

MAC Tool Operation and Integration Guidelines

And assembly instructions for partly completed machinery per directive 2006/42/EC Annex VI

Summary

The MAC tools described herein are partly completed machinery and are intended to be used as lifting accessories when integrated with lifting machinery or partly completed machinery such as robotic manipulators. These tools are pneumatically actuated and some are fitted (or are compatible) with electrical feedback sensors to indicate the current state of the tool and object to be lifted. These tools are NOT intended for the lifting or movement of persons, persons and goods, or goods which may carry persons; they shall only be used for movement of goods. It is the responsibility of the integrator to adhere to the assembly instructions provided within and certify the use of this tool in the environment in which it is used to ensure compliance with machinery directive 2006/42/EC and the safety requirements of ISO 12100.

IMPORTANT: This document is an adjunct to the specific standards relating to the intended application and is not intended to replace the relevant statutory documents for industrial practice.

Safety

- Items or body parts between the gripping surface of the magnet and ferromagnetic material are at risk of crushing and impact forces.
- **Never exceed the max rated load⁴** of the Magswitch magnet. This may result in an unsafe or dangerous condition. See de-rating factors for more details of load rating factors. All Magswitch Automation Company magnets specify maximum breakaway strength, but should be operated at a 3:1 Safe Working Load for safety. Please refer to the documentation for the individual magnet for the Safe Working Load of your magnet^{2,4}.
- **DO NOT attempt to alter the device** in any way. This will void the warranty and may result in an unsafe or dangerous condition.
- **Never operate** an unsafe or 'out-of-service' tagged Magnet, or one with missing parts or labels.
- **DO NOT attempt to disassemble** the Magswitch Magnet; there are no operator serviceable parts inside the device and the warranty is void if disassembled.
- All Magswitch products are **designed for normal worksite/jobsite conditions**, do not use underwater or in a hazardous environment unless specifically designed for that purpose.¹
- **Never use any MAC tool as a welding ground or as part of an electrical circuit.**
- **DO NOT use the Magswitch product if it is damaged or is not working properly.** Severe injury can occur if this device is not used properly and safely.
- Actuate the tool to the 'off' state prior to installation or entering work cell. Always **transport and store tools in the 'off' state** to avoid crushing and impact hazards from nearby ferrous metal.
- **Do no turn the magnet 'ON' unless it is in contact with ferromagnetic metal.** Actuation off-target will generate a strong, static, projected magnetic field which can accelerate, draw-in, and trap ferromagnetic material and damage magnetic storage media.¹
- **Always inspect the tool** to ensure that it is in good working order before and periodically during use. Maintain inspection records.
- Always perform thorough testing to ensure that the selected magnet is sufficient to handle the application.
- Tool must be affixed to rigid fixture points on manipulator or test frame prior to actuation. The magnet is capable of lifting and moving itself toward ferrous materials when turned 'ON'.
- Always ensure that **only one sheet is being lifted at a time** during de-stacking operations.
- Always ensure that the **lifting mechanism is capable of lifting the combined weight** of the load plus the magnet.

¹Design guidance is available upon request through your supplier for custom applications.

²SWL determined based on target thickness, air gap, material composition, and other factors. Always test each magnet in your application.

³If high heat applications are desired, custom magnet builds with high temperature magnets can be accommodated. Please contact your supplier for details.

⁴All data is collected in laboratory settings and may not accurately represent your application. Always test each magnet in the desired application before use.

- Operator shall **immediately stop** using the magnet **if it exhibits loss of strength or unusual behavior** during the lift.
- This magnetic tool **performs best when lifting flat, horizontal materials**. Caution should be taken when lifting in shear. Thorough testing should be performed before use in shear applications.
- **Avoid sudden jerking or shock force** as this may exceed magnet holding capacity. Consider use of shear stops or other secondary methods, such as soft starts and stops to prevent loss of magnetic circuit.¹
- **Use caution and ensure that the drop area is safe for release of the part from the magnet.**
- **DO NOT Operate the Magnet at temperatures greater than 120°Fahrenheit (49°Celsius) for prolonged periods unless your tool is rated for higher temperatures and is of class UH or EH.**
- **DO NOT expose standard Magswitch tools to temperatures above 176°Fahrenheit (80°Celsius)**. High temperatures will permanently degrade the Magnet's effectiveness and may result in an unsafe condition.³
- **Never use a Magswitch product for OVERHEAD LIFTING. Ensure the operational area of the magnet is clear of personnel at all times and ample warnings and guards are provided around the pick point, drop point, and travel path. (see ASME B30.20 and other relevant Standards for safe use)**
- Never place any part of your body under the load.
- DO NOT lift a load higher than necessary to complete the task.
- DO NOT leave a static lifted load unattended at any time.
- Magnets must be **centered on load or installed within a fixture to evenly distribute the load between multiple Magswitch tools.**¹
- Always **ensure that the full face of the Magnet is in contact with the load**. Maximum safe lifting capacity may only be achieved when the full face of the magnet is in contact with the load being lifted.¹
- **Not recommended for painted or finish coated surfaces without proper testing and advice** as these may reduce the magnetic bond, affecting lift and shear performance. The magnet may damage the surface finish. Contact supplier for air gap data.⁴
- Always ensure that the target load **will not come in to contact with any obstruction** during travel.
- **Never carry people** or allow people to ride on materials being lifted.
- Pneumatic leaks and tool actuation when not in direct contact with part can generate loud noises. Ensure audible hazards are addressed when tool is integrated.
- This product contains PTFE or Lithium based lubricant. For MSDS information contact Magswitch.



WARNING: This product can expose you to chemicals including nickel and tetrafluoroethylene, which are known to the State of California to cause cancer. For more information, go to www.P65Warnings.ca.gov



WARNING: This product can expose you to chemicals including toluene, which are known to the State of California to cause birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov

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Magswitch Automation Company Series Overview

AR - The Magswitch "AR" series of tools is the root model of pneumatic lifters. Pole shoes must be attached to the unit in order to maximize breakaway force and minimize residual magnetism. Each Magswitch "AR" unit comes equipped with one set of dual purpose pole shoes for flat or pipe/round stock. Rotate the pole shoes so the V shape is exposed for use on pipe and other rounds. The "AR" series allows complete customization of pole shapes to provide the best hold on your hard to grip parts.

Note: You may have to design and fabricate custom pole shoes depending on your application for optimal performance.



AY - The Magswitch "AY" series of tools utilize field interaction between individual Magswitch units to manipulate magnetic field shape for shallow or deep field penetration (depending on the array configuration) and increased holding in shear. A single pneumatic actuator engages all magnets in the array simultaneously. This makes the "AY" series the perfect cost-effective unit for de-stacking operations and lifting flat steel in shear.



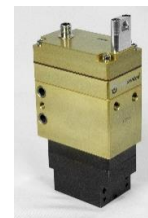
PLAY - The Magswitch LAY series utilizes field interaction in linear magnet patterns to increase depth of field and spread the attractive force over a larger footprint, which increases lifting capacity and control of larger work pieces. A single pneumatic actuator engages all magnets in the pattern simultaneously. With customizable pole shoes to fit almost any application, the LAY is a great all around tool that is perfect for picking pipe and round as well as large plate steel.



T - The Magswitch "T" series is a compact, low-profile version of the AR-series of tools. The pneumatic actuator and magnet housing are shortened significantly but function the same way as the classic varieties. T-series tools can be modified with alternate pole shoes for custom applications as well.



J - The Magswitch "J" series integrates hall effect sensor feedback and "part present" calibration into the T-series of actuators. These pneumatic smart tools can detect whether the desired part is being properly "gripped" by the magnet and pole shoes. Part present and calibration information is communicated with the controller via electrical cable and optional calibration/display box.



D - The Magswitch "D" series features a pneumatic linear actuator and increases the number of magnetic poles from two to seven, dramatically increasing hold strength on thin-gauge materials. D-series tools accept C-slot and T-slot proximity sensors for ON/OFF actuator feedback. These tools do not feature removable pole shoes, and are specialized for flat part pick and place applications.



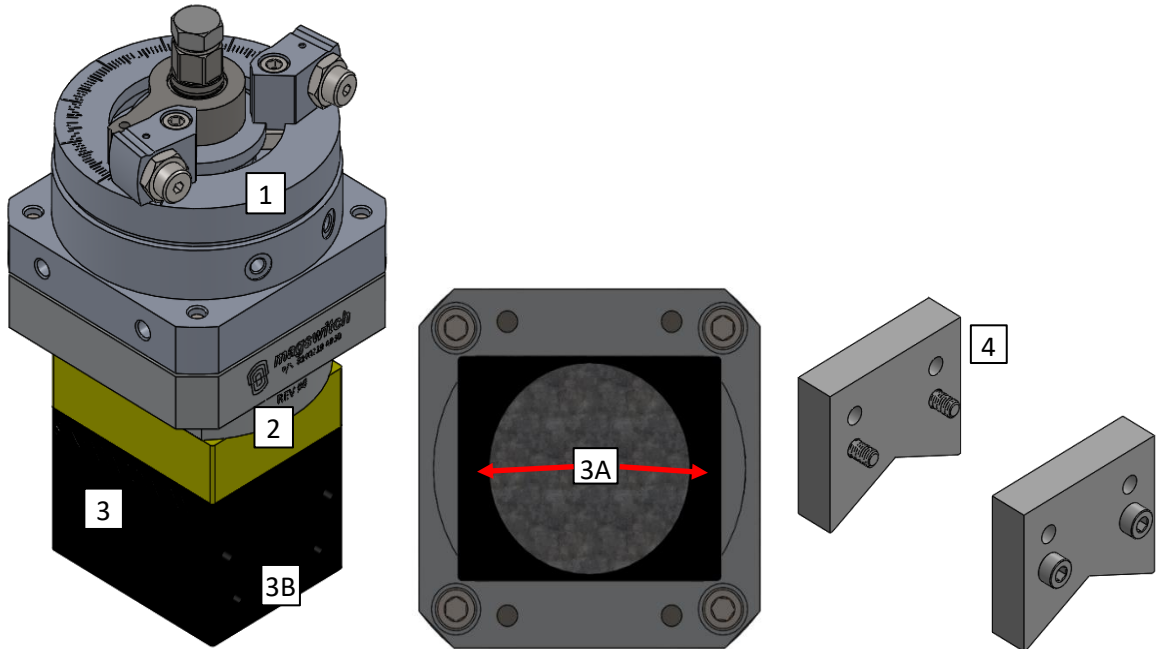
E - The Magswitch "E" series replaces the AR-series' standard pneumatic actuator with a gear reducer, stepper motor, and stepper controller. Power and communicate with the stepper controller by wire using CANopen protocols. Stepper control allows precise, partial actuation of the magnet for fine control of field strength and depth.

E-series tools are electric, not pneumatic. Consult the E-series spec sheets and manuals for information not included in this document.

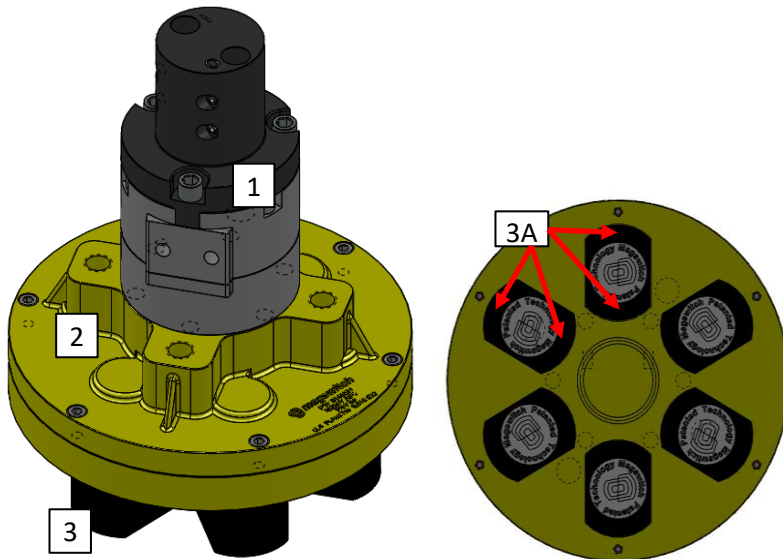


Magswitch Components

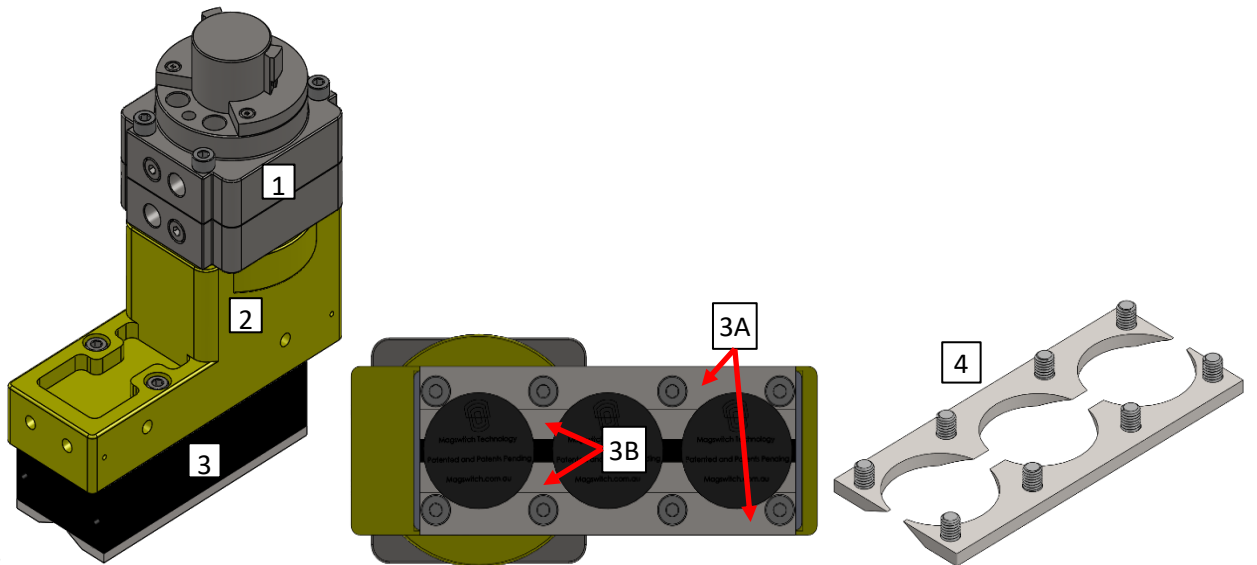
- Parts of a magswitch
 1. Actuator
 2. Adapter
 3. Housing
 - A. Primary Working Face
 - B. Secondary Working Face (if applicable)
 4. Pole Shoes (if applicable)
 5. Electrical Interface (if applicable)



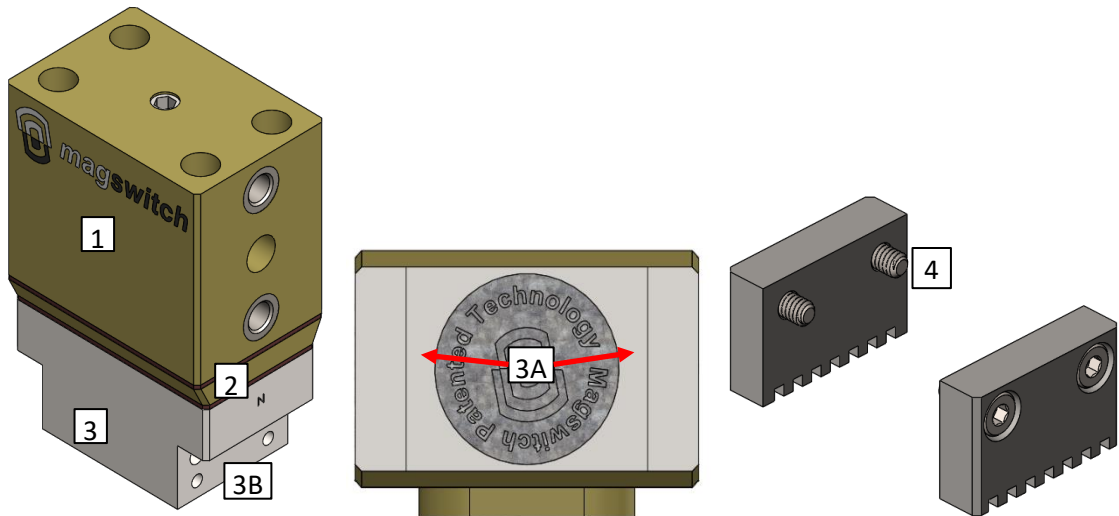
AR Series



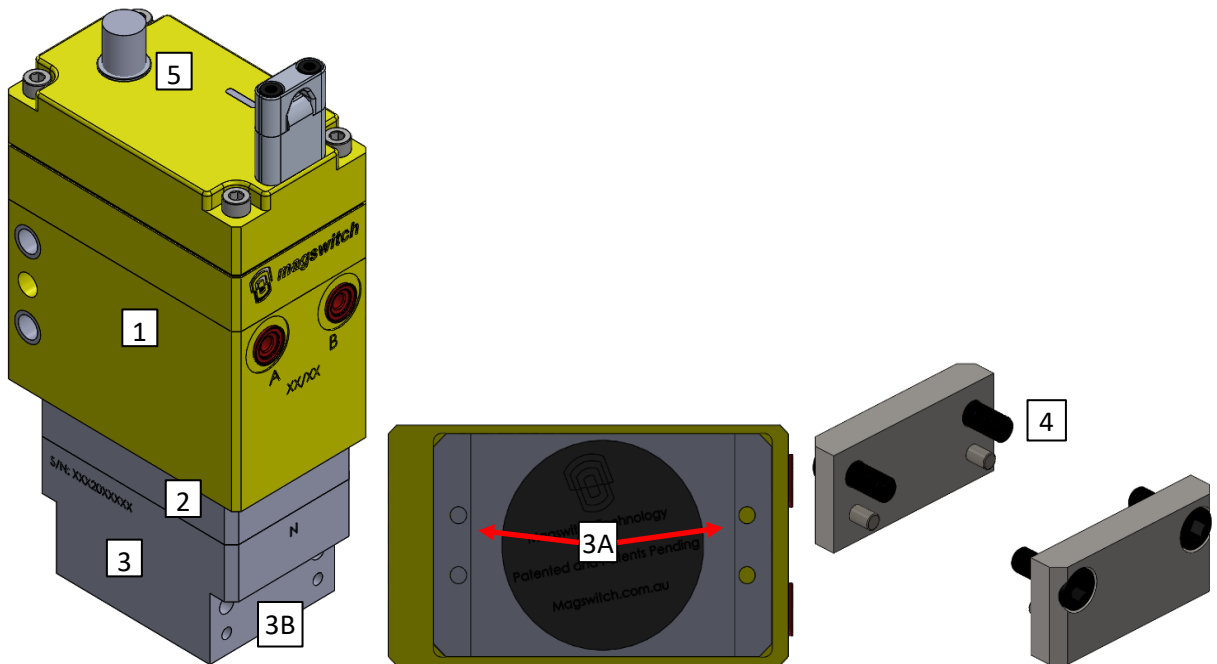
AY Series



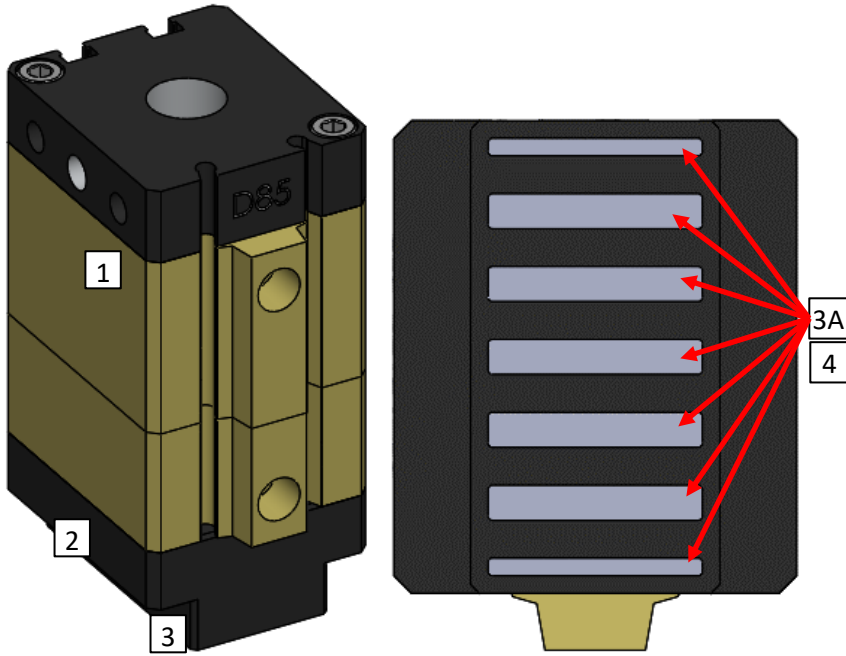
PLAY Series



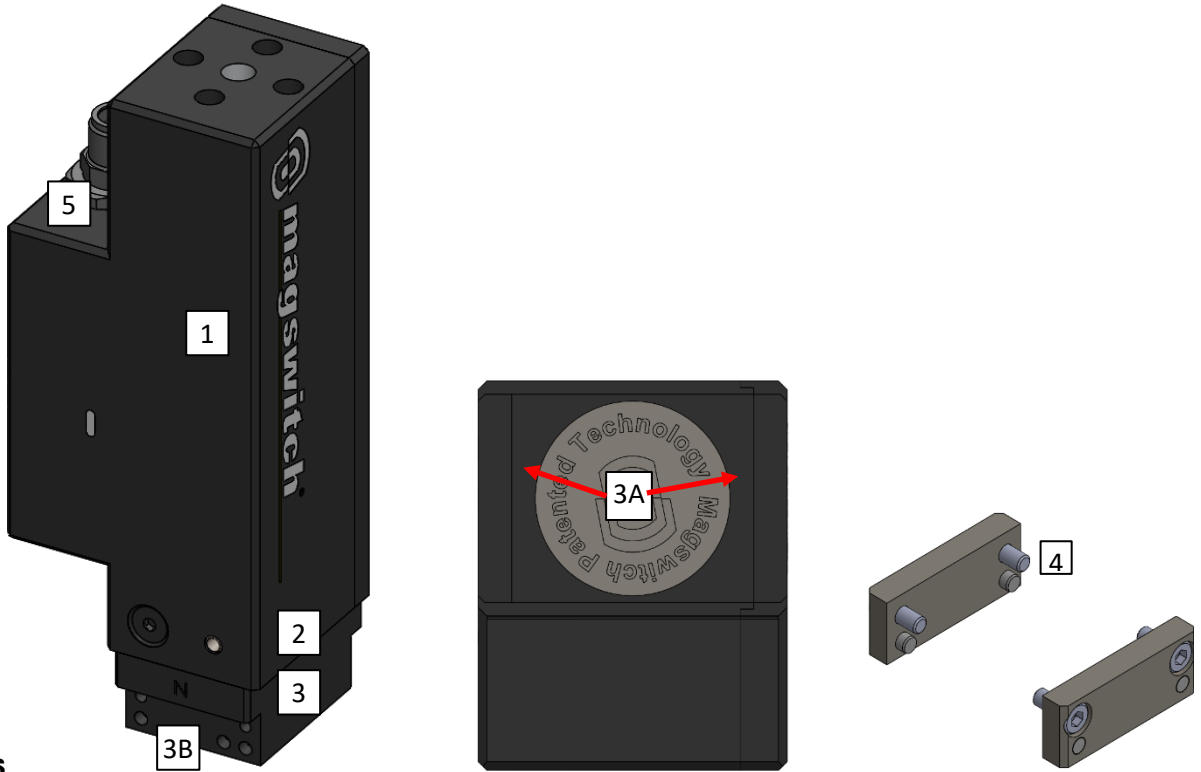
T Series



J Series



D Series



E Series

Target Material

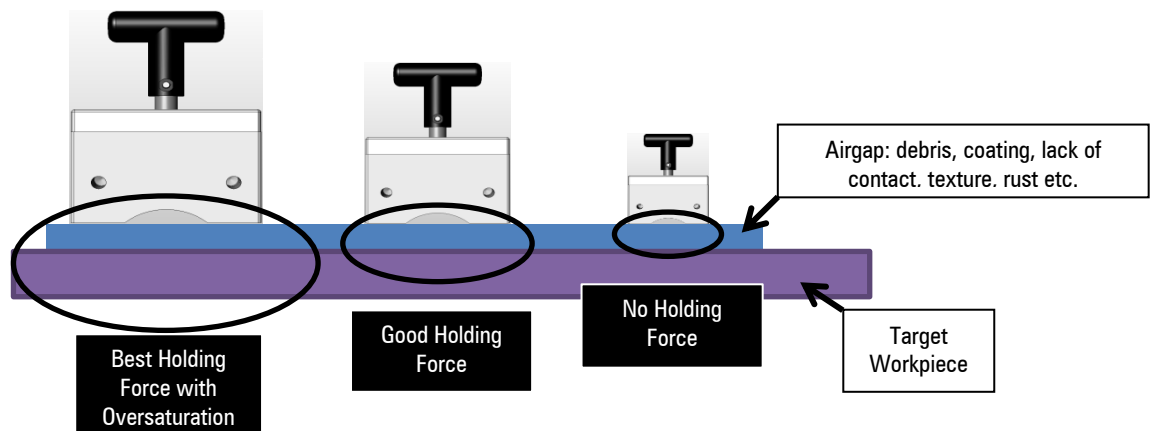
- Target material must be ferromagnetic
 - Low carbon steels are the preferred target
 - Derating factors apply depending on alloy content and carbon content

Reduction Factors for Materials other than SAE 1020 Steel	
Material	Reduction Factor
Cast Steel	0.90
3% Silicon Steel	0.80
AISI 1095 Steel	0.70
416 Stainless Steel	0.50
High Carbon Steel	0.50
Cast Iron Non-Chilled	0.45
Pure Nickel	0.10

- Surface Condition
 - Best performance is achieved when the contact area is clean and free of debris and coatings
 - Paint or rust will introduce an air gap which reduces breakaway force, and should be taken into consideration when designing tooling

Reduction Factors for Materials Surface Conditions	
Material Finish	Reduction Factor
Fine Machined	0.90
Rough Machined	0.80
Foundry Finish (Scale)	0.70
Rough Cast (Porous)	0.50

- Air gaps can take many forms including grooves or other surface features of a target
- Any nicks or cuts in the magnet working face will create an air gap
 - i. These surfaces may be ground smooth to improve deteriorating performance
- Typically larger magnets will have a deeper field depth which allows the magnet to perform better than smaller magnets on air gaps as shown below.



Number of Units

- The number of similar units required for a specific application can be defined by the following equation:

$$\text{Number of Units} \geq \frac{\text{Target Weight}}{\text{Magnet Rated Safe Working Load for Specified Material}}$$

- Safety Factor
 - All MAC products specify maximum breakaway force. We recommend a factor of safety of 3 to compensate for air gaps, dynamic loading, part center of gravity peel effects, etc.
 - i. Individual applications may require higher or lower safe working load ratings
 - ii. Alternative SWL's can be determined by the equation

$$\text{Alternate SWL} = \frac{\text{Breakaway Force}}{\text{Desired Factor of Safety}}$$

- Maximum breakaway force is measured from a fully saturated material with ideal surface conditions (ASTM 794 Steel with surface roughness 63 μ in)
 - Safe working load will vary depending on thickness of material and any derating factors
 - See individual unit manual for safe working load documentation and charts
- Shear force ratings and safety factors specified in tool-specific manuals depend highly on test sample surface finish/texture. If your application requires lifting or rapidly accelerating parallel to the surface of the magnet, supplemental testing must be performed to guarantee the grip of the tool on the part in these conditions.

Fixture Design

- No ferrous fixtures
 - Attachment plates should be non-ferrous; stainless steel or aluminum are ideal
 - Fixtures to hold attachment plate should be non-ferrous
 - Only non-ferrous fasteners should be used in fixture designs
 - Any material that bridges magnet poles must be non-ferrous
- Allow for possible protective guards
 - Protects the sides of the Magnet from impact in operation
 - Prevents accidental contact with adjoining non-target ferromagnetic objects. An air gap will stop secondary flux paths if the base circuit/contact with the intended part is not strong.
 - Guard to be constructed from non-ferrous material (stainless steel recommended)
- Clearance for sensors
 - Position sensors for actuators mount to the top of the unit
 - Impact/contact sensors may be mounted on or around the sides of the unit
 - If possible, these sensors should be non-ferrous
 - In case of ferrous material, unit should be mounted >60mm away from the sides of the unit or as far away as possible.
- Attachment Points
 - Multiple attachment points are provided on each unit
 - Strongest points are in steel housing – use these first (Primary)
 - Second strongest points in aluminum caps and adapters (Secondary)
 - Use these for mounting sensors/accessories if necessary
 - See tool-specific datasheets or contact Magswitch engineering for mounting point information.

Pole Shoe Design

➤ Pole Shoe Material

- Material should be ferrous low-carbon steel; SAE 1018 is recommended
- Material should **NOT** be heat treated or hardened as this reduces flux permeability and can increase residual magnetism after the magnet has been turned off
- Surface finish
 - i. The pole shoes should be bare for best results
 - ii. If corrosion resistance is required, the preferred finishes are listed below

Priority Ranking	Pole Shoe Plating Material
1	Nickel
2	Titanium Nitride
3	Zinc

- iii. Black Oxide coatings are not to be used under any circumstance

➤ Shape design

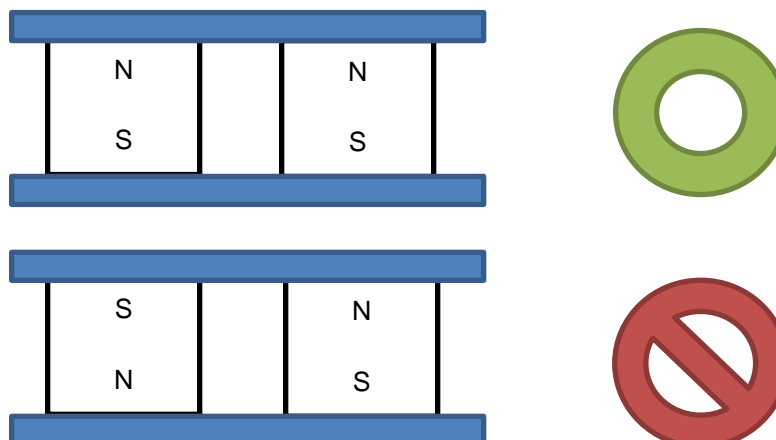
- **Contact your supplier for design advice**
- Design must include two pole shoes
- For best results design should mirror shape and dimension of object being gripped
- Pole shoes should extend to top of steel housing below aluminum cap for maximum flux transmission
- Pole shoes should not make contact with each other to prevent shorting of the magnetic circuit
- Avoid sharp edges along flux path

➤ Hardware

- Any fasteners that mount through or into the pole shoes must be non-ferrous; SAE304(18-8) is preferred

➤ Using multiple Magswitch units in a single fixture

- Spacing
 - i. Position Magswitches such that load is evenly distributed between grippers
 - ii. Optimal Magnetic Interaction
 1. Position the magnets such that the poles are less than 25% of magnet diameter apart to obtain Magnetic interaction between poles
- Pole Alignment
 - i. Common poles may be connected with pole shoes
 - ii. NEVER connect opposing poles on the same pole shoe



Electric Actuators

The E-series electrically-actuated tools have magnet housings that are for the most part very similar to the AR, LAY, and J-series tools, but their electrical actuation characteristics are outside the scope of this document. If operating voltage, current draw, electrical pinouts, etc. are required, please consult their respective spec sheets and the E-series calibration manual. All pole shoe, substrate, breakaway, and safety information previously stated remains true for E-series tools.

Pneumatic Actuators

- Actuation pressure required to actuate a Magswitch tool varies by unit and is dependent on thickness of target and quality of connection.
 - Failure to provide adequate pressure may result in incomplete actuation and reduced breakaway force
 - If tool is partially actuated and power failure occurs, the tool will lose grip and the part may fall.
 - **Maximum, minimum, and off-target actuation pressures for each tool are listed on the following page.**
 - If your model is not listed, contact Magswitch engineering for actuation pressures or consult the model-specific specification sheet.
 - Refer to individual unit specification sheet for pressure vs thickness chart.
- Positive pressure must be applied to port "A" labeled on the actuator to actuate the magnet to the 'ON' state.
 - Reversal of pneumatic ports can result in accidental off-target actuation.
- Some units include adjustable hard stops which must be set correctly in order to achieve optimal performance
 - Unit will arrive with stops set in correct positions
 - Removal, incorrect, adjustment, or modification of hard stops correctly may result in incomplete actuation and may cause unwanted residual magnetism when the tool is turned off.
 - If you have inadvertently modified hard stop position on your MAC tool, it is recommended you contact Magswitch engineering for instructions on setting hard stops in their correct locations. You may be asked to return the tool to Magswitch for servicing and fixing hard stop location (especially for our more powerful tools).

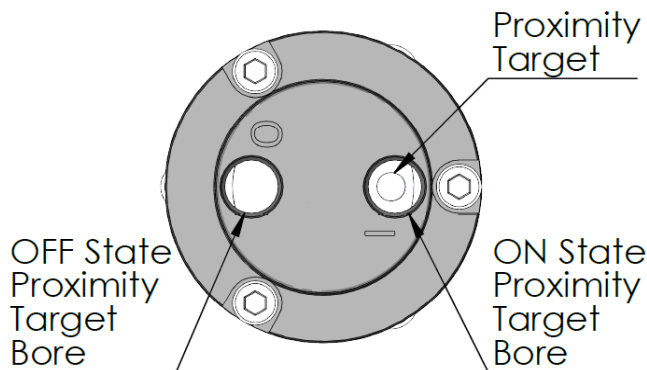
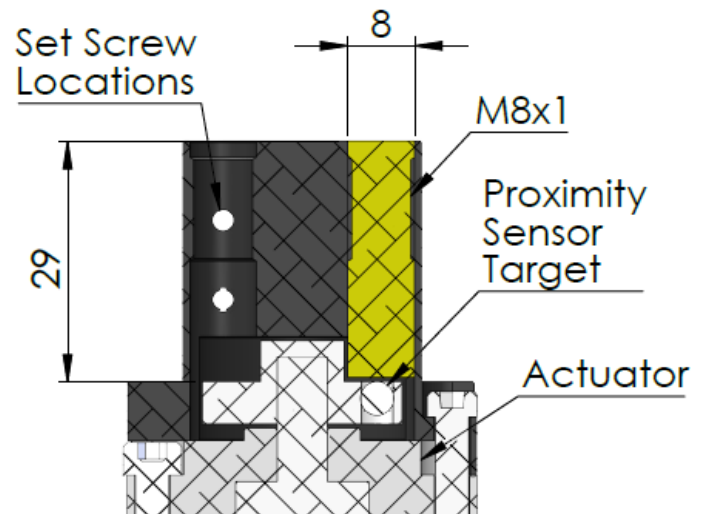
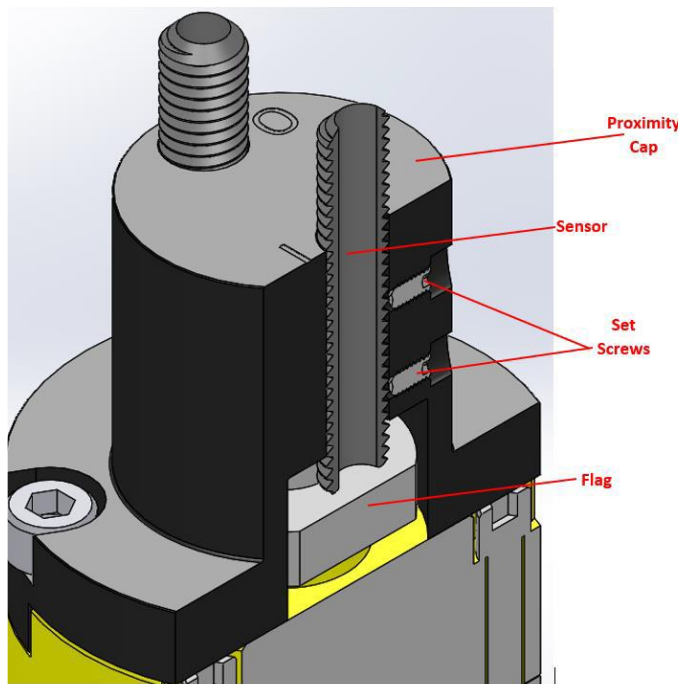
Pneumatic Actuators (continued)

Product	Series	P/N	Spec Sheet	Actuator		Min Actuation Pressure		Off-Target Actuation Pressure		Max Operating Pressure	
				Number	Name	[psi]	[bar]	[psi]	[bar]	[psi]	[bar]
AR20 Classic	AR	8140481	110613	280022	RAS-015-P	21.8	1.50	39	2.69	100	6.89
AR20 NAAMS	AR	8140678	110868								
AR20 NAAMS EH	AR	8140718	110888								
AR20 NAAMS KNE	AR	8140637	110846								
AR20 NAAMS KNS	AR	8140636	110845								
AR30 Classic	AR	8140480	110631	280023	RAS-020-P	21.8	1.50	48	3.31	100	6.89
AR30 LASER FIXTURE TOOL	AR	8.1E+07	1101257								
AR30 NAAMS	AR	8140679	110869								
AR30 NAAMS EH	AR	8140719	110889								
AR30 NAAMS KNE	AR	8140629									
AR30 NAAMS KNS	AR	8140628	110837	280024	RAS-030-P	30	2.07	85	5.83	145	##
AR40 NAAMS	AR	8140715	110883								
AR40 NAAMS EH	AR	8140720	110890	280002	DSM-25-270-P-FW	25	1.72	60	4.14	145	##
AR50 Classic	AR	8140319	110632	280037	CDRB2BW40-180S	20	1.38	55	3.79	145	##
AR50 NAAMS	AR	8140680	110870	280003	DSM-32-270-P-FW	30	2.07	80	5.52	145	##
AR50 NAAMS EH	AR	8140721	110891								
AR70 Classic	AR	8140320	110633								
AR70 NAAMS	AR	8140681	110871	280019	CDRB1BW63-180S	30	2.07	70	4.83	145	##
AR70 NAAMS EH	AR	8140722	110892								
AR110	AR	8140740	110989	280041	DSM-T-63-270-P-FW-A-B	50	3.45	50	3.45	145	##
M10AY ASC	AY	8140543	110727	280036	RAS-020-90-P	40	2.76	46	3.17	100	6.89
M10AY JSC	AY	8140550	110776					40	2.76		
M15AY ASC	AY	8140447	110652					93	6.41		
M15AY JSC	AY	8140332	110651					95	6.55		
M20AY ASC	AY	8140591	110649	280007	CRB2BW30-90D	35	2.41	52	3.59	100	6.89
M20AY JSC	AY	8140590	110650			20	1.38	72	4.96	100	6.89
M30AY ASC	AY	8140263	110653			30	2.07	95	6.55	100	6.89
M30AY ASC EH	AY	8140837	1101074			30	2.07	70	4.83	100	6.89
M30AY JSC	AY	8140176	110645								
PLAY20x4	LAY	8140575	110855	280024	RAS-030-P	30	2.07	56	3.86	145	##
PLAY20x4 EH	LAY	8140711	110885								
PLAY20X4 NAAMS	LAY	8.1E+07	1101226								
PLAY 20x4 EH NAAMS	LAY	8140957	1101227								
PLAY30x7	LAY	8.1E+07	1101300	280065	DRVS-25-270-P	27	1.86	61	4.21	90	6.21
PLAY50x2 EH	LAY	8140873	1101268	280019	CDRB1BW63-180S	40	2.76	75	5.17	145	##
PLAY50x2 MDC	LAY	8140405	110647								
PLAY50x3 Low Profile	LAY	8140771		280044	CDRA1BX50-180Z-M9P						
PLAY50x3 EH	LAY	8140838	1101073	280018	CDRB1BW80-180S	17.1	1.18	80	5.52	145	##
PLAY50x3 MDC	LAY	8140393	110646								
PLAY50x4 EH	LAY	8140874	1101076								
PLAY50x4 MDC	LAY	8140404	110648			45	3.10	90	6.21	145	##
PLAY70x2 EH	LAY	8140875	1101077								
PLAY70x2 MDC	LAY	8140391	110642	280032	CDRB1BW100-180S	30	2.07	100	6.89	145	##
PLAY70x3 EH	LAY	8140836	1101072								
PLAY70x3 MDC HT	LAY	8140544	110723								
PLAY70x4 EH	LAY	8140876	1101078			55	3.79	110	7.58	145	##
PLAY70x4 MDC	LAY	8140417	110644								
J30 Smart Tool	J	8.1E+07	1101299	280050	RAS-020-SQ7-V1	30	2.07	80	5.52	90	6.21
MJ15AY Smart Tool	J	8.1E+07				26	1.79	N/A	N/A		
J50 Smart Tool	J	8.1E+07	1101298	280055	RAS-020-SQ7	19	1.31	80	5.52	90	6.21
J50 V-NAAMS Smart Tool	J	8.1E+07	1101311	280055	RAS-020-SQ7						
T30	T	8.1E+07	1101297	280060	RAS-020-T7	21	1.45	72	4.96	90	6.21
T20	T	8.1E+07	1101397	280069	RAS-015-SQ-T7	29	2.00	38	2.60	102	7.00
D85	D	8.1E+07	1101370	280070				29	2.00	116	8.00

Electrical Interfaces

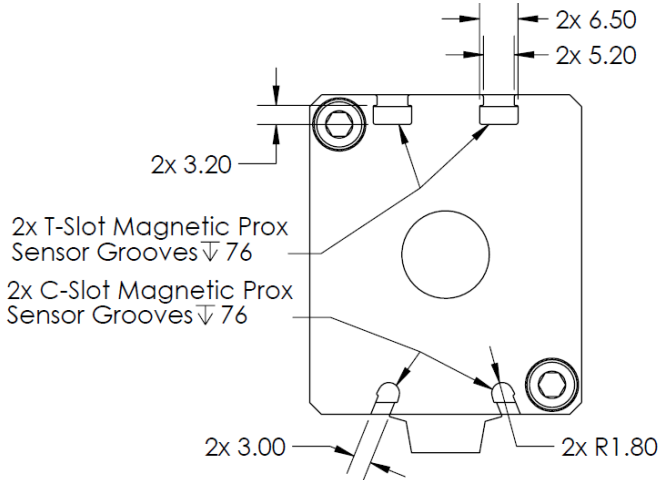
➤ 8mm Proximity Sensors

- The majority of the AR, AY, and LAY-series tools have sensor caps installed to accept two (2x) 8mm diameter proximity sensors.
- Some sensor caps will include M8x1 threads for threading the proximity sensor to the proper depth.
- All sensor caps feature set screws intersecting the M8 bores to hold the proximity sensor in place.
- Dimensions of the proximity sensor bores are shown below (in millimeters).
- Allow a small gap between the proximity sensor and the proximity sensor target to prevent rubbing between components. It is recommended that the user consult the manual for their specific sensor application to adjust this gap accordingly.
- Installation procedure:
 - Loosen the set screws on the side of the proximity cap
 - Measure the distance from the top of the proximity cap to the top face of the flag. Mark this distance on the sensor
 - Insert the proximity sensor into the proximity cap (thread in if necessary)
 - Raise the sensor in its bore so it does not interfere with the surface of the flag (which holds the sensor target). Do not press down on the sensor while tightening the set screws.
 - Repeat procedure for the second sensor.

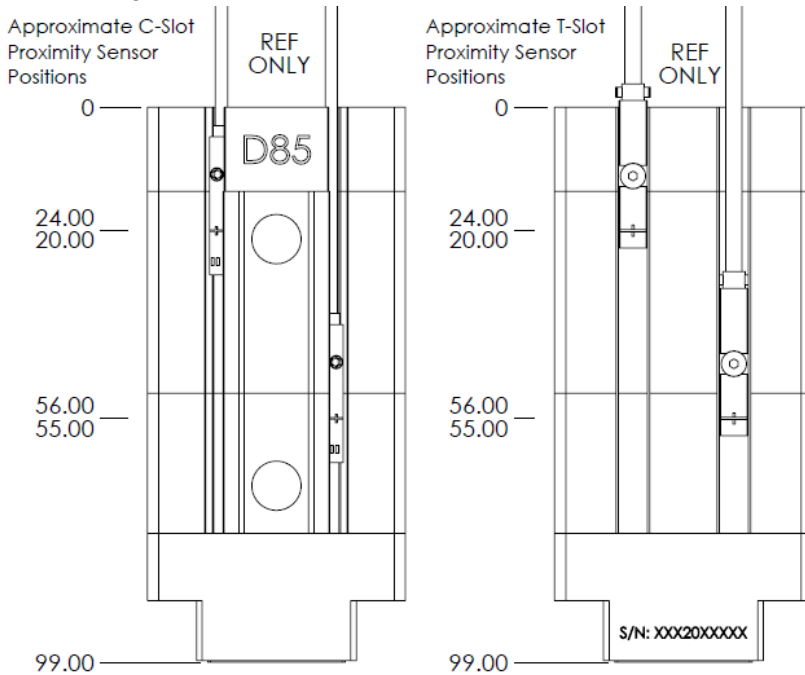


➤ **C-slot and T-slot Proximity Sensors**

- The D85 tool housing contains two C-slot and two T-slot channels around the perimeter of the actuator. Consult spec sheet 1101370 for full tool detail including mounting locations. Slot dimensions are shown below:



- The following images show the approximate regions where magnetic proximity C-slot and T-slot sensors should be installed to ensure reliable ON/OFF signals when the tool is actuated. Note that these positions should be validated at the time of installation before relying on sensor feedback for an automated process.



- Sensor locations are approximated because sensor sensitivity and manufacturing tolerances (of the tool and the sensor) will have an impact on the accuracy to which the sensor must be positioned.
- Installation Procedure:
 - Attach pneumatic supply/solenoid to both threaded (1/8 BSP or 1/8 G) ports on the tool
 - Adjust the thread on the T-slot or C-slot sensor to ensure it has clearance for insertion into the grooves shown above
 - Position the D85 tool on a ferrous target
 - Actuate the tool ON and OFF, sliding the proximity sensor up or down the C-slot or T-slot in the approximate locations shown above until the sensor feedback reliably indicates ON and OFF states
 - The sensor location ~22mm from the top is normally magnetic until the tool is turned ON (NC)
 - The sensor location ~55mm from the top is normally nonmagnetic until the tool is turned OFF (NO)
 - Tighten the thread/locking feature of the proximity sensor in place
 - Route sensor cables to prevent pinching or unnecessary wear.

➤ **PLAY30x7 Integrated Hall Sensor Cap**

- The PLAY30x7 (part number 81401193) lifter can be ordered with an integrated hall sensor cap (8800721), such as in assembly 81401159. Information about this sensor cap can be found in the Festo overview for SRBS-Q12-25-E270-EP-1-S-M8 and the SRBS-Q12 operating instructions:
 - https://www.festo.com/cat/nl_nl/data/doc_engb/PDF/EN/SRBS_EN.PDF
 - https://www.festo.com/net/SupportPortal/Files/354663/SRBS-Q1_2014-12_8042286d2.pdf
- Recalibration of the hall effect “ON” and “OFF” states should not be required unless your application requires custom NO/NC switching logic or PNP/NPN switching output configuration.
- The sensor cap will arrive installed on the PLAY30x7 tool. Removal and readjustment are not required.
- Adhere to the wiring pinout specified in the SRBS-Q12 operating instructions:

Pin	Allocation	Wire colours ¹⁾	Plug connectors ²⁾
1	Operating voltage +24 V DC	Brown (BN)	
2	Switching output 2	White (WH)	
3	0 V	Blue (BU)	
4	Switching output 1	Black (BK)	

1) With use of a connecting cable with open end.

2) Tightening torque for the union nut at the plug connector is max. 0.3 Nm.

- Cables compatible with this sensor should be equivalent to or of the Festo type NEBU-M8G4-K as specified in the datasheet.
- The default switching output of the sensor cap is as a PNP (sourcing) output. The default switching logic is normally open (NO).
- Switching output 1 is triggered when the actuator is in the OFF state.
- Switching output 2 is triggered when the actuator is in the ON state.

➤ **J-Series wiring and interface**

- Refer to the tool-specific spec sheet documentation for additional information on the J-series tools beyond that which is described below:
 - J30 Smart Tool (81401003) spec sheet P/N 1101299
 - J50 Smart Tool (81401007) spec sheet P/N 1101298
 - J50 V NAAMS Smart Tool (81401115) spec sheet P/N 1101311
 - MJ15AY Smart Tool (81401111) spec sheet P/N 1101332
- When interfacing a J-series tool with a PLC or other 24VDC-compatible controller, refer to the M12 12-pin wiring pinout specified in the J-series spec sheets listed above.
 - Note that the functionality of certain pins changes depending on whether the tool is in calibration mode, which is entered by raising the voltage on pin 3 to a logical high for more than 1 second.
- Refer to J-Series part present and pole calibration documentation described below for a more detailed walkthrough of proper calibration procedure.

➤ **J-Series Calibration and Part Present**

- **WARNING** - Tool “part present” calibration and feedback functionality is only accurate for equivalent tool and part combinations. Recalibration is needed if different tools and parts are used in a given work cell. Failure to recalibrate can result in reduced tool and part awareness, including false positive and false negative “part present” states.
- A detailed calibration flowchart for J-series tools is included in each respective spec sheet listed above and the following smart tool setup procedure document.
 - Smart tool setup procedure guide P/N 1101261

Troubleshooting and End-of-Life

- **WARNING** - Prior to troubleshooting, please attempt the following to minimize risk of injury:
 - If an unscheduled stop or power failure occurred, the tool will remain in its last actuated state. If power failure occurred during actuation, the tool will be neither full ON nor OFF, and may revert to the OFF state.
 - Actuating the tool to the OFF state will release any material the magnet is gripping and can pose a drop hazard.
 - Actuating the tool to the ON state on system resume will generate a strong magnetic field and shorten tool life if not in contact with ferromagnetic material.
- Attempt to actuate the tool to the OFF state and bleed remaining air pressure prior to removing from the manipulator/fixture
 - Some tools have exposed actuator shafts. It is permissible to rotate those manually using an Allen key or crescent wrench to turn off the tool. In most cases, rotate the shaft counterclockwise to turn tools off.
- If a tool is not actuating on or off, or is only partially actuating, it will not behave as expected and may exhibit residual magnetic attraction to ferromagnetic objects. These magnetic fields pose crushing and impact hazards. Parts gripped by actuators pose pinching and shearing hazards if they must be pried off.
- If air is audibly passing through a pneumatic actuator without turning the tool on or off, it is likely the actuator will need to be replaced.
- If a tool requires servicing, contact Magswitch customer service or application engineering at 303-468-0662.
 - If a tool has failed in the ON state, you may be asked to disassemble and turn off the magnet prior to shipping, but under no circumstances should this be done without first consulting Magswitch.

	Possible Causes	Possible Solutions
Tool is stuck in the ON state	- lost air pressure - pneumatic blockage - internal mechanical failure	- verify compressed air supply is clean, free of debris, and applied to correct port - if possible, try manually rotating actuation shaft counterclockwise to determine if internal mechanism is jammed
Tool is stuck in the OFF state	- lost air pressure - pneumatic blockage - internal mechanical failure	
Tool is stuck between ON and OFF	- lost air pressure - pneumatic blockage - insufficient air pressure - internal mechanical failure	
Tool is not as strong as it was when new	- operation in temperatures above rating - airgap or layer of non-ferrous material between pole shoes and part - change in part material	- verify operating environment is cooler than 80°C (176°F) unless magnet is UH or EH rated. - clean debris off pole shoes or part - file away any dings or ridges on pole shoes to improve surface contact with part - confirm material ferrous content is consistent
Tool will not turn on all the way	- insufficient air pressure - actuator blow-by (failure)	- verify compressed air supply is clean, free of debris, and applied to correct port - increase air pressure (below max limit)
Tool will not turn off all the way	- hard stops adjusted improperly - internal mechanical failure	- readjust hard stops for full 0°-180° (or 0°-90°) actuation

Warranty

Magswitch Limited Warranty

Magswitch products are covered by a one year limited warranty on material and workmanship. Warranty is non-transferable. Magswitch reserves the right to inspect all product claims under warranty. Any alteration of the device voids this warranty. User assumes all risk for the proper use of this device and for ensuring product suitability for intended application. This warranty shall not cover any incidental or consequential damages due to the improper use or failure of this device.

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