = 3/8" **661** = 1/2" **661** = 11/16"

STEP 3

If the plunger size from STEP 2 does not match the System's physical plunger the selection must be updated.

To activate the plunger selection Menu:

1. Click and Hold UP/DOWN button together simultaneously

2. PLU will display [Hold 10 Seconds]



3. Plunger size will display when plunger selection routine active



STEP 4

Select new plunger size and confirm/close the plunger selection menu:

1. Press Up or Down Arrow button to scroll through plunger list 2. When desired plunger size is displayed stop scrolling

3. Click and hold the VOLT METER button until displayed plunger size blinks 3 times confirming plunger selection







NOTE: If you wish to exit the plunger selection routine without registering a change press the 'ON/OFF' button at anytime.

On-board Volt Meter



The control panel includes an on-board volt meter that allows operators to read the systems voltage with the push of a button. To display the systems DC voltage simply press the volt meter button anytime power is supplied to the System.

The System's current voltage will display for approximately 2 seconds.

4 Inputs / Outputs

To enjoy the benefits of remote communications on C1 System's (v2.0 or greater) the software must be unlocked with an activation code from MCI. This can be performed at point of sale or via the System's free graphical user interface (GUI) anytime. Contact customer service for more information: +1.888.263.4565

Analogue 4-20mA Input

Specifications	Description
Analog Inputs	1 (10-bit Resolution)
Analog Outputs	N/A
Full Signal Range	4 to 20 mA
Pump OFF ('Standby') Signal	4.5mA (+/- 0.15 mA)
Flow Rate Resolution	< 50 LPD = +/- 0.2 LPD, >50 LPD = +/- 0.4 LPD
Pump Flow Rate Signal Range	5.0 - 20.0 mA (See 'Analogue Injection Rate Setup')
Fail Safe Mode	Last entered MANUAL pump rate setting
Transmitter (Source) Voltage Range	2V - 30V
Source Current	50 mA max. continuous

4-20mA Wiring - Pump Rate Control Interface



4-20mA Injection Rate Setup

A CAUTION!

Ensure you have fully read and understood all sections of this manual before operating this equipment.

The analogue interface has been designed to allow remote speed control and ON/OFF control of the System. Please refer to the following signal ranges and setup instructions to ensure proper functionality.

Signal Range(s)

Pump OFF ('Standby') Signal	4.5mA (+/- 0.15 mA)
Pump ON Flow Rate Signal Range	5.0 - 20.0 mA (See flow rate setup equation below)

Note: The 'UP/DOWN' arrow buttons are disabled when a valid 4-20mA source signal is provided. The local 'ON/OFF' controller interface button remains active and will allow the pump to be cycled OFF 'Standby' in case of emergency. To re-activate cut source signal for five seconds and then re-apply source to resume normal 4-20mA control.

STEP 1

Determine the Minimum and Maximum injection rates available for the System's current configuration.

Minimum Injection Rate is constant for a given plunger size. (See Table Below)

Plunger Size	Minimum LPD Rate
1/4"	0.2
3/8"	0.4
1/2"	0.8
11/16"	2.0

Maximum Injection Range varies with system Configurations. To determine Max. injection rate available press and hold the UP button on controller until the display stops scrolling, this is the Maximum Injection rate available

STEP 2

Record the Minimum and Maximum injection rate values. (Valid injection range for current setup configuration)

STEP 3:

Choose an injection rate that is within the determined valid injection range and use the following formula to determine the corresponding mA set point required to achieve the desired injection rate(s):

Desired Injection Rate [Within Valid Range] (Max Injection Rate/15) + 5 = mA Setting

Example Calculations

The following example explains how to determine the correct mA setting for several injection rates:

System has 1/4" Plunger installed.

From the lookup table a 1/4" Plunger Minimum injection rate = 0.2 LPD and the Maximum injection rate at controller panel was found to be 10.0 LPD (Controller display scrolled to Maximum by 'clicking' and holding the UP button).

Therefore, the valid Injection range for the System is determined to be: Minimum Injection Rate = 0.2 LPD, Maximum Injection Rate =10.0 LPD.

If the user wants to output 0.2 LPD it would be entered as shown:

$$\frac{0.2}{(10/15)}$$
 + 5 = 5.3 mA

If the user wants to output 4.6 LPD it would be entered as shown:

$$\frac{4.6}{(10/15)}$$
 + 5 = 11.9 mA

If the user wants to cycle the pump 'OFF' remotely:

4.5 mA +/- 0.15 (constant)

Modbus RTU RS485

Basic Knowledge Required: The following instructions are not intended to be a complete tutorial on the Modbus RTU protocol, and it is assumed the end user already has a general working knowledge of Modbus RTU communication, especially in respect of master station configuration and operation. However an overview is included in the following section to explain some fundamental aspects of the protocol.

Modbus RTU Introduction

This document is intended to provide an introduction to the MODBUS implementation with MCI Injection System's. The MODBUS protocol defines a message structure that controllers will recognize and use, regardless of the type of networks over which they communicate. It describes the process a controller uses to request access to another device, how it will respond to requests from the other devices, and how errors will be detected and reported. It establishes a common format for the layout and contents of message fields.

For more information on MODBUS go to the web site http://www.modbus.org/

There are a number of hardware configurations used for MODBUS networks, this guide will consider only the two wire RS485 network as that is the configuration currently supported by MCI System's.

MODBUS is a trademark of AEG Schneider Automation Inc.

RS485 Wiring

Modbus RTU over RS485 Wiring: MCI System (Slave)



Connecting Instruments

A Belden 9841 (Single pair) or 9842 (Two pair) cable with a characteristic impedance of 120 ohms is recommended. The cable should be terminated at each end with a 120 ohm, quarter watt (or greater) resistor.



There must be no more than two wires connected to each terminal, this ensures that a "Daisy Chain" or "straight line" configuration is used. A "Star" or a network with "Stubs (Tees)" is not recommended as reflections within the cable may result in data corruption.

Modbus Messages

Communication on a MODBUS Network is initiated (started) by a "Master" with a "query" to a "Slave". The "Slave" which is constantly monitoring the network for "Queries" will recognize only the "Queries" addressed to it and will respond either by performing an action (setting a value for example) or by returning a "response". Only the Master can initiate a query.



In the MODBUS protocol the master can address individual slaves, or, using a special "Broadcast" address, can initiate a broadcast message to all slaves. **MCI products do not support the broadcast address**.

Setup Configuration	Description
Slave Device Communication Address	1-247 (Default Setting 1)
Baud Rate (Default Setting 9600)	300,1200,2400, 4800, 9600, 19200
Parity (Default Setting Even)	Even, Odd, or None
Stop Bits (Default Setting 1)	1,2
Data Bits	8

Note: All configuration settings are adjusted through the free graphical user interface application, and can only be changed if the remote communications package has been purchased and activated on the device.

Message Frame

Slave Address	Function Mode	Data	CRC
1 Byte (From 1 to 247)	1 Byte	0 252	2 Bytes

Supported Message Codes / Lengths

Code / Sub Code	Data Address Base	Description	Request message length in Bytes (Including Address and CRC)	Comments
2	10000	Read Discrete Inputs (Status)	8	
3	40000	Read Holding Registers	8	Due to non-contiguous addresses, read count is limited to 1.
4	30000	Read Input Registers	8	
5	00000	Write (Force) Single Coil	8	
6	40000	Write (Force) Single Holding Register	8	Limited non-contiguous addresses allowed.
8 / 0	N/A	Diagnostics	8	Only the "Return Query Data" sub- function (sub-function 0) is sup- ported. Data length is 2 bytes only.
43 / 14	N/A	Read Device Identification	7	Supports only code 01: basic (stream access) "company identification", "product code", and "Version" are returned.

Message Structures

See 'User Adjustable Setup Parameters' table later in this section for details of supported Data.

Code 02 (0x02) Read Discrete Inputs

The Request specifies the starting address, i.e. the address of the first input specified, and the number of inputs. In the protocol data unit (PDU) discrete Inputs are addressed starting at zero. Therefore Discrete inputs numbered 1-16 are addressed as 0-15. Discrete inputs 10001 through 10005 are supported. See 'User Adjustable Setup Parameters' table.

The discrete inputs in the response message are packed as one input per bit of the data field. Status is indicated as 1 = ON; 0 = OFF. The least significant bit (LSB) of the first data byte contains the input addressed in the query. The other inputs follow toward the high order end of this byte, and from low order to high order in subsequent bytes.

If the returned input quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The Byte Count field specifies the quantity of complete bytes of data.

Code 02 Request

Function code	1 Byte	0x02
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Inputs	2 Bytes	1 to 2000 (0x7D0)

Code 2 Response

Function code	1 Byte	0x02
Byte Count	1 Byte	N*
Input Status	N* x 1	Byte

Code 02 Error

Error Code	1 Byte	0x82
Exception Code	1 Byte	01 or 02 or 03 or 04

Code 03 (0x03) Read Holding Registers

This function code is used to read the contents of a contiguous block of holding registers in a remote device. The Request PDU specifies the starting register address and the number of registers. In the PDU Registers are addressed starting at zero. Therefore registers numbered 1-16 are addressed as 0-15. See 'User Adjustable Setup Parameters' table.

The register data in the response message are packed as two bytes per register, with the binary contents right justified

within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Code 03 Request

Function code	1 Byte	0x03
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers	2 Bytes	1 to 125 (0x7D)

Code 3 Response

Function code	1 Byte	0x03
Byte Count	1 Byte	2 x N*
Register Value	N* x 2 Bytes	

Code 03 Error

Error Code	1 Byte	0x83
Exception Code	1 Byte	01 or 02 or 03 or 04

Code 04 (0x04) Read Input Registers

This function code is used to read from 1 to 125 contiguous input registers in a remote device.

The Request specifies the starting register address and the number of registers. Registers are addressed starting at zero. Therefore input registers numbered 1-16 are addressed as 0-15. There are three supported input registers. See 'User Adjustable Setup Parameters' table.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits. See 'User Adjustable Setup Parameters' table.

Code 04 Request

Function code	1 Byte	0x04
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Input Registers	2 Bytes	1 to 125 (0x7D)

Code 04 Response

Function code	1 Byte	0x04
Byte Count	1 Byte	2 x N*
Register Value	N* x 2	Bytes

Code 04 Error

Error Code	1 Byte	0x84
Exception Code	1 Byte	01 or 02 or 03 or 04

Code 05 (0x05) Write Single Coil

The Request specifies the address of the coil to be forced. Coils are addressed starting at zero. Therefore coil numbered 1 is addressed as 0. The requested ON/OFF state is specified by a constant in the Coil Value field. A value of 0XFF00 requests the coil to be ON. A value of 0X0000 requests the coil to be off. All other values are illegal and will not affect the coil. See 'User Adjustable Setup Parameters' table.

Only one coil output is defined, setting the motor state to ON or OFF. The normal response is an echo of the request, returned after the Coil State has been written.

Code 05 Request

Function code	1 Byte	0x05
Starting Address	2 Bytes	0x0000 to 0xFFFF
Output Value	2 Bytes	0x0000 to 0xFF00

Code 05 Response

Function code	1 Byte	0x05
Starting Address	2 Bytes	0x0000 to 0xFFFF
Output Value	2 Bytes	0x0000 to 0xFF00

Code 05 Error

Error Code	1 Byte	0x85
Exception Code	1 Byte	01 or 02 or 03 or 04

Code 06 (0x06) Write Single Register

This function code is used to write a single holding register in a remote device.

The Request specifies the address of the register to be written. Registers are addressed starting at zero. Therefore register numbered 1 is addressed as 0. See 'User Adjustable Setup Parameters' table.

The normal response is an echo of the request, returned after the register contents have been written.

Code 06 Request

Function code	1 Byte	0x06
Starting Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0000 to 0xFFFF

Code 06 Response

Function code	1 Byte	0x06
Starting Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0000 to 0xFFFF

Code 06 Error

Error Code	1 Byte	0x86
Exception Code	1 Byte	01 or 02 or 03 or 04

Code 08 (0x08) Diagnostics (Serial Line only)

MODBUS function code 08 provides a series of tests for checking the communication system between a client device and a server, or for checking various internal error conditions within a server.

The function uses a two–byte sub-function code field in the query to define the type of test to be performed. The server echoes both the function code and sub-function code in a normal response. Only one sub function is supported, "00: Return Query Data".

The normal response to the Return Query Data request is to loop back the same data. The function code and subfunction codes are also echoed.

Code 08 Request

Function code	1 Byte 0x08		
Sub-function	2 Bytes		
Data	N x 2 Bytes		

Code 08 Response

Function code	1 Byte 0x08		
Sub-function	2 Bytes		
Data	N x 2	Bytes	

Code 08 Error

Error Code	1 Byte	0x88
Exception Code	1 Byte	01 or 03 or 04

Code 43 / sub-code 14 (0x2B / 0x0E) Read Device Identification

This function code allows reading the identification and additional information relative to the physical and functional description of a remote device, only.

The Read Device Identification interface is modeled as an address space composed of a set of addressable data elements. The data elements are called objects and an object Id identifies them.

Only objects of the Basic Device Identification category are supported. All objects of this category are mandatory: Vendor Name, Product code, and revision number.

Example of a Read Device Identification request for "Basic device identification":

In this example all information are sent in one response PDU.

Request		Response	
Field Name	Value	Field Name	Value
Function	2B	Function	2B
МЕІ Туре	0E	МЕІ Туре	0E
Read Dev Id code	01	Read Dev Id Code	01
Object Id	00	Conformity Level	01
More Follows		00	
NextObjectId		00	
Number Of Objects		03	
Object Id		00	
Object Length		16	
Object Value		" Company identification"	
Object Id		01	
Object Length		0D	
Object Value		" Product code XX"	
Object Id		02	
Object Length		05	
Object Value		"V2.11"	

Supported modbus exception codes

Code	Name	Meaning
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server. This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server. More specific- ally, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is sub- mitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 "Illegal Data Address" since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for server. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register.
04	SERVER DEVICE FAILURE	An unrecoverable error occurred while the server was attempting to perform the requested ac- tion.

Modbus User Parameters

The following table is a list of the required USER adjustable setup parameters.

Discrete inputs (status flags)

Modbus write code	Modbus read code	Address	Description	Туре	Read / Write	Range
n/a	2	10001	Pump On/Off Status	COIL	R	1 = Pump ON, 0 = Pump OFF
5	n/a	1	Pump Off Control	COIL	W	1 = Pump ON, 0 = Pump OFF
n/a	2	10002	Low Voltage Dropout Indication (Low Voltage disconnect active)	DISCRETE INPUT	RO	1 = Low Voltage Dropout (Pump OFF), 0 = OK
n/a	2	10003	Temperature Dropout Indication (Temperature 'OFF' set-point reached)	DISCRETE INPUT	RO	1 = Temperature Dropout (Pump OFF), 0 = OK
n/a	2	10004	Standby (OFF) Status	DISCRETE INPUT	RO	1 = Pump in Standby, 0 = Pump Active (Pump Cycling)
n/a	2	10005	Cold Start Routine Status	DISCRETE INPUT	RO	1= ON, 0= OFF

Modbus Input Registers (real-time data)

Modbus write	Modbus	Address	Description	Туре	Read	Range
code	read code				/ Write	

n/a	4	30001	System DC Voltage (e.g. 2468 = 24.68 volts)	INPUT	RO	16 bit integer value in v/100 (2 Sig.Dig.)
n/a	4	30002	Temperature Sensor Reading	INPUT	RO	16 bit integer value in Deg C
See Holding Register 40035	4	30003	Injection Rate Litres (e.g. 935 = 93.5 Liters Per Day)	INPUT	RO	16 bit integer value in LPD/10 (1 Sig. Dig.)
	4	30004	Maximum Liters per day range (e.g. 935 = 93.5 Liters Per Day)	INPUT	RO	16 bit integer value in LPD/10 (1 Sig. Dig.)
	4	30005	Minimum Litres per day range (e.g. 10 =1.0 Liters Per Day)	INPUT	RO	16 bit integer value in LPD/10 (1 Sig. Dig.)

Modbus Holding Registers (r/w)

Modbus write code	Modbus read code	Address	Description	Туре	Read / Write	Range
n/a	3	40003	Pump Model: Duplex (C2) or Simplex (C1)	HOLDING	RO	0 = SIMPLEX, 1= DUPLEX
n/a	3	40005	Supply Voltage Model 12v or 24v	HOLDING	RO	0=12 Volts 1=24 Volts
n/a	3	40007	Low Voltage Disconnect Feature	HOLDING	RO	1 = ON, 0 = OFF
6	3	40030	Dwell vs Continuous Injection Cycle	HOLDING	RW	1 = DWELL, 0 = VARIABLE
6	3	40031	Temperature Based ON/OFF Control ¹	HOLDING	RW	1 = ON, 0 = OFF
¹ To ensure accura the sensor in the b	ite ON/OFF fu pattery enclos	inctionality, e ure on all so	ensure the thermistor sensor is placed outsid lar installations (No appreciable heat source	de of the main p available)	ump encl	osure. It is recommended to place
6	3	40032	Auto Start After Power Interrupt (ON/ OFF)	HOLDING	RW	1 = ON, 0 = OFF
6	3	40033	Maximum Injection Rate Lockout: This value limits the users max. selectable LPD setting at local front panel. (e.g. 452 = 45.2 Liters per day max selectable rate setting)	HOLDING	RW	16 bit integer LPD/10 (1 Sig. Dig., 0.1 Resolution) Note: A setting of 0.0 cancels injection rate lockout (disables)
n/a	3	40034	System Plunger Size (Primary, Fixed End Only on Duplex C2 Models)	HOLDING	RO	0 = 1/4", 1 = 3/8", 2 = 1/2", 3 = 11/16"
6	3	40035	Pump Injection Rate Setting in Litres per Day (Read/Write) ² (e.g. 354 = 53.4 Liters per day)	HOLDING	RW	16 bit integer value in LPD/10 (1 Sig. Dig.)
² When adjusting t	he System's i	njection rate	refer to parameter(s) 30004 & 30005 for av	ailable min. and	max. inje	ction range (Litres Per Day)
6	3	40036	Low Voltage Reconnect ³ (e.g. 96 = 9.6 Volts)	HOLDING	RW	16 bit integer v/10 (1 Sig. Dig, 0.1 Resolution)
						12V System Range: 9.6v - 15.0v [Default 9.6v] 24V System Range: 19.1v - 28.0v [Default 19.1v]
6	3	40037	Low Voltage Disconnect ³ (e.g. 95 = 9.5 Volts)	HOLDING	RW	16 bit integer v/10 (1 Sig. Dig, 0.1 Resolution) 12V System Range: 9.5v - 13.0v [Default 9.5V] 24V System Range: 19.0v - 26.0v [Default 19.0v]
³ Address 40036 &	40037: Reco	nnect point	nust alwavs be a minimum of 0.1v higher th	an the disconne	ct set poi	nt.

6	3	40038	Temperature Off Value ⁴ (Ambient temperature setting to cycle pump OFF) (e.g15 = 15 Deg. C, 10 = 10 Deg.C)	HOLDING	RW	16 bit integer (Deg C) Range: -40 to +40 deg C
6	3	40039	Temperature On Value ⁴ (Ambient temperature setting to cycle pump ON) (e.g15 = 15 Deg. C, 10 = 10 Deg.C)	HOLDING	RW	16 bit integer (Deg C) Range: -40 to +40 deg C
⁴ Address 40038 8 ⁴ Address 40031(1	40039 value emperature E	s cannot be Based On/Of	equal, Ensure a minimum of one deg C sep f Control must be set to 1 (ON) for Address 4	aration in set po 40038 & 40039 t	ints. to take ef	fect.
6	3	40041	Max Pressure Customization (Psi) (Set with MCI GUI Application) This value notifies users what the System's maximum discharge pressure is(psi) based on system configurations. DO NOT exceed these pressure ratings or system damage will occur.	HOLDING	RO	When 40034 = 0 (1/4" Plunger): 0=450, 1=750, 2=900, 3=1100 4=1500, 5=2100, 6=2500, 7=3000 (Psi) When 40034 = 1 (3/8" Plunger): 0=400, 1=750, 2=900, 3=1100 4=1500, 5=1750, 6=2100, 7=2500 (Psi) When 40034 = 2 (1/2" Plunger): 0=400, 1=750, 2=900, 3=1100 4=1300, 5=1750, 6=2100, 7=2500 (Psi) When 40034 = 3 (11/16" Plunger): 0=400, 1=475, 2=650, 3=1100 4=1300, 5=1750, 6=2100, 7=2500 (Psi)

Example Messages:

Message Format: [Slave ID][Function Code][Data][CRC]

Sample Message Setup Configuration	Description
Slave Device Communication Address	1
Baud Rate (Default Setting 9600)	9600
Parity (Default Setting Even)	None
Stop Bits (Default Setting 1)	1
Data Bits	8

Command	Message Sent	Expected Response
Pump ON	[01][05][00][00][FF][00][8C][3A]	[01][05][00][FF][00][8C][3A]
Pump OFF	[01][05][00][00][00][00][CD][CA]	[01][05][00][00][00][CD][CA]
Set Pump Rate 13.7 LPD (137)	[01][06][00][22][00][89][E8][66]	[01][06][00][22][00][89][E8][66]
Set Pump Rate 18.8 LPD (188)	[01][06][00][22][00][BC][28][71]	[01][06][00][22][00][BC][28][71]
Request Diagnostics (Sub Function 0)	[01][08][00][00][AB][CD][5E][AE]	[01][08][00][00][AB][CD][5E][AE]
Request Device Identification	[01][2B][0E][01][00][70][77]	[01][2B][01][01][00][00][03][00][16][4D][43][49][20][53] [6F][6C][75][74][69][6F][6E][73][10][0D][49][4E][4A] [45][43][54][49][4F][4E][20][53][59][53][54][45][4D][53] [20][09][46][57][5F][56][30][30][2E][30][37][16][52]

Digital I/O

Digital Input 'ON/OFF' Pump Control

Pin 11 input provides a means to place the pump into standby (OFF). Provide a switch or relay contact closure to signal ground pin 3 to place the pump into standby. (Fig 4.1)

Note: Leave unconnected if not used.



Fig 4.1

Digital Output Pump Status 'ON/OFF'

Pin 10 is an open collector type logic output that will float to approximately 5 Volts (with respect to pin 3 signal ground) when the pump is in operation. (Fig 4.2)

When pump is placed in standby, pin 10 will be pulled to ground via a 100 ohm current limiting resistor. When pin 10 is low (standby) it will sink 5 mA with 0.5 Volt level referenced to signal ground.

Note: Output provides no current sourcing capability, Leave unconnected if not used.



5 Troubleshooting

Reference Table

Symptom	Potential Cause(s)	Recommendation(s)		
Electric drive does	Pump controller is off (Auto Start Disabled)	Press the On/Off button to cycle power		
not cycle when powered	Loose or damaged power supply wiring	Confirm all connections are securely fastened and that no mechanical damage to wiring has occurred Re-connect wiring and confirm screw terminals are tight		
	Input power supply wiring polarity reversed [SEE 'INSTALLATION' SECTION OF THIS MANUAL FOR WIRING DIAGRAM]	Reverse wiring if found to be incorrect		
	Damaged fuse	If front panel interface 'Check Fuse' light is activated the fuse is likely dam- aged and will require replacement.		
		Remove fuse holder cap and inspect fuse for damage. Replace if required [5mm x 20mm - 2.5A]		
	Low voltage condition*: *ALL SYSTEMS ARE EQUIPPED WITH AN	Confirm 12V or 24V DC input power supply is available to the control module Replace or repair power supply as required		
	INTEGRATED LOW VOLTAGE DISCONNECT [LVD] THE SCREEN WILL DISPLAY 'LP' WHEN A POWER PROBLEM HAS OCCURRED	If the System is running off a DC battery bank it is recommended to discon- nect the charging source [I.E. SOLAR PANELS] before checking line voltage to ensure accurate results		
	[LOW VOLTAGE CONDITION]	Note: MCI Controller interface includes on-board voltmeter. Pressing this button will display the systems current DC supply voltage for approx. 2 seconds		
	Damaged charge regulator	Confirm charge regulator is outputting 24-30 VDC (24V Models) or 12-15 VDC (12V Models). If your charge regulator is equipped with a low voltage disconnect make sure to test its functionality and set points		
Pump is chattering or not stroking a full	Low voltage condition	Confirm 12V or 24V power supply is available to the controller by cycling the on-board volt meter.		
stroke		If the System is running off a DC battery bank it is recommended to discon- nect the charging source (i.e. solar panels) before checking line voltage to ensure accurate results		
		This condition can cause damage to the System's drive if left for extended periods. If, after identifying and correcting a voltage problem the drive is still found to chatter it is recommended to send the System in for inspection as motor bearings may be damaged		
	Discharge Isolation valve(s) closed	If any valves are found to be closed and if safe to do so, open valves		
	Original controller replaced	MCI offers many drive options that require specific controllers. Before installing a new pump controller please contact MCI customer service: +1.250.888.4565 to confirm compatibility. Please have the System's model and serial number ready for technical support		
	Pumps maximum rated discharge pressure has been exceeded	Please confirm your pumps maximum output pressure rating. This can be found under the 'Specifications' section of this manual. It is very important this pressure not be exceeded. It is unsafe and will cause premature System failure		
	Damaged Control Module	Contact customer service for repair options +1.888.263.4565		

Symptom	Potential Cause(s)	Recommendation(s)		
Pump cycles cor- rectly but chemical does not discharge at the correct rate	Pump may have lost prime 'Air locked'	With the pump cycling, open the priming screw to release any trapped air in the pump chamber. When chemical flows smoothly air has been displaced. It is recommended to repeat this procedure to be sure all trapped air has been evacuated from the System		
		Direct all chemical to a contained area to prevent spills when priming pump		
	Suction check valve clogged with debris	Close suction isolation valves. Disconnect suction plumbing and remove the suction check bushing. Inspect check valve O-ring and seat for debris. Clean and/or replace as required (O-ring size -012)		
		If the O-ring appears pitted, deformed or swollen it is recommended to confirm your elastomers compatibility with media being injected.		
		Check Valve 316 SS seats do not routinely need replacement when seals are replaced unless seal face is damaged. Rebuild seal kits are available from MCI or your authorized pump distributor. Please contact MCI customer service for more information: +1.888.263.4565		
	Low chemical Inventory	If inventory is empty, refill supply		
		Running the pump dry may allow air to enter the System. When refilling your chemical supply it is always recommended to prime the pump head to evacuate air from System		
	Suction side isolation valve closed	Isolation valves are typically found immediately exiting the chemical tank bulkhead. Confirm all valves are in the open position		
	Chemical obstructed from entering the pump. No chemical flow through primer port	Plumbing upstream of the System may have blockages preventing chemical from entering the fluid end. Check the following:		
	when opened.	 A common example is a plugged in-line chemical filter, if this is found to be the cause clean or replace the in-line chemical filter 		
		 If the pump has been decommissioned for a period of time it is possible for the suction check ball to stick to its o-ring seat. To repair, dislodge the ball from the suction bushing. Note: It is not required to remove the suction seat to perform this task. 		
Low Pressure seal	Seals are worn/damaged	Order replacement seal kit and replace		
leaking through drain port		Although spring energized seals do not require adjustment throughout the life expectancy of the seal, they do have a life span and due to possible system contaminants or abrasive qualities of certain chemicals it is difficult to predict seal life expectancy for all applications		
		MCI recommends a semi-annual seal cartridge change to reduce the risk of bypassed chemical		
		It is possible for older chemical storage tanks to become contaminated with debris over time. This can greatly reduce the life expectancy of the seals and also affect check valve performance		
		MCI offers high performance in-line chemical filters to greatly reduce the likelihood of this occurring. Please contact MCI customer service for more information: +1.888.263.4565		
	Drain Port			

Symptom	Potential Cause(s)	Recommendation(s)
Static seal bypass 'liquid' between pump halves	Damaged Teflon® O-ring or seal face	Inspect O-ring seal faces for damage and replace O-ring as required

MCI chemical injection System's are designed to be simple to operate and easy to repair. The best way to ensure reliable and efficient service is to have your pump repaired at the factory. If non-factory repairs are to be carried out please read and understand all maintenance procedures found under the 'Maintenance' section of this manual.

If you are experiencing an operating problem not listed above, or if none of the troubleshooting actions have corrected your operating problem, please contact your authorized MCI reseller or call MCI customer service: 1.888.263.4565. Exchange programs are also available through MCI. Minimize your downtime and labor by swapping out a rebuilt pump rather than having to troubleshoot, order parts, uninstall and repair your pump. Eliminate the guesswork, and get your System back to work quickly, at a cost that makes your decision easy. Please contact customer service for more information: 1.888.263.4565

6 Bill of Materials

Material Codes

The following pages include multiple System views with part numbers and material codes to assist in identifying parts in the System's assembly.

If additional information is required please contact customer service: +1.888.263.4565

When contacting customer service it is helpful if you have the System serial number available to ensure proper replacement parts are recommended.

(Serial Numbers can be found on the front cover of the System's enclosure Lid)

System Material Codes

316L STAINLESS STEEL	SS
FLAME RETARDANT - THERMOPLASTIC	TH
PERFLUOROELASTOMER	FE
LOW CARBON STEEL	CS
VIRGIN TEFLON®	TE
IMPREGNATED TEFLON®	IT
TUNGSTEN CARBIDE - SOLID	TC
ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE - UHMW PE	UH
ZINC PLATED CARBON STEEL	ZP
POWDER COATED STEEL	PC

General System Detail View





	0		ż	Qty. Matl.	Fluid End Plunger Size				
	Compone	ent	ā		All Sizes	1/4"	3/8"	1/2"	11/16"
1	5/16" SOCKET HEAD (CAP SCREWS	4	ZP	S44				
2	FUSE [2.5A] (5mm x 20	mm, Glass)	1		C100				
3	SCREW TYPE CONNE	CTOR (12-PIN)	1	TH	C067				
4	O-RING - TEFLON (-03	1)	1	TE	S49				
F	FMT FLUID END	CARBON STEEL	1	CS		FMT-XX- CS-04	FMT-XX- CS-06	FMT-XX- CS-08	FMT-XX- CS-11
5	(COMPLETE)	STAINLESS STEEL	I	SS		FMT-XX- SS-04	FMT-XX- SS-06	FMT-XX- SS-08	FMT-XX- SS-11
6	90 DEG. 1/4" TUBE X 1 VALVE)	/4" NPT (CHECK	1	SS	S64				
7	3/8" RUN TEE		1	SS	Q29				
8	1/4" REDUCER		1	SS	Q58				
9	SECONDARY CONTAI	NMENT LINE	1	SS	P79				
11	COMPLETE C1	12 V SYSTEM	1		Z-PB-C1- V2-12				
	PUMP ASSEMBLY	24 V SYSTEM			Z-PB-C1- V2-24				

FMT Fluid End (Pump)



Component		×	atl.	Fluid End Plunger Size					
		Component	ð	Β	ALL SIZES	1/4"	3/8"	1/2"	11/16"
1	SEAL RETAIL	NER SCREWS #10-32	2	SS	S43				
2	SEAL RETAIL	NER	1	SS		S93	S94	S95	S96
3	CAP SCREW	- 1/4"	4	ZP	S42				
		CARBON STEEL	4	CS		S24	S26	S28	S30
4	RODEND	STAINLESS STEEL	1	SS		U22	U23	U24	U25
5	5 TEFLON® LOW PRESSURE O-RING		1	TE	T87				
6	SPRING ENE	RGIZED SEAL	2	UH		S75	S76	S77	S78
7	TEFLON® HIG	GH PRESSURE O-RING	1	TE		S45	S46	S47	S48
8	DISCHARGE	CHECK VALVE BUSHING	1	SS	S11				
9	DISCHARGE	BALL CHECK SPRING	1	SS	R93				
10	STAINLESS S	STEEL BALL - 0.375 DIAM.	2	SS	R94				
11 PER-FLUOROELASTOMER (FFKM) O-RING		2	FE	T82					
12 STAINLESS STEEL BALL - 0.250		1	SS	R95					
13 DISCHARGE CHECK VALVE SEAT		1	SS	S32					
14	PRIMING SC	REW	1	SS	S92				

	Component		×	itl.	Fluid End Plunger Size					
Component		ð	Σ	ALL SIZES	1/4"	3/8"	1/2"	11/16"		
15	PIPE PLUG - 1	/8" NPT		1	SS	S73				
	(CARBON STEEL	1	CS		S25	S27	S29	S31	
10	S S	TAINLESS STEEL		SS		U26	U27	U28	U29	
17	SUCTION CHE	ECK VAL	VE SEAT	1	SS	S12				
TUNGSTEN			PRIMARY, FIXED END	1	тс		T58	T59	T60	T61
18	CARBIDE PLUNGER SECONDARY, ADJUSTABLE END		SECONDARY, ADJUSTABLE END	1	тс		C105	C106	C107	C108

Plunger Seals



Component		y.	Matl.	Fluid End Plunger Size				
		ğ		All Models	1/4"	3/8"	1/2"	11/16"
А	TEFLON [®] LOW PRESSURE O-RING]	1	TE	T87				
D		2	UH		S75	S76	S77	S78
D	SFRING ENERGIZED SEAL	2	IT		C007	C008	C009	C010
С	TEFLON [®] HIGH PRESSURE O-RING	1	ΤE		S45	S46	S47	S48
D	FMT SEAL REBUILD KIT (UHMW-PE)	1			FMT- SEALKIT-04	FMT- SEALKIT-06	FMT- SEALKIT-08	FMT- SEALKIT-11

In-line Filter



Component		y.	atl.	Fluid End Plunger Size				
	Component	ğ	Σ	All Models	1/4"	3/8"	1/2"	11/16"
А	TUBE CONNECTOR - 3/8"	1	SS	S65				
В	IN-LINE STRAINER - 440 MICRON (3/8" TUBE)	1	SS	R18				
	REPLACEMENT FILTER ELEMENT	1	SS	R19				

Pressure Relief Valve



Component		, X	y. atl.	Fluid End Plunger Size				
	Component		Σ	All Models	1/4"	3/8"	1/2"	11/16"
1	MALE CONNECTOR - 1/4" NPT X 3/8" TUBE	1	SS	P78				
2	PRESSURE RELIEF VALVE	1	SS	R04				
3	RUN TEE - 1/4" NPT	1	SS	S72				
4	TUBE CONNECTOR - 3/8"	1	SS	S65				
5	UNION TEE - 3/8"	1	SS	Q28				
6	STAINLESS STEEL TUBING - 3/8"	1	SS	P81				



To ensure accurate and prompt parts delivery, the following information must be provided when ordering components:

Serial Number - Located on the front cover of System's enclosure.

Item Number - Found in Bill of Materials section of this manual Maintenance.

7 Maintenance

MCI series System's are designed to provide trouble free service for many years with little inspection, lubrication or other routine maintenance. However, like any other mechanical device proper maintenance can extend the life cycle of the System.

The following schedule is intended as a guide only. Each application is different and should be evaluated and serviced according to its own custom maintenance schedule.

SUGGESTED MAINTENANCE	MONTHLY	SEMI - ANNUAL	ANNUAL
GENERAL SYSTEM CHECK			
 Inspect system for any leaks Check valve(s) seating - use calibrated gauge to confirm Linear drive cycling normally Confirm all mechanical fasteners are tight If the system is charged off a 12V or 24V DC battery bank confirm batteries and charging system are in good working order 	•		
INSPECT AND CLEAN IN-LINE FILTER ELEMENT			
(If applicable)		•	
REPLACE PLUNGER SEALS			
See 'bill of materials' section for appropriate part numbers and refer to the 'maintenance' section for complete step-by-step instructions		•	
LUBRICATE BALL- NUT / BALL-SCREW ASSEMBLIES			
Refer to the 'maintenance' section for complete step-by-step instructions. Always use synthetic low temp grease that is rated for a minimum of -45 $^{\circ}\mathrm{C}$			•
INSPECT, CLEAN AND REPLACE CHECK VALVE SEALS AS REQUIRED			
Refer to 'check valve maintenance' section of this manual for complete step-by-step instructions			•

Lubrication Details



Remove pump and plunger to access grease fitting where shown with arrow

Grease Fitting Type: 1/4 inch Straight

Always disconnect power to the System before lubricating ballscrew assembly

To be used with Lincoln[®] pistol grip 18 in. grease gun (or equivalent). MCI recommends adding 2 grams of grease on an annual basis. (This is equivalent to approximately 2.5 strokes on typical pistol/hand grip grease guns, refer to your specific grease guns output specifications to confirm)

Do Not Over Grease

Always use a SYNTHETIC low temperature grease that is rated for a minimum temperature of -45 $^{\circ}\mathrm{C}$

Fluid End (Pump) Maintenance

Please ensure you have fully read and understood the general safety section of this manual before proceeding with any maintenance procedures.

A CAUTION!

Disconnect power to the System before proceeding with any maintenance procedures.

Replacement seal kit required for repair, see page 42 for details.

STEP 1

To assist plunger removal it is highly recommended to turn off the System (Press ON/OFF) while the pump is completing the extension portion of the stroke (to the right).

Disconnect System's power supply. Close all suction and discharge isolation valves and remove both the suction and discharge chemical lines from fluid end.

STEP 2

Disconnect secondary containment line [A] from fluid end as shown.



Remove fastening screws (A x2) and fluid end assembly (B) as shown.



STEP 4

Remove Plunger:

Tilt, lift and pull plunger to remove* (as shown) inspect for any damages and clean thoroughly.

*The System must be located in the extended position (All the way to the right) to allow plunger removal. (See Step 1)





STEP 5

Remove screws [A] (x4) and separate blind end [C] from rod end [B] as shown.



If pump porting is filled with debris it is highly recommended to clean pump head thoroughly and perform maintenance on check valves. (See 'Check Valve Maintenance' section for more information)

STEP 6

Remove high pressure dynamic seal [A] and static Teflon[®] face seal [B] from rod end and discard.

USE CAUTION NOT TO SCRATCH SEAL FACES WHEN REMOVING SEALS.

ALWAYS CLEAN SEAL FACES THOROUGHLY BE-FORE RE-INSTALLING SEALS.



STEP 7

Remove screws [A] (x2) and seal retainer [B] from rod end followed by the low pressure seal [C]. Clean Rod end thoroughly. and inspect seal face for any scratching or pitting damage.



STEP 8

Slide seal retainer [A] onto plunger [B] (MIN. 2 INCHES) followed by a \underline{NEW} low pressure seal [C] as shown.



SEAL DIRECTION IS CRITICAL ENSURE SEAL SPRING FACES AWAY FROM SEAL RETAINER WHEN INSTALLING.

Slide plunger into rod end at least 1.5 inches [Fig. A]. Next, press down on seal retainer to insert seal and retainer into the rod end counter bore [Fig. B]. Finally, remove the plunger while holding the seal retainer in place.

DO NOT GREASE PLUNGER

OR DYNAMIC SEALS





STEP 10

Install second seal in opposite side of rod end as shown. Ensure the seals spring faces out when installing.



SEAL DIRECTION IS CRITICAL ENSURE SEAL SPRING FACES AWAY FROM ROD END [OUT] WHEN INSTALLING.

STEP 11

Remove high pressure static seal [A] from blind end [B] as shown.

Inspect and clean seal face before proceeding.

STEP 9

Install screws (x2) to lock seal retainer in position.



STEP 12

Install NEW high pressure static seal [A] in blind end [B] as shown.



STEP 13

Install $\underline{\text{NEW}}$ low pressure static seal [A] in rod end [B] as shown.



STEP 14

Mate rod end to blind end and secure with mount screws (x4) as shown.

ENSURE ALL O-RINGS ARE PROPERLY SEATED BEFORE FASTENING SCREWS.



STEP 15

Re-install plunger.

Place plunger [A] into plunger receiver [B] as shown.



STEP 16

Align FMT fluid end assembly with plunger and slowly slide assembly up to distance piece [A].





STEP 19

Connect all previously installed suction and discharge lines to the fluid end.

STEP 17

Secure FMT fluid end assembly to existing drive by installing mount screws (x2) as shown.

A CAUTION!



Only properly qualified and trained personnel should be involved in the setting up, putting into service, inspecting and repairing of this equipment.

Ensure National, Provincial/State and local codes are followed when plumbing equipment. Failure to follow these codes can result in serious bodily injury or death.



Typical installation shown above. Please refer to the 'Installation' section of this manual for a complete item breakdown.

STEP 18

Re-connect secondary containment line [A] to fluid end assembly as shown.



Tie-In kit assemblies and in-line filter assemblies are available direct from MCI. Kits include all tubing [where applicable] and fittings required to complete the installation. Contact customer service for more information: +1.888.263.4565

STEP 20

When safe to do so, open all applicable suction and discharge isolation valves.

STEP 21

Re-connect 12V or 24V DC power supply to System.

A CAUTION!

SYSTEM STARTS AUTOMATICALLY



Note: If your electric drive is equipped with a warm up routine the display will read 'CS' The routine will automatically transition to normal operation after a 6 minute cycle. To bypass the warm up routine simply press either the UP/ DOWN arrow.

STEP 22

Confirm the suction side of the pump is filled with fluid by opening the priming valve to check for fluid. When the fluid flows smoothly through the primer (air displaced) close the priming valve.

The FMT Fluid End has been designed to redirect all lost fluid to a containment area when priming by attaching 1/4" flexible tubing to the primer valve before opening.



Confirm injection rates using a calibrated tank/barrel gauge to ensure the pump is injecting fluid as expected.

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Check Valve Maintenance

Please ensure you have fully read and understood the general safety section of this manual before proceeding with any maintenance procedures.

STEP 1

Disconnect System's power supply. Close all suction and discharge isolation valves and remove both the suction and discharge chemical lines from fluid end.

STEP 2

Disconnect secondary containment line [A] from fluid end .



STEP 3

Remove suction check valve seat [A] from fluid end assembly.



STEP 4

Remove check valve ball [A] and O-ring [B] from suction bushing, as shown.

USE CAUTION NOT TO SCRATCH SEAL FACES WHEN REMOVING SEALS.

THOROUGHLY CLEAN ALL PARTS BEFORE PROCEEDING.



STEP 5

Remove discharge check valve bushing [A] from fluid end assembly.



STEP 6

Remove discharge check valve components shown. Clean all items as required.



Inspect Porting In Main Pump Body For Any Debris At This Time. If Cleaning Is Required Please Refer To 'Plunger Seal Maintenance' (Page 28) - Steps 1-5 To Remove Pump Body. Once Removed Clean Thoroughly, Re-Install And Proceed.

STEP 7

Insert <u>NEW</u> (-012) O-ring* [B] into check valve seat followed by existing check valve ball as shown.

*Ensure O-ring material is compatible with chemical used with System.



STEP 8

Thread check valve assembly into fluid end body. [Torque 90-100 In-lbs]



STEP 9

Remove O-ring [A] from discharge check valve seat [B] . Clean seat and insert $\underline{\text{NEW}}$ (-012) O-ring.*

 $^{\ast}\textsc{Ensure}$ O-ring material is compatible with chemical used with System.



STEP 10

Clean pump body as required then re-install discharge check valve components in order shown shown.





STEP 13

Connect all previously installed suction and discharge lines to the fluid end.

STEP 11

Thread discharge check valve bushing [A] into fluid end body. [Torque 90-100 In-lbs]



A CAUTION!

Only properly qualified and trained personnel should be involved in the setting up, putting into service, inspecting and repairing of this equipment.

Ensure National, Provincial/State and local codes are followed when plumbing equipment. Failure to follow these codes can result in serious bodily injury or death.



STEP 12

Re-connect secondary containment line to the system.

Typical installation shown above. Please refer to the 'Installation' section of this manual for a complete item breakdown.

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Tie-In kit assemblies and in-line filter assemblies are available direct from MCI. Kits include all tubing [where applicable] and fittings required to complete the installation. Contact customer service for more information: +1.888.263.4565

STEP 14

When safe to do so, open all applicable suction and discharge isolation valves.

STEP 15

Re-connect System's power supply.

A CAUTION!

SYSTEM STARTS AUTOMATICALLY



Note: If your electric drive is equipped with a warm up routine the display will read 'CS' The routine will automatically transition to normal operation after a 6 minute cycle. To bypass the warm up routine simply press either the UP/ DOWN arrow.

STEP 16

Confirm the suction side of the pump is filled with fluid by opening the priming valve to check for fluid. When the fluid flows smoothly through the primer (air displaced) close the priming valve.

The FMT Fluid End has been designed to redirect all lost

fluid to a containment area when priming by attaching 1/4" flexible tubing to the primer valve before opening.



Confirm injection rates using a calibrated tank/barrel gauge to ensure the pump is circulating fluid as expected.

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Graphical User Interface (GUI)

The MCI Graphic user interface (GUI) was designed to allow simple and powerful configuration of your chemical injection system within a user-friendly graphical environment. The GUI installation package is available for download: www.mcisolutions.ca/support



Main Feature Overview

- · Firmware and software updates
- Activate remote communications package (code required)
- System status feedback
- Injection delivery mode switching (continuous, variable)
- Custom discharge pressure set points

- Modbus setup Interface
- Remote temperature control 'on/off' activation and setup
- Low voltage disconnect customization
- Pump rate lockout
- Auto-start on power interrupt (Enable, Disable)

Many additional features are available with the GUI application, for a detailed overview of all available features please download the GUI user guide at: www.mcisolutions.ca/support

Requirements

- Microsoft® Windows® XP, Win 7, Win 8/8.1, Win 10
- · USB enabled computer system with available USB port
- 1x USB Cable [USB A to Mini B]

If you have questions concerning the graphical user interface for MCI System's, call the MCI Solutions customer service department at 1-888-263-4565. Customer Service hours are 8:00 AM to 4:30 PM, Mountain Standard Time, Monday through Friday.

Limited Warranty

MCI SOLAR MFG. LTD. ("MCI") warrants to the purchaser of its chemical injection line of products, including the C-1 Series chemical injection System's (the "Product"), to be free of defects in materials and workmanship under normal usage for a period of twelve (12) months from the date of purchase.

The purchaser is responsible for the compatibility of the product with any non MCI Product and, consequently, this warranty does not apply if the product and its components including the seal assembly and plunger are not compatible with any non MCI Product with which the product is being used. In addition, this warranty does not apply: (i) to damage caused by accident, abuse or misuse, (ii) to damage caused by service performed by anyone who is not authorized to do so by MCI or (iii) to a product or part that has been modified without the written permission of MCI. All dynamic seals used in the System are not included under warranty.

If a defect exists, at its option, MCI will (i) repair the Product at no charge, using new or refurbished replacement parts, (ii) exchange the Product with a Product that is new or which has been manufactured from new or serviceable used parts and is at least functionally equivalent to the original Product or (iii) refund the purchase price of the product. The old Product will become the property of MCI.

MCI makes no other warranty, including, without limitation, any warranties or merchantability or of fitness for a particular purpose, whether express or implied. MCI will not be liable under any circumstances whatsoever to the purchaser for any damages relating to loss of production, loss of product, environment damage, or any incidental, consequential, special or punitive damages regardless of whether arising in contract, strict liability, other tort or otherwise. The exclusive remedy of the purchaser for any and all losses, injuries or damages resulting from the sale, use or handling of any product whether in contract, warranty tort, negligence, strict liability or otherwise, will not exceed the purchase price paid, or at MCI's sole election, the repair or replacement of the product.



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