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SMR-V Modules

Control Valve with Air and/or Fluid Pass-through fittings

SmartChange Tool Change System
Manual 95402 Rev 00

November 16, 2009

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Revision

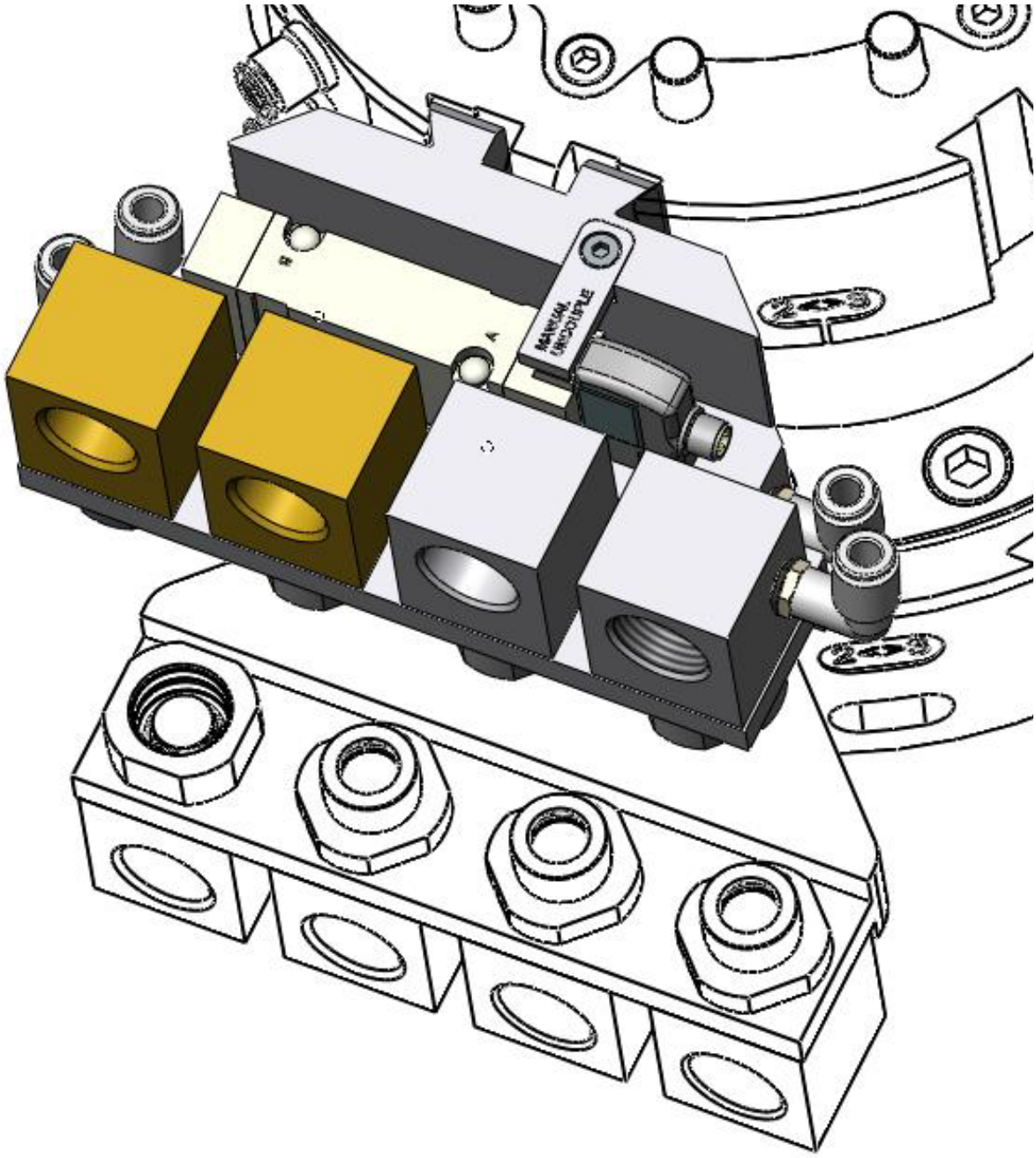
Revision	Date	Author	Description
00	11-16-2009	GV	Initial release

Contents

1 System Description

The SmartChange SMR-V modules provide a compact, easily integrated method to control the air supply for coupling and uncoupling the SmartChange system. A 4-way single solenoid valve and all electrical and pneumatic connections are included.

The SMR-V modules also include the option to include up to four fluid fittings that work in conjunction with the SMT-F fluid pass-though modules. See SMR/T-F Modules User Guide for more details on these modules.



2 Safety

2.1 Safety Notices

READ MANUAL—Do not start, operate or service machine until you read and understand User's Manual. Failure to do so could result in serious injury.

HAND CRUSH NOTICE—Indicates the possibility for a crush force between components during coupling of the Robot and Tool adaptors.

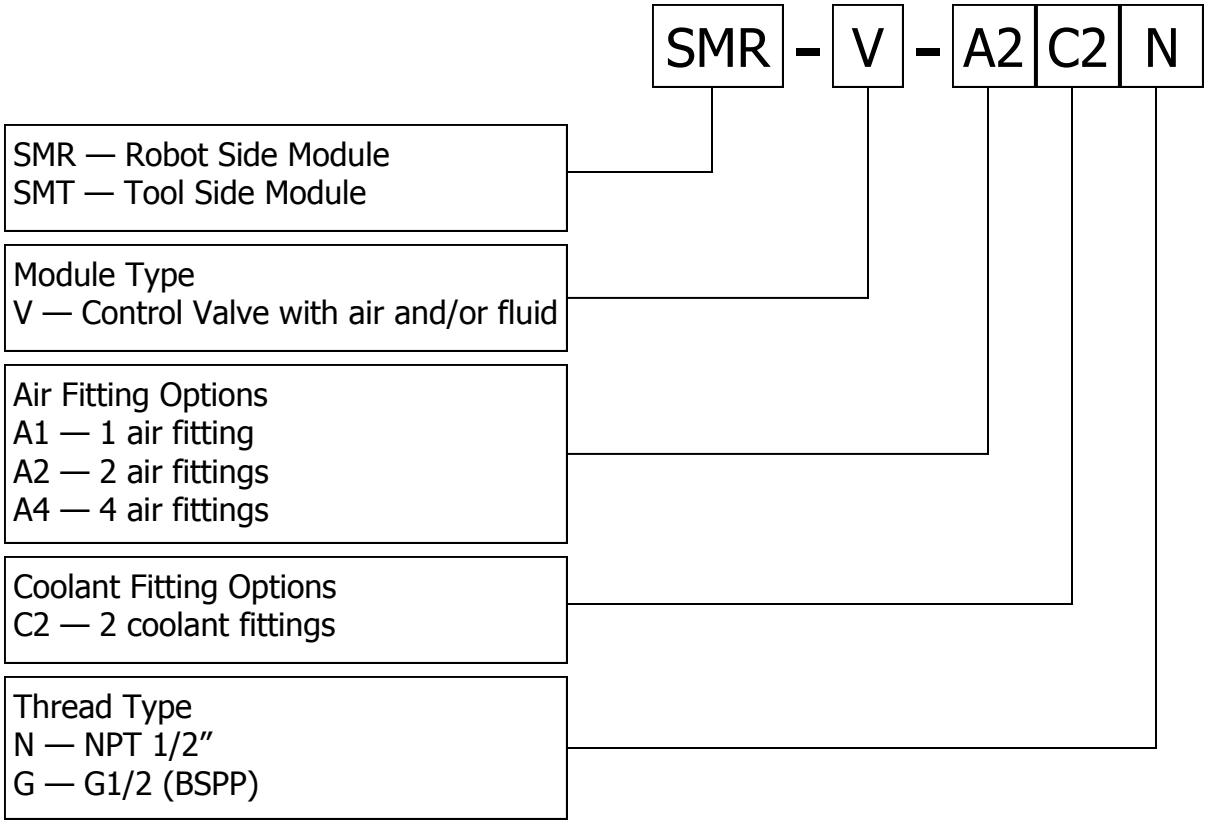
DANGER NOTICE — Indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death.

WARNING NOTICE — Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

CAUTION NOTICE — Indicates a potentially hazardous situation which, if not avoided, will or could result in minor or moderate injury; also used where the risk applies only to property damage.

IGNORING INFORMATION ABOUT POTENTIAL HAZARDS CAN LEAD TO SERIOUS HARM TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT, AND MAY RESULT IN THE

3 Ordering Information



4 Technical Specifications

Module Robot / Tool	Valve Specifications		Pass-through fitting specifications				
	Working Pressure	Cv	Number of fittings		Thread size/ type	Maximum Working Pressure	Cv
			air	coolant			
SMR-V-A1N	4-6 Bar (60-90 psi)	.93	1	0	1/2” NPT	17 Bar (250 psi)	1.54
SMR-V-A2N			2	0			
SMR-V-A4N			4	0			
SMR-V-A1G			1	0	G1/2 (BSPP)		
SMR-V-A2G			2	0			
SMR-V-A4G			4	0			
SMR-V-A1C2N			1	2	1/2” NPT		
SMR-V-A2C2N			2	2			
SMR-V-A1C2G			1	2	G1/2 (BSPP)		
SMR-V-A2C2G			2	2			

4 Installation

4.1 Module Mounting and Removal

The SMR-V modules include a male dovetail feature that match up to the six dovetail slots around the perimeter of the SmartChange robot adaptor assemblies. Each module is located to the robot adaptor housings using the dovetail feature and retained by a single captivated fastener for easy installation and replacement. Typical installation for this module is in position 2.

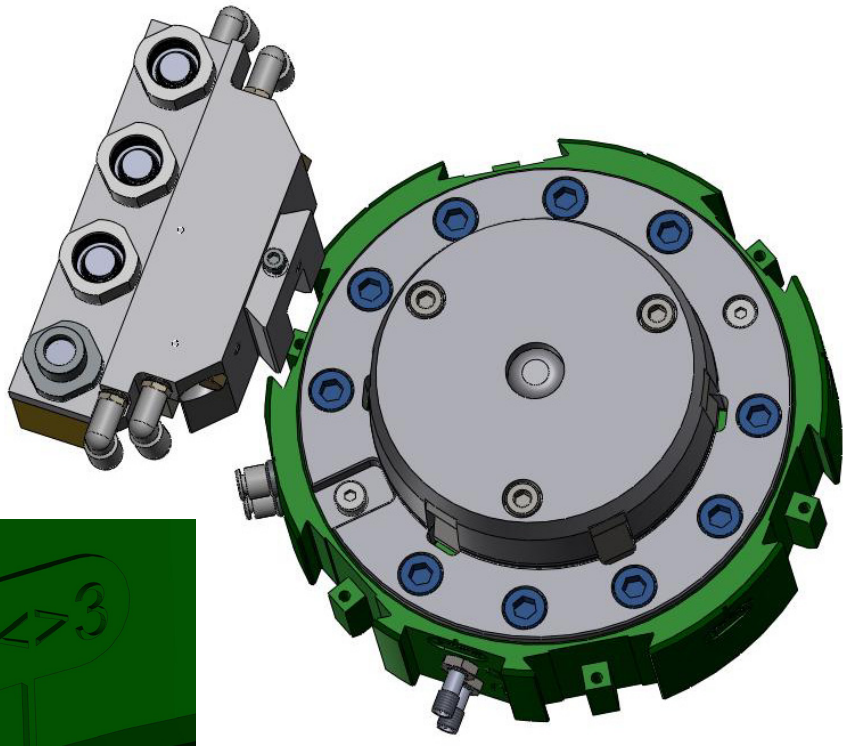
The following steps should be taken for proper installation:

4.1.1 Module Mounting

1. Determine the desired location for the utility module to be positioned. The robot and tool adaptor housings are marked with a number and an arrow between each dovetail slot to designate module positions.
2. Ensure dovetail features on both the utility module and the robot or tool adaptor housings are free from burrs or raised material that would cause interference.
3. Slide the male dovetail feature of the utility module into the desired female dovetail of the robot or tool adaptor housing until it bottoms out on the threaded male feature of the robot or tool adaptor housing.
4. Using a 4mm hex wrench, insert and tighten the M5 captivated socket head cap screw to a torque value of 5.5 Nm (48in-lbs).

4.1.2 Module Removal

1. Using a 4mm hex wrench, loosen the M5 captivated socket head cap screw in the male dovetail feature of the utility module until it is free from the threads in the robot or tool adaptor housing. Do not continue loosening this screw out of the utility module so that it will remain captivated.
2. Slide the male dovetail feature of the utility module out of the female dovetail slot of the robot or tool adaptor housing.



4.2 Electrical & Pneumatic Connections

The SMR-V module includes all of the fittings, tubing, and electrical cable required to operate the included single solenoid spring return valve in order to control the operation of the double acting cylinder of the SmartChange robot adaptor assembly. The single solenoid valve included with these modules has been specified to provide the appropriate amount of air and includes other features required for simple installation and safe operation as an integral part of our Tool Stand Monitoring circuit.

The electrical connection is made between the included solenoid valve and the SMR-E electrical module using a double ended M8 cord set. If an SMR-E module is not required for the application an M8 cord set can be connected directly to the solenoid to provide the control signal.

The pneumatic supply to the solenoid valve is typically tapped off of the existing air line being passed through the tool changer. This is accomplished using two 6mm tube fittings. The first is connected to the bulkhead of the first pass-through air fitting. The second is connected to the module base and is ported directly to the supply of the solenoid valve. The output lines from the solenoid valve are connected directly to the couple and uncouple ports of the SmartChange robot adaptor via 6mm tube and fittings.

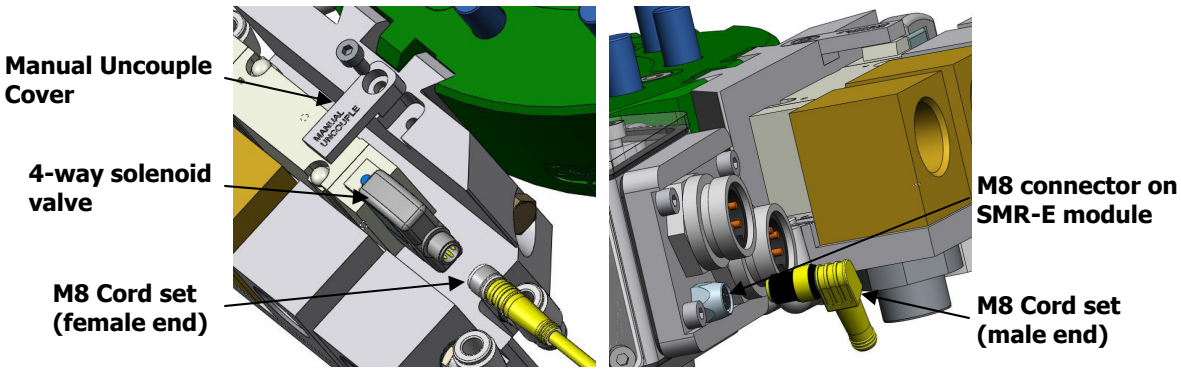
The following conditions must be adhered to when supplying air to the SmartChange system:To ensure proper operation air must be supplied to both the Couple and Uncouple ports via a pneumatic control valve.

1. A single solenoid spring return 4-way pneumatic valve should be utilized to control the air supply to the Couple and Uncouple ports. When the valve is in the de-energized state and air is supplied to the valve, the air being supplied from the valve in this condition should be plumbed to the couple port. This condition will ensure air is maintained to the couple port on a loss of power to the solenoid valve.
2. Supply air must be maintained between 4-6 Bar (60-90 psig).

The following procedures will explain the specific method for connecting both the electrical signals and air supply to the SMR-V module and in turn to the SmartChange robot adaptor:

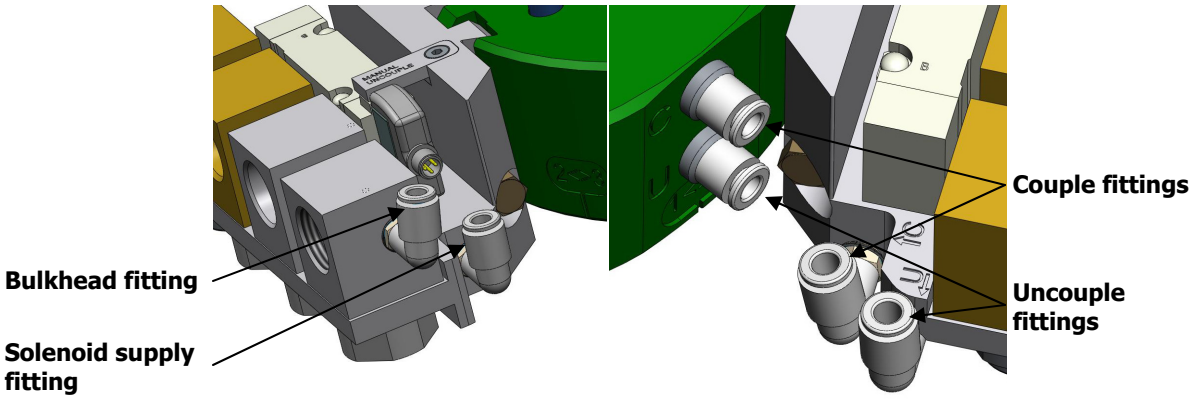
4.2.1 Electrical Connection for Solenoid Valve

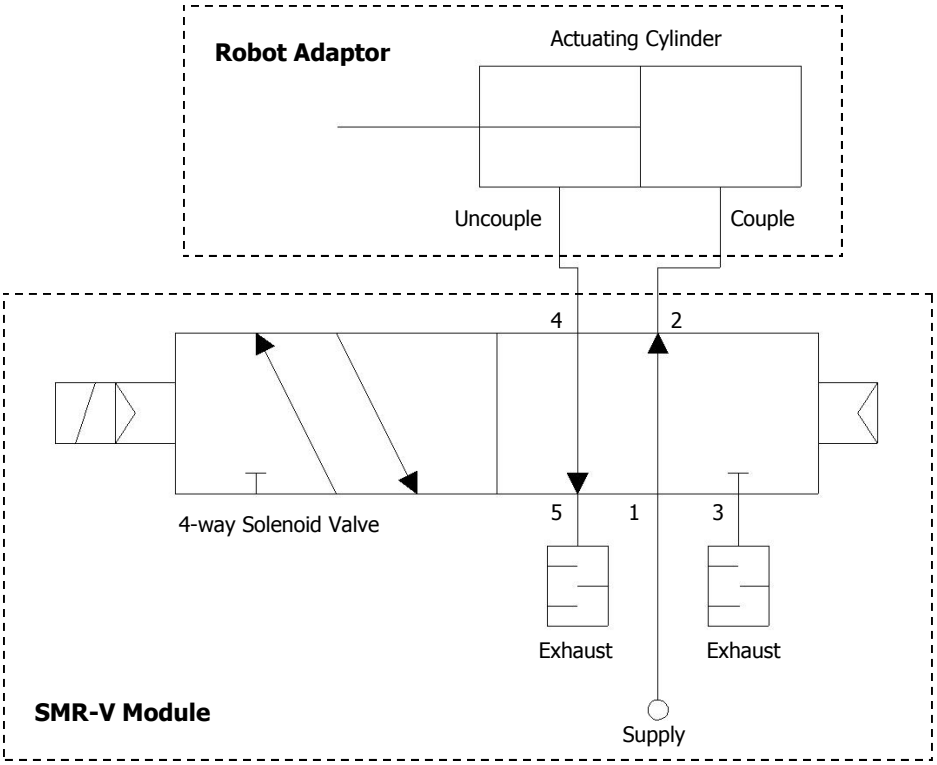
1. Attach female end of the 0.5 meter M8 cord set included with the SMR-V module to the male 3 pin connector on the solenoid valve.
2. Using a 3mm hex wrench loosen and remove the M4 screw holding the Manual Uncouple cover.
3. Remove Manual Uncouple cover.
4. Route M8 cord set between the solenoid valve and the module base.
5. Connect male M8 connector to the female M8 receptacle on SMR-E module.
6. Place Manual Uncouple cover back into position.
7. Using a 3mm hex wrench, insert and tighten The M4 screw removed in step 2 to a torque value of 2.7 Nm (24 in-lb).



4.2.2 Pneumatic Connection for Solenoid Valve

1. Ensure 6mm tube between the bulkhead air fitting and solenoid supply fitting is installed. This tube is typically installed at the factory.
2. Connect the 6mm tubing between the corresponding couple and uncouple ports on both the SMR-V module and robot adaptor. The Couple ports are marked with a C and the uncouple ports are marked with a U.





PNEUMATIC PRESSURE SHOULD NEVER BE SUPPLIED TO THE SMARTCHANGE SYSTEM UNLESS THE POSITION OF THE VALVE SUPPLYING THE AIR IS KNOWN AND HAS BEEN CONFIRMED. FAILURE TO DO SO CAN RESULT IN SERIOUS INJURY OR DEATH FROM A DROPPED TOOL. THE ROBOT SHOULD NEVER BE RUN WITHOUT AIR PRESSURE SUPPLIED TO THE TOOL CHANGER. PRESSURE TO THE TOOL CHANGER MUST BE AT LEAST 4 BAR (60 PSIG) FOR PROPER OPERATION.

5 Guide to Operation

5.1 Initial Test

To perform an initial functionality test of the solenoid valve the electrical and pneumatic connections should be verified against the installation instructions in Section 4 of this manual. Once this verification is complete, the following steps should be followed for the test:

1. Verify the Robot Adaptor Assembly is clear of any obstruction and not coupled to the Tool Adaptor Assembly.
2. Turn on supply air to the control valve and verify cams move to the extended position. This will verify the single solenoid 4-way valve is plumbed correctly.
3. Supply control power to the solenoid valve and supply the signal from the controller/PLC to move the valve to the Uncouple (Solenoid energized) position. The cams should retract to the Uncoupled position and the input from the Uncoupled sensor should be received by the robot controller/PLC.
4. Change the state of the solenoid valve by turning off the Uncouple signal (solenoid de-energized). The cams should extend back to the Coupled position and the Uncoupled sensor signal should turn off and the Coupled Signal should turn on at the robot controller/PLC.
5. Repeat steps 3 and 4 several times. The cam action should be smooth and quick.

DURING TESTING KEEP YOUR FINGERS CLEAR OF THE MECHANICAL COUPLING MECHANISM.

5.2 Tool Drop Prevention

The prevention of accidental uncoupling is of utmost importance when setting up your SmartChange system for operation. As a minimum level of prevention Applied Robotics recommends the use of one of our SMR/T-E Electrical modules that includes our Tool Stand Monitoring Circuit.

The Tool Stand Monitoring Circuit incorporates two switches that are wired in line, parallel to each other, with the uncouple signal controlling the actuation valve of the tool changer.

1. The first switch, “Tool Present”, is a normally closed proximity switch located inside the Robot side electrical module with its target embedded in the tool side electrical module. This switch is necessary to allow for the tool changer to maintain itself in the Uncoupled state when moving to pick up the next tool.
2. The second switch, “Tool in Stand”, a magnetically coded switch, is mounted on the end-of-arm-tool with its actuator mounted to the tool stand. This switch is wired via an M12 connector to our tool side electrical module and the circuit is passed via spring probes to the robot-side electrical module to complete the circuit.

The combination of these two switches provides the following "OR" logic function:
The actuation valve will not receive the signal to uncouple unless a tool side is not present OR the tool is resting in the tool stand.
In other words, the uncouple signal will not reach the actuation valve unless one of the following two conditions are met:

1. A tool side of the tool changer is not connected. The normally-closed “Tool Present” switch in the robot side signal module is in its normally-closed position allowing the uncouple signal to reach the actuation valve. This switch is necessary to allow for the tool changer to maintain itself in the Uncoupled state when moving to pick up the next tool.
2. The tool side of the tool changer is connected and the tool is safely resting in its tool stand. With a tool adaptor coupled up to the robot adaptor the normally-closed “Tool Present” switch will open. Now the uncouple signal will not reach the actuation valve unless the “Tool in Stand” switch on the EOAT is actuated by its magnetically coded actuator on the tool stand.

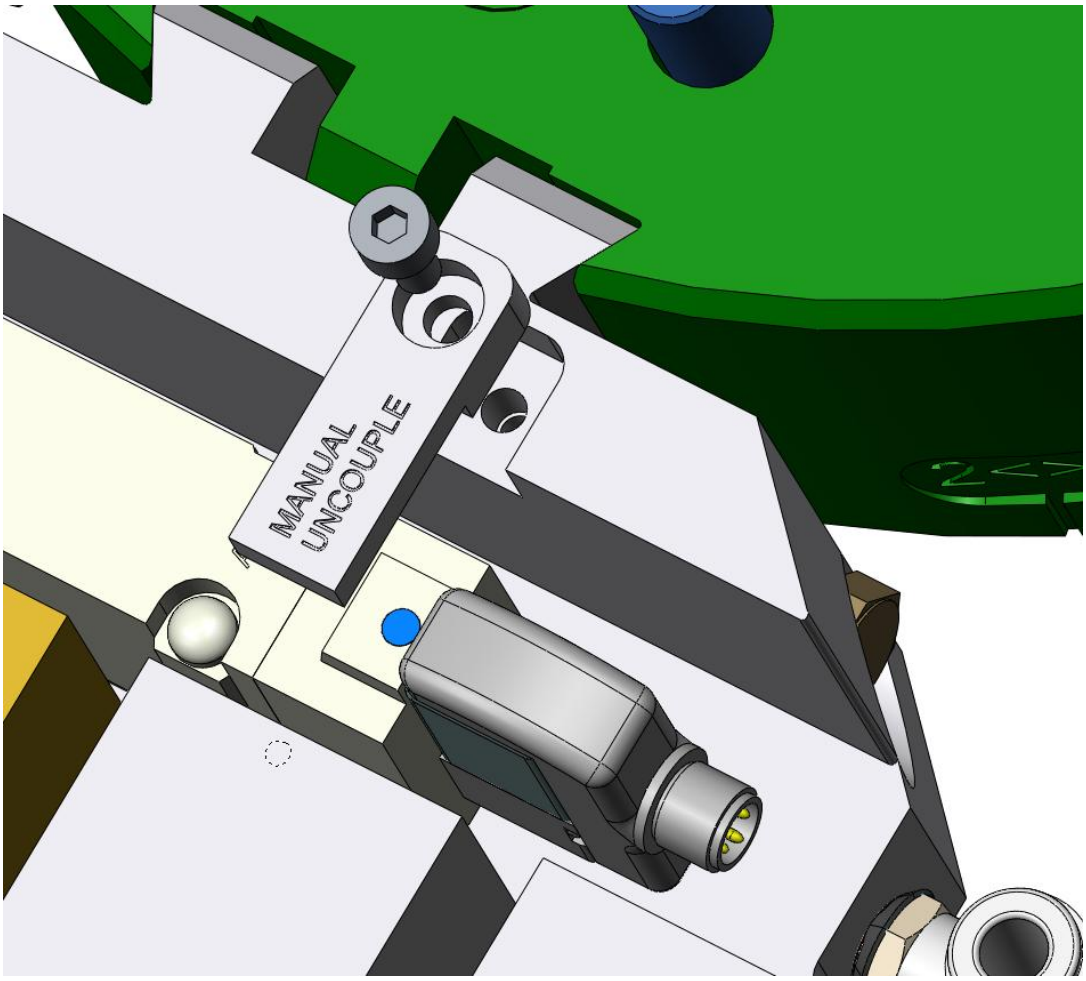
5.3 Method to Manually Over ride Solenoid Valve

THE SMR-V SOLENOID VALVE SHOULD NEVER BE MANUALLY OVER-RIDDEN UNLESS THE ATTACHED TOOL IS FULLY SUPPORTED, PREFERABLY IN ITS TOOL STAND.

If the electrical signals to the **SmartChange** SMR-V valve module are lost in a manner that prevents the system from uncoupling under normal means we have included a feature in our design that allows the solenoid valve to be manually over-ridden.

The following steps must be followed to ensure the **SmartChange** system is manually uncoupled in a safe manner:

1. Ensure the attached tooling is safely supported, preferably in its tool stand, so that no damage or personal injury occurs when the tool is released.
2. Ensure all unnecessary personnel are clear of the tooling before going further in this procedure.
3. Using a 3mm hex wrench, remove the M4 screw that holds the Manual Uncouple cover in place.
4. Remove the Manual Uncouple cover to expose the manual override button on the solenoid valve.
5. Press the manual over-ride button to uncouple the tool changer and release the tool.
6. Once the tool is released and safely resting in its tool stand, release the manual over-ride button.
7. Re-install the Manual Uncouple cover and tighten the M4 screw to a torque value of 2.7 Nm (24 in-lb).



6 Troubleshooting

6.1 Troubleshooting Guide

Symptom	Possible Causes	Resolution
Tool Changer will not couple	Tool Changer not within required distance for coupling (2mm between Robot and Tool Adaptor Assemblies)	Adjust robot program to move within the required distance
	Air Supply to tool changer has been lost	Verify all air connections are in place and air supplied to robot cell
Tool Changer will not uncouple	Air Supply to tool changer has been lost	Verify all air connections are in place and air supplied to robot cell
	Electrical Connection to actuation valve has been lost	Verify all connections are in place and that valve is not damaged and operating correctly
	Solenoid for control valve has failed	Replace 4-way solenoid valve per Section 9.4.1
Fitting Leak	Dirt, Debris, or hard scale fouling sealing surfaces	Clean fitting and lubricate per Section 9.3 of this manual
	Damage to sealing surfaces	Replace fitting per Section 9.4 of this manual

For troubleshooting issues not covered in this guide please contact the Applied Robotics Technical Support Department at (518)384-1000 or techsupport@appliedrobotics.com.

8 Spare Parts

The spare parts listed below are recommended to be maintained in stock for the life of the unit. These quantities are based on a single unit. If higher quantities are purchased please contact our Technical Support Department at 518-384-1000 or techsupport@appliedrobotics.com to determine the quantity of spares we recommend for the size of your installation.

Recommended Spares for SMR-V		
Description	**Part Number**	**Quantity**
4-way Solenoid Valve	0905-P25N	1
90 degree 6mm tube fittings	0910-P67N	4
6mm polyurethane tubing (qty. in feet)	0801-P79N	2
0.5M M8 cord set	0910-P91N	1

Additional Spares for SMR-V module with A (air fitting) option		
Description	**Part Number**	**Quantity**
Female Fitting LPF-08F-SS-EXTENDED	0509-C38A	1-4[1]

Additional Spares for SMR-V module with C (coolant fitting) option		
Description	**Part Number**	**Quantity**
Male Fitting LPF-08M-SS-EXTENDED	0509-C39A	1
Female Fitting LPF-08F-SS-EXTENDED	0509-C38A	1

[1] *Quantity required based on specific SMR-V module. Quantity required will match the number following A in the module part number. For example, SMR-V-A4N requires 4 female fittings and SMR-V-A2C2G requires 2 female fittings for the air pass through.*

9 Maintenance

CAUTION

FAILURE TO FOLLOW THE MAINTENANCE SCHEDULE DESCRIBED BELOW COULD ALTER OR VOID THE WARRANTY PROVIDED BY APPLIED ROBOTICS.

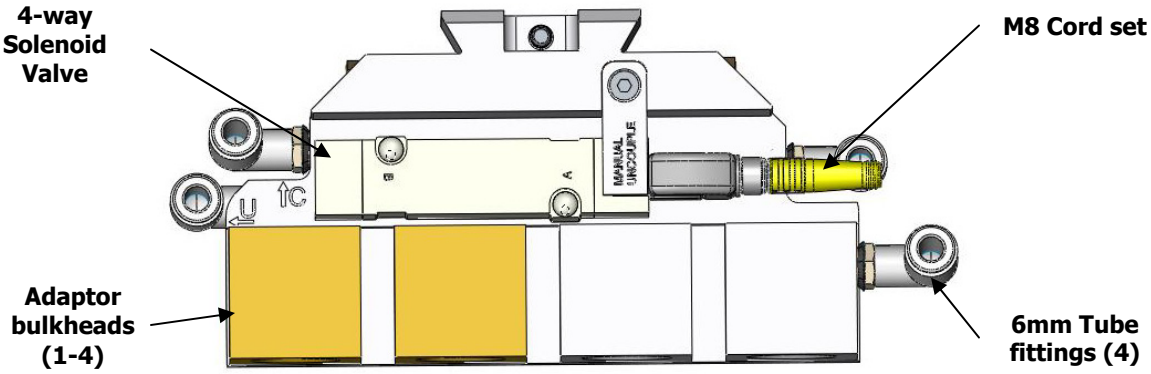
9.1 Maintenance Schedule

Maintenance Items	Frequency of Maintenance		
	SMR-V Module	Female Fittings	Male Fittings
Visual Checks	Every 2 weeks (> 1000 cycles per day) Every 4 weeks (< 1000 cycles per day)		
Lubrication	N/A	250,000 cycles or as necessary based on visual inspections	
Fitting Replacement	N/A	1,000,000 cycles	

9.2 Visual Checks

9.2.1 SMR-V Module

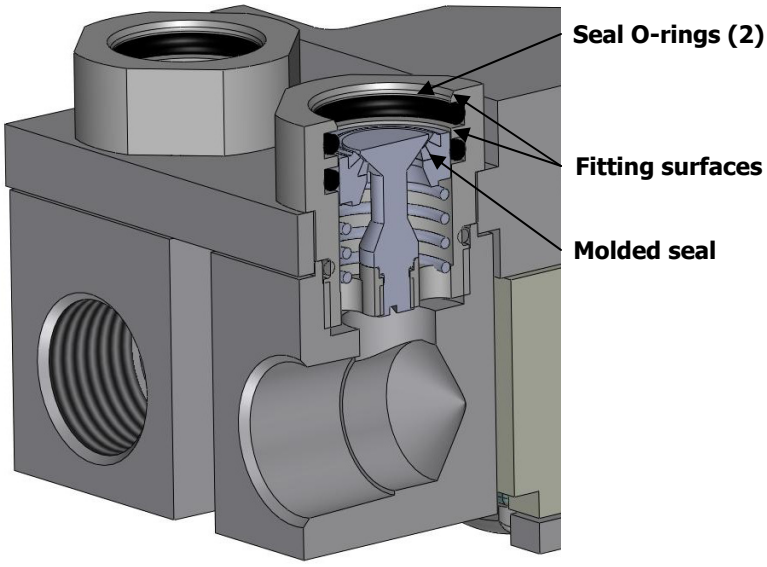
1. Inspect 4-way solenoid valve[1] and M8 cord set[1] (signal cable) for damage.
2. Inspect all 6mm tube fittings[1] for damage or air leaks.
3. Inspect air/coolant tube or hose fittings[2] for damage or leakage a the point where they connect to the adaptor bulkheads.



[1]*If damage is found that prevents these items from operating correctly, they should be replaced following the procedures in Section 9.4 of this manual.*
[2]*Hose and tube fittings are typically supplied by the customer*

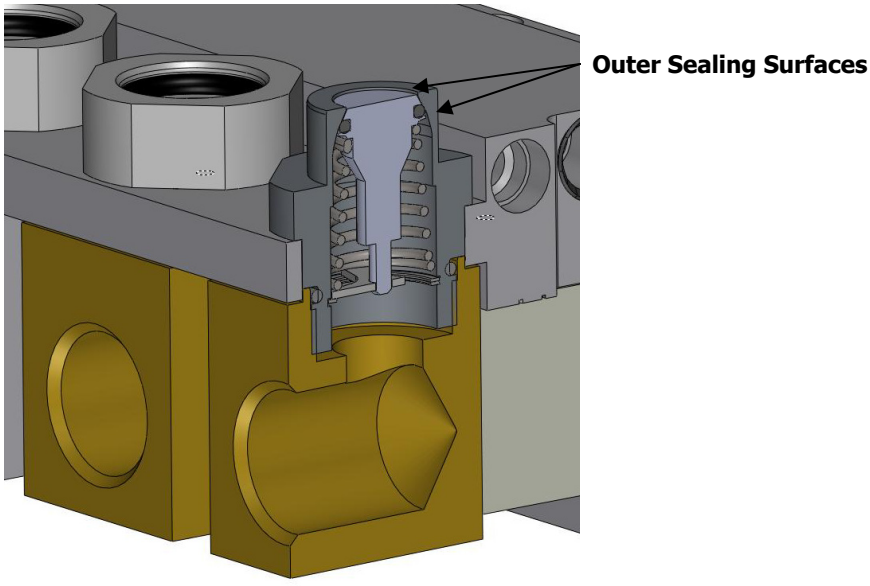
9.2.2 Female Fittings

1. Inspect fitting surfaces adjacent to o-ring seals for excessive wear or raised material[3] that could cause damage to sealing surfaces on the corresponding male fitting.
2. Inspect seal o-rings and molded seal for damage or excessive build-up of dirt, debris, or hard scale[4].
3. Inspect o-rings for proper lubrication[4].



9.2.3 Male Fittings

1. Inspect outer sealing surfaces for excessive wear or raised material[3] that could cause damage to seal o-rings or molded seal in the corresponding female fitting.
2. Inspect outer sealing surfaces for excessive build-up of dirt, debris, or hard scale[4].
3. Ensure outer sealing surface is properly lubricated[4].



[3]*If excessive wear or damage is found in any of the surfaces of the male or female fitting they should be replaced following the procedures in Section 9.4 of this manual. Leaving the fittings in place with damaged interface surfaces will lead to premature failure of the o-ring and molded seals.*

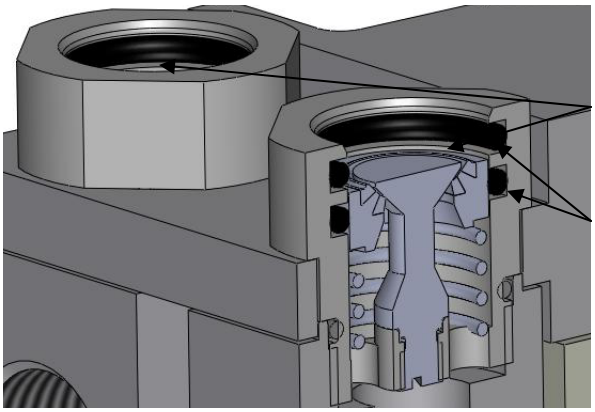
[4]*If excessive build-up of dirt, debris, or hard scale is present or a lack of proper lubrication is found during the performance of visual checks, the fittings should be cleaned and lubricated per Section 9.3 of this manual.*

9.3 Lubrication

The following procedures will define the proper method for lubricating the Female and Male fittings utilized in the SMR-V module to maximize the cycle life of your SmartChange system.

9.3.1 Female fitting

1. Clean the inner cavity of the female fitting of on any existing grease, dirt, or debris using a clean lint free rag.
2. Apply a liberal coating of Staburags NBU 30 grease (ARI part # 0903-P11N) to the inner cavity of the fitting along the entire diameter. The coupling of the female fitting to the male fitting will force the grease to the lower o-ring and also lubricate the outer surfaces of the male fitting[1].



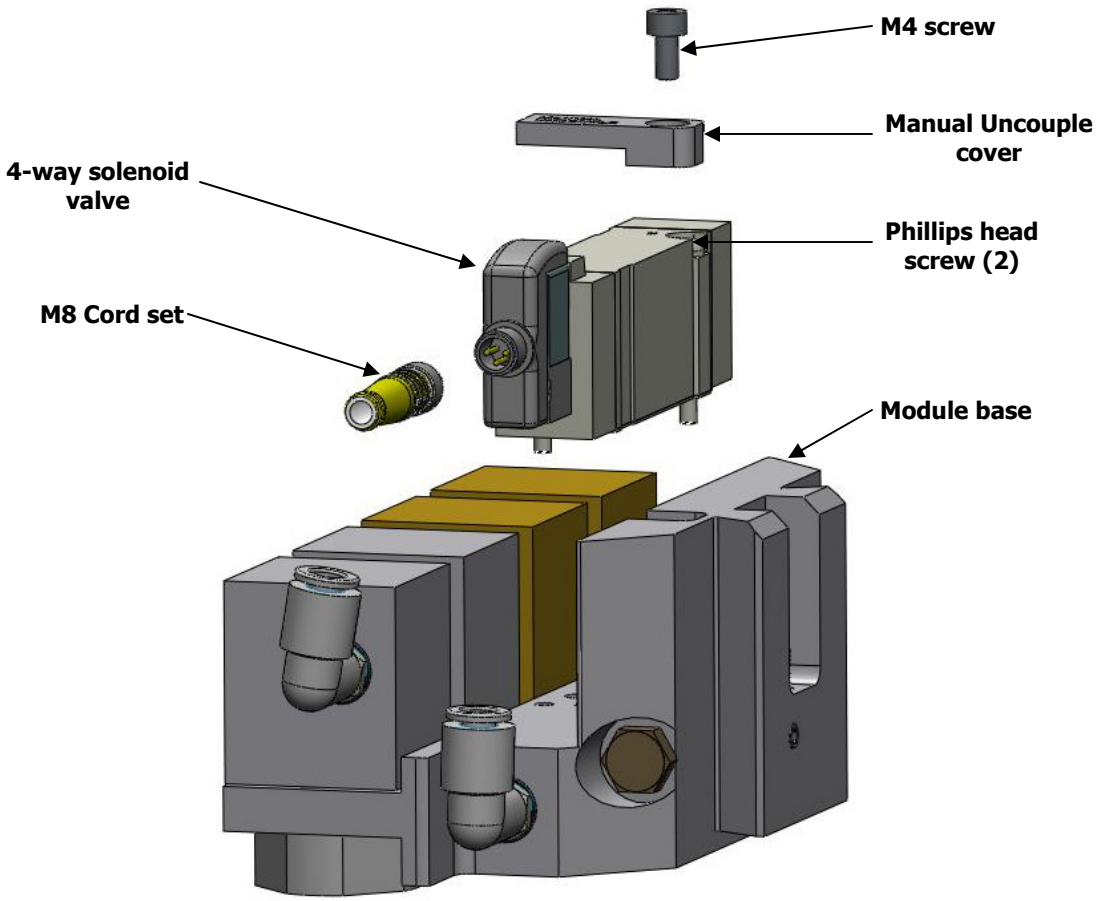
[1] *This method allows for no direct lubrication being required for the male fitting*

9.4 Spare Part Replacement

The following procedures will explain the correct method for removing and replacing the recommended spare parts listed in Section 8 of this manual.

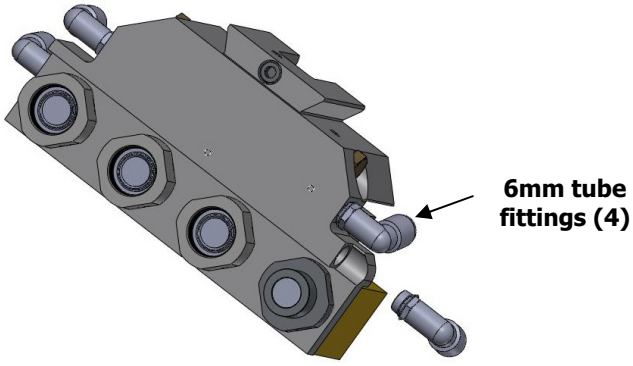
9.4.1 4-way Solenoid Valve

1. Ensure air supply to tool changer is removed prior to performing the remainder of this procedure.
2. Using a 3mm hex wrench, remove the M4 screw that holds the Manual Uncouple cover in place.
3. Remove the Manual Uncouple cover and set aside for installation once solenoid valve is replaced.
4. Disconnect the M8 cord set from the solenoid valve and move cord set away from the valve to prevent the possibility of damage when installing the new valve.
5. Using a No. 2 Phillips screwdriver, loosen and remove the two screws that hold the solenoid to the module base.
6. Remove solenoid valve and discard. Ensure gasket is also removed and discarded.
7. Ensure the gasket surface on the module base is clean and free of debris.
8. Place new solenoid valve into position ensuring that the gasket is in place and aligned to the solenoid valve body.
9. Insert and tighten the two Phillips head screws to a torque value of 1.5 Nm (13 in-lbs).
10. Route the M8 cord set between the solenoid valve and module base.
11. Connect female M8 connector to solenoid valve.
12. Place Manual Uncouple cover in place so that it covers the manual over ride push button on the solenoid valve.
13. Using a 3mm hex wrench, insert the M4 screw through the Manual Uncouple cover and tighten to a torque value of 2.7 Nm (24 in-lb).
14. Restore air supply to the tool changer.
15. Perform Initial Test procedure in Section 5.1 of this manual to verify proper operation of the new solenoid valve.



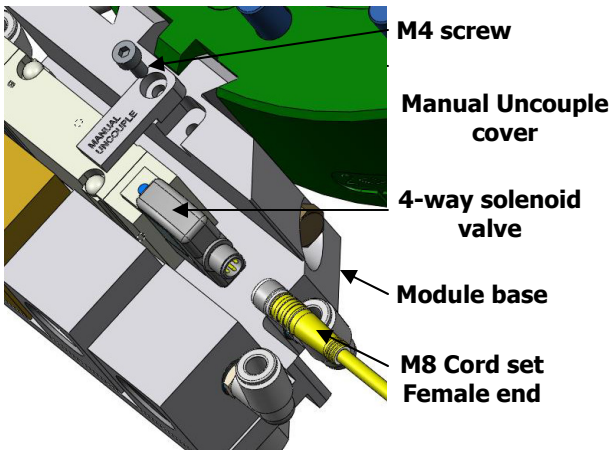
9.4.2 90 degree Tube fittings

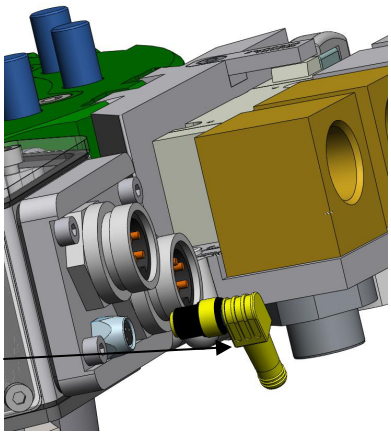
1. Ensure air supply to tool changer is removed prior to performing the remainder of this procedure.
2. Remove 6mm air line from fitting to be replaced.
3. Using a 12mm open end wrench, loosen, remove, and discard the tube fitting being replaced.
4. Ensure G1/8 (BSPP) threads are clean and free of dirt and debris.
5. Insert and tighten new fitting using a 12mm open end wrench until the seal is compressed to the robot adaptor housing.
6. Re-install the corresponding 6mm tube into this fitting.
7. Restore the air supply to the tool changer and ensure the replaced fitting does not leak.



9.4.3 M8 Cord set

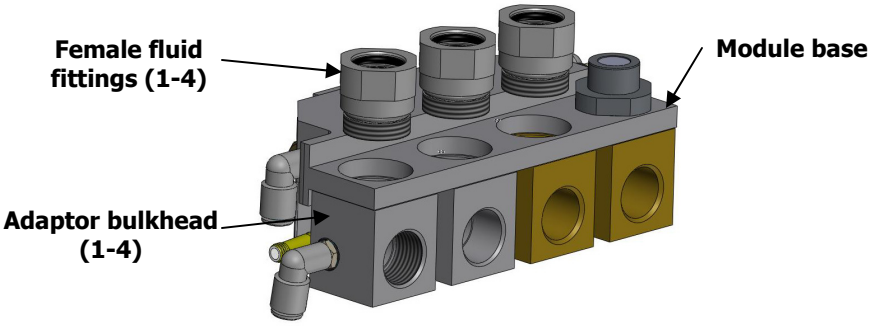
1. Ensure air supply to tool changer is removed and tool side of tool changer is disconnected.
2. Using a 3mm hex wrench, remove the M4 screw that holds the Manual Uncouple cover in place.
3. Remove the Manual Uncouple cover and set aside for installation once the M8 cord set is replaced.
4. Disconnect the female end of the M8 cord set from the solenoid valve.
5. Disconnect the male end of the M8 cord set from the SMR-E electrical module.
6. Discard the existing M8 cord set.
7. Connect the male end of the new M8 cord set to the SMR-E electrical module.
8. Route the M8 cord set between the solenoid valve and the module base ensuring there is enough length to allow for the cable to bend around and the female end connected.
9. Connect the female end of the M8 cord set to the solenoid valve.
10. Place Manual Uncouple cover in place so that it covers the manual over ride push button on the solenoid valve.
11. Using a 3mm hex wrench, insert the M4 screw through the Manual Uncouple cover and tighten to a torque value of 2.7 Nm (24 in-lb).
12. Restore air supply to the tool changer.
13. Perform Initial Test procedure in Section 5.1 of this manual to verify proper operation of the solenoid valve with the new M8 cord set.





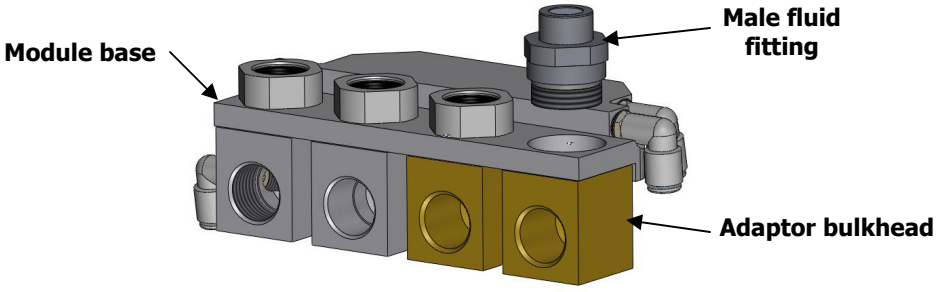
9.4.4 Female fluid fittings

1. Ensure air and fluid lines for the fittings are shut off and drained if necessary.
2. Using a 27mm open end wrench, loosen and remove the female fluid fitting. The adaptor bulkhead and attached tube/hose will be free from the module.
3. Ensure the M24 x 1.5 threads on the fitting and in the bulkhead adaptor are clean and free of dirt and debris.
4. Also ensure seal o-ring is also clean and free from dirt, debris, or hard scale.
5. Insert the new female fluid fitting into the adaptor bulkhead through the module base and tighten the fitting using a 27mm open end wrench to a torque value of 5 Nm (45 in-lb).
6. Ensure fitting in properly lubricated per Section 9.3 of this manual before use.



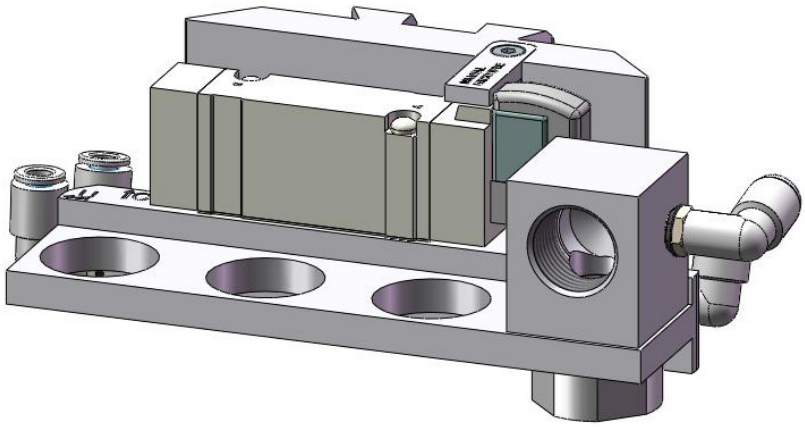
9.4.5 Male fluid fittings

1. Ensure air and fluid lines for the fittings are shut off and drained if necessary.
2. Using a 27mm open end wrench, loosen and remove the male fluid fitting. The adaptor bulkhead and attached tube/hose will be free from the module.
3. Ensure the M24 x 1.5 threads on the fitting and in the bulkhead adaptor are clean and free of dirt and debris.
4. Also ensure seal o-ring is also clean and free from dirt, debris, or hard scale.
5. Insert the new female fluid fitting into the adaptor bulkhead through the module base and tighten the fitting using a 27mm open end wrench to a torque value of 5 Nm (45 in-lb).
6. Ensure fitting in properly lubricated per Section 9.3 of this manual before use.

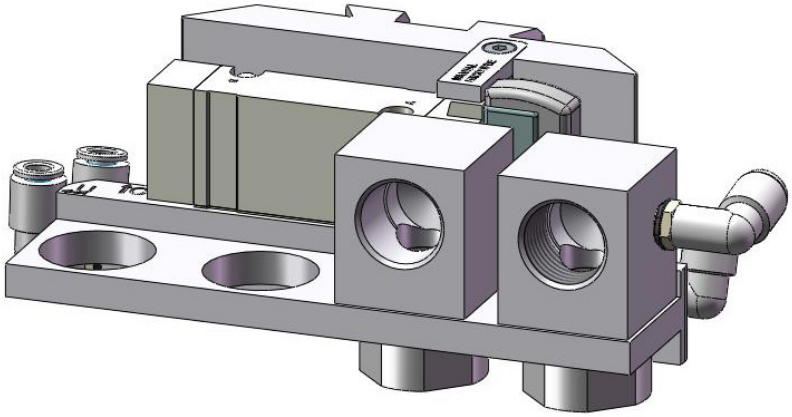


10 Module Variations

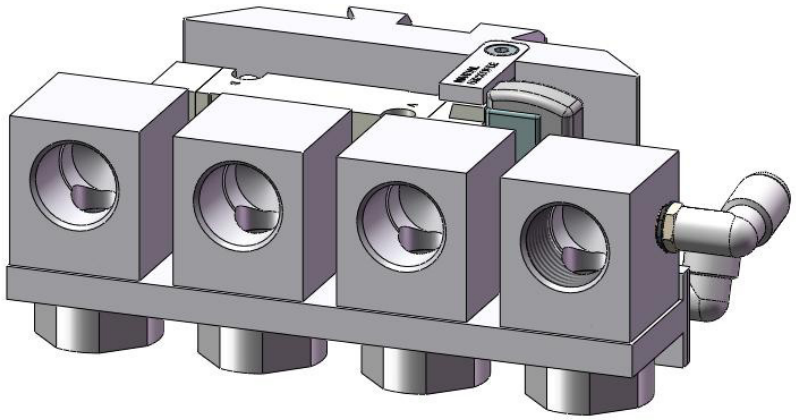
SMR-V-A1N / SMR-V-A1G



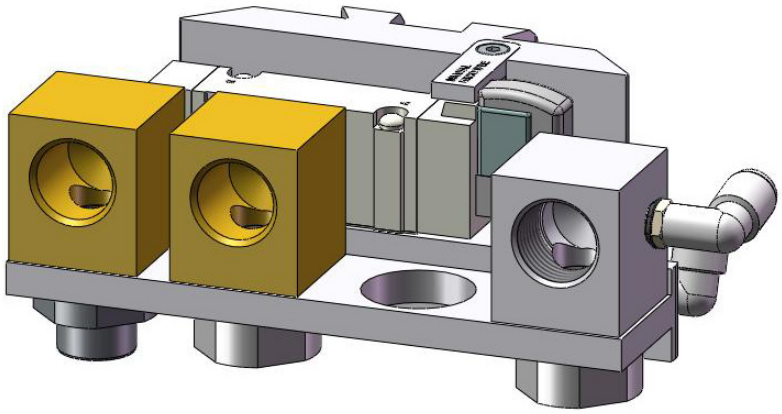
SMR-V-A2N / SMR-V-A2G



SMR-V-A4N / SMR-V-A4G



SMR-V-A1C2N / SMR-V-A1C2G



SMR-V-A2C2N / SMR-V-A2C2G