MIS Operation and Design Guidelines

SAFETY

- Never exceed the max rated load of the Magswitch magnet. This may result in an unsafe or dangerous condition. See DeRating factors for more details of load rating factors. All Magswitch Industrial Solutions magnets are rated at 4:1 Safe Working Load for safety. Please refer to the documentation for the individual magnet for the Safe Working Load of your magnet.
- 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 will become void.
- 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.
- Never use any Magswitch Industrial Solutions Magnet 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.
- Ensure that the Magnet is stored in the “off” position when not in contact with metals.
- Never turn the Magnet ‘ON’ unless it is in contact with Ferro-Magnetic metal. When they are in the ON position, and near ferromagnetic materials, there will be a powerful magnetic attraction.
- Always inspect the lifting device 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.
- 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.
- Operator shall immediately stop using the Magnet if any improper performance or conditions exist during the lift.
- This Magnetic tool performs best during straight, flat horizontal lifting. Caution should be taken when lifting in shear and thorough testing performed before use in shear applications.
- Avoid sudden jerking or Shock force as this may cause the Magnet to lose its hold. Consider use of shear stops or other secondary methods, such as soft starts and stops to prevent loss of magnetic circuit.
- Use Caution to ensure that the drop area is safe to release the Magnet and that nothing will fall or become dangerous.
- DO NOT expose the Magswitch Magnets to temperatures above 176 deg Fahrenheit (80 Celsius). High temperatures will permanently degrade the Magnet’s effectiveness and may result in an unsafe condition.
- DO NOT Operate the Magnet at temperatures greater than 120 deg Fahrenheit (49 Celsius) for prolonged periods.
- 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 magswitches.
- 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 lifted.
- 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.
- 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.
- This product contains PTFE or Lithium based lubricant. For MSDS information contact Magswitch.

IMPORTANT – This document is meant as an adjunct to the specific standards relating to the application intended and is not intended to replace the relevant statutory documents for Industrial Practice.

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.
MAGSWITCH SERIES

- **M**
  - The Magswitch “M” series actuated units are designed around an optimized housing that allows for greater breakaway force in a compact design that outperforms other magnets of a similar size. The “M” series is the perfect tool for gripping flat sections of steel.

- **ME**
  - The Magswitch “ME” series actuated units utilize the unique M shape housing with an integrated threaded pin attachment point for quick positioning and superior holding power while allowing for customized pin designs that are easy to change. The ME series is the perfect unit for sheet welding applications.

- **AR**
  - The Magswitch “AR” series is explicitly designed for use with pole shoes. 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. Simply flip the pole shoes around 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 utilizes field interaction between individual Magswitch units to manipulate magnetic field shape allowing for a deeper or shallower depth of field and increased holding in shear while utilizing a single actuator. This makes the “AY” series the perfect cost effective unit for de-stacking operations and lifting flat steel in shear.

- **LAY**
  - The Magswitch LAY series utilizes field interaction between individual magnets to increase depth of field and spread the attractive force over a larger footprint. This allows for greater working loads and increased control over larger work pieces. 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.
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)

AR SERIES

M/ME SERIES

LAY SERIES

AY SERIES
TARGET MATERIAL

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

<table>
<thead>
<tr>
<th>Material</th>
<th>Reduction Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Steel</td>
<td>0.90</td>
</tr>
<tr>
<td>3% Silicon Steel</td>
<td>0.80</td>
</tr>
<tr>
<td>AISI 1095 Steel</td>
<td>0.70</td>
</tr>
<tr>
<td>416 Stainless Steel</td>
<td>0.50</td>
</tr>
<tr>
<td>High Carbon Steel</td>
<td>0.50</td>
</tr>
<tr>
<td>Cast Iron Non-Chilled</td>
<td>0.45</td>
</tr>
<tr>
<td>Pure Nickel</td>
<td>0.10</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Material Finish</th>
<th>Reduction Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Machined</td>
<td>0.90</td>
</tr>
<tr>
<td>Rough Machined</td>
<td>0.80</td>
</tr>
<tr>
<td>Foundry Finish (Scale)</td>
<td>0.70</td>
</tr>
<tr>
<td>Rough Cast (Porous)</td>
<td>0.50</td>
</tr>
</tbody>
</table>

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

\[
\text{Number of Units} = \frac{\text{Target Weight}}{\text{Magnet Rated Safe Working Load for Specified Material}}
\]

Safety Factor
- All MIS products are rated at a safe working load of 4:1 (SWL 4:1)
  - Individual applications may require higher or lower safe working load ratings
  - Alternative SWL’s can be determined by the equation
    \[
    \text{Alternate SWL} = \frac{(SWL 4:1) \cdot 4}{\text{Desired Factor of Safety}}
    \]
- Maximum breakaway force is measured from a fully saturated material with ideal surface conditions (ASTM 794 Steel with surface roughness 63µin)
- 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

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
- Ensures an air gap to stop a secondary flux path to an adjoining non-target ferrous object if the base circuit 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)
  - Use these for mounting sensors/accessories if necessary
- See images on the following page indicating Primary and Secondary mounting points
PNEUMATIC ACTUATORS

- Actuation pressure required to actuate a Magswitch 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

<table>
<thead>
<tr>
<th>Maximum Air Pressure by Part Number</th>
<th>psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>8140440/8140331/8140485/8140481/8140477/8140480/8140447/8140332</td>
<td>100</td>
</tr>
<tr>
<td>8140447/8140478/8140389/8140343/8140319/8140320/8140474/8140475/8140263/8140176/814005/8140405/8140393/8140404/8140391/8140392/8140171</td>
<td>145</td>
</tr>
<tr>
<td>8140479/8140478/8140389/8140343/8140319/8140320/8140474/8140475/8140263/8140176/814005/8140405/8140393/8140404/8140391/8140392/8140171</td>
<td>145</td>
</tr>
</tbody>
</table>

- Refer to individual unit specification sheet for pressure vs thickness chart

- Some units include adjustable stops which must be set correctly in order to achieve optimal performance
  - Unit should arrive with stops set in correct positions
  - Failure to set stops correctly may result in incomplete actuation and may cause unwanted residual magnetism when the Magswitch is turned off
  - To adjust stops, you may need the following tools:
    i. Hex key set
    ii. Phillips Screwdriver
    iii. Square or Protractor

TOOLS

“F” Series Actuator Adjustment (see diagram on next page)
  i. Position indicator arm should point to one of the large markings on the indicator dial parallel to the air port side of the unit
  ii. Loosen the socket head cap screw holding the position limiters in place
  iii. Move the unit to the full off position
  iv. Check magnet for residual magnetism by touching the housing with a thin metal sheet
    1. If there is magnetic force on the sheet, the unit is not in the fully off position
  v. Move the position stop until it is touching the position indicator arm
  vi. Tighten the socket head cap screw until the position limiter is locked into position
  vii. Set the opposing position limiter 180 degrees opposite the first limiter and tighten down
  viii. Place the unit on a piece of steel and turn “on”
  ix. Check that the final position of the indicator arm points to the large hash mark 180 degrees from the initial starting point
Correct Setting of Position Limiters for Style “F” Actuator

- “M” Series Actuator Adjustment (AY UNITS ONLY) (See diagrams below)
  i. Turn unit to “off” position
  ii. Loosen both switch brackets via Phillips head screws ½-1 turn or until switch brackets move freely
  iii. Remove socket head cap screw from top of unit
  iv. Remove dial indicator lid and switch brackets from unit
v. Loosen socket head cap screw holding position limiting block nearest the indicator pin
vi. Adjust position limiting block such that the flat on the block creates a 90 degree angle with the indicator pin

Correct Positioning of rotation limiter block “M” Series Actuator on AY series units

vii. Reassemble unit by reversing steps vi. – ii.

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

<table>
<thead>
<tr>
<th>Priority Ranking</th>
<th>Pole Shoe Plating Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nickel</td>
</tr>
<tr>
<td>2</td>
<td>Titanium</td>
</tr>
<tr>
<td>3</td>
<td>Zinc</td>
</tr>
</tbody>
</table>

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

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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. All Magswitch products are covered under International and U.S. Patents 6,707,360 & 7,012,495. Add’l patents pending.