MAKESAFE® TOOLS
PREVENTING INJURIES SINCE 2016

Industrial Machinery Brake (IMB)

User Manual

Note: The image above represents one particular configuration of this product though this manual can be used for all product configurations.

⚠ Warning ⚠

You have just purchased a safety device and this manual contains critical safety instructions on the proper setup, operation, maintenance, and service of this safety device. Keep this document readily available, refer to it often, and use it to instruct other operators.
Failure to read, understand and follow the instructions in this manual may result in property damage and/or serious personal injury - including amputation, electrocution, or death. The owner of this device is solely responsible for its safe use.
The manufacturer will not be held liable for injury or property damage from negligence, failure to adhere to this documentation, improper training, device modifications or misuse.

⚠ Warning ⚠

This safety device is intended to be installed as a retrofit to a very specific class of power tool. Read and understand the intended use and limitations of this device before installing it.
The manufacturer has made reasonable attempts to test and describe this device's compatibility with different power tools but cannot certify or guarantee its compatibility with any one power tool. It is the responsibility of the owner of this device to follow the guidance provided below to determine compatibility.

⚠ Warning ⚠

All induction motors, such as those running power tools, have inherent limitations on their maximum number of starts per hour and their minimum rest time between starts, as described in NEMA MG 10, Table 8. Motor braking contributes additional heat to the motor and can significantly impact these values. Reduce allowable startups per hour by a factor of 0.5 and increase rest time between starts by a factor of 1.5, until such time that a more precise factor can be determined by the operator for a specific tool and set of conditions.

⚠ Warning ⚠

When this device is in braking mode, it delivers high voltage direct current to your tool. If you operate the tool switch during braking, you will destroy or significantly reduce the life of your tool switch while also increasing the risk of electrical fire. Never operate your tool switch during braking and always cover the tool switch as described in the instructions below.

⚠ Warning ⚠

RISK OF ELECTRIC SHOCK

DISCONNECT ALL SOURCES OF POWER PRIOR TO SERVICING THIS DEVICE.

Important!

Retain this manual and include it with the original user manual for the machine on which this device is installed.

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Introduction

Application

The MAKESafe Industrial Machinery Brake (IMB) is a safety device that provides the following safety functions to an existing machine:

- restart protection
- emergency stop
- motor braking
- short-circuit protection
- motor overload protection

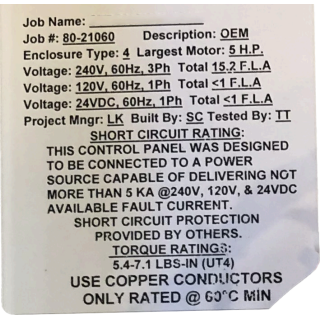
Compatibility

This safety device is not compatible with all machinery. Please complete the included compatibility checklist below before installing this device.

Specifications

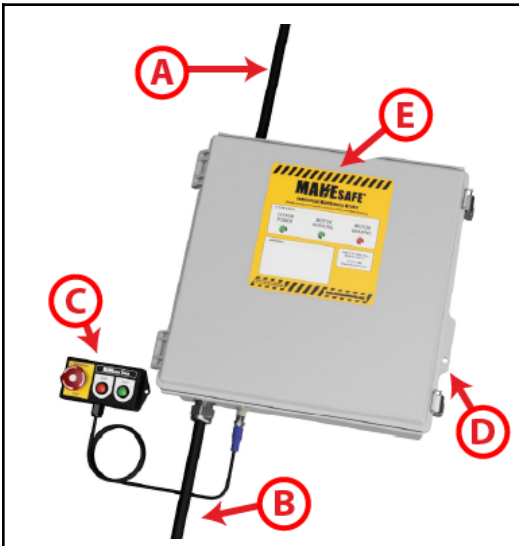
Each IMB is built-to-order to meet the voltage, horsepower, and accessory requirements of a specific customer application. To obtain the ratings of your specific IMB, refer to the ratings label on the panel itself. The label will be located on the exterior side of the panel and/or the inside of the panel lid.

(example of UL mark)



(example ratings label)

Device Diagram



A	Primary input power for the IMB
B	Output to the machine motor
C	3-Button Control Panel (start/stop/e-stop)
D	Lockable Tab
E	Status Indicators

Compatibility Checklist

Getting Ready

Prior to completing the compatibility checklist, collect the following items:

- The MAKESafe Industrial Machinery Brake (IMB).
- The machine you intend to use this IMB with.
- The instruction manual and specifications sheet for your machine.

As the owner of this safety device and your pre-existing machine, it is your responsibility to complete this compatibility checklist before installing this safety device. If you cannot complete the checklist, do not install the device.

Checklist	For More Information
❑ Confirm that the voltage, number of phases, and frequency of your **machine** match the voltage, number of phases, and frequency indicated on your **IMB.**	***Machine*** *specifications are typically marked on the machine's motor.* ***IMB*** *specifications are marked on an attached label.*
❑ Confirm the motor horsepower on the **machine** is rated at or below the horsepower rating of your **IMB**.	
❑ Confirm the **machine** uses an AC induction motor for its motive force.	See section titled *Identifying Motor Type*
❑ Confirm that the **machine** motor and any other parts of the drivetrain (e.g. gears, pulleys, etc.) are not mounted on a reverse threaded spindle or confirm that you will operate the IMB within the specified limits.	See section titled *Understanding Reverse-Threaded Spindles*.
❑ Confirm the **machine** contains only a simple on/off switch (for plug-and-play installation) or that you plan on hard-wiring this IMB directly to the machine motor.	See section titled *Recognizing Existing Controls*.

Identifying Motor Type

Machine motors come in a wide variety of shapes, sizes, and types. The intent of this section is to help you identify if your machine uses an AC Induction Motor.

You have an Induction Motor if …

- You see one or more external capacitors on your motor. These often appear as cylindrical or rectangular lumps on the exterior of your motor (see photos) but may be hidden inside some bench grinders.
- You have a stationary (not “portable” or “jobsite”) power tool. Tools like bench grinders, band saws, table saws, jointers, and disc sanders typically use AC Induction Motors.

You <u>do not</u> have an Induction Motor if…

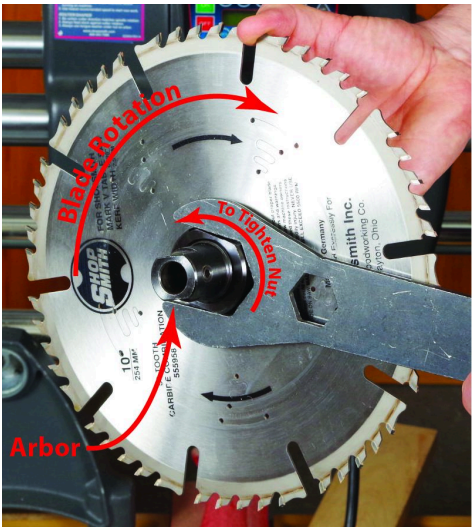
- Your tool is hand held. Tools like a corded drill or angle grinder do not use an AC Induction Motor.
- Your motor uses brushes. Brushes are a common maintenance item on other motor types. If your **machine** manual describes brushes, you see brush caps on your motor (image below),or you see sparking from your motor during use, your **machine** does not have an AC induction motor.

(handheld power tools example)

Reverse-Threaded Spindles

Reverse threaded spindles are used on some types of machines. “Reverse threaded” means that the torque of the motor in normal operation puts force on the arbor nut to tighten the “business end” onto the spindle. This is an inherent safety measure to make sure that cutting blades and sanding/grinding surfaces don’t loosen during normal operation.

When a motor brake is used to slow a machine’s operation, the momentum of the “business end” puts a loosening force onto the arbor nut. If this force is sufficiently large, it can loosen or unscrew the arbor nut. For this reason, you should never apply excessive braking torque to a reverse threaded spindle. To prevent excessive braking torque on reverse-threaded arbor tools, adhere to the following operational limitations.



Limitations of Operation

If you have a machine with a reverse threaded spindle, ensure that you follow the rules and limitations below. Failure to follow the limitations below may increase risk of injury.

1. Check the tightness of the arbor nut prior to installation and as a regular maintenance item.

   Regularly check the tightness of your arbor nut against the torque specifications listed in your tool manual. To prevent loosening, use double-nuts or other positive locking methods.

2. Calibrate the braking torque to achieve a stopping time greater than the time it takes the **machine** to turn-on and reach full speed.

   When braking a machine with a reverse-threaded spindle, never calibrate the brake to stop the tool in less than two seconds. Refer to the calibration section of this manual for a discussion of how to calibrate your device.

3. Never use the IMB to brake high inertia reverse-threaded loads, such as:
   - a lathe with a reverse-threaded spindle.
   - a saw with a dado or other non-standard blade installed.

   The larger the business end, the more loosening force will be applied during braking. For example, a lathe with a reverse-threaded spindle should never be used with a motor brake. The chuck has sufficient mass to unscrew itself from the spindle during braking and is a severe safety risk.

4. Always make sure that all machine wheel guards, blade guards, shields, and other manufacturer-provided and OSHA required guards are properly installed and adjusted.

   Machinery should never be operated without manufacturer-provided and OSHA required guards.

Recognizing Existing Controls

The MAKESafe Industrial Machinery Brake (IMB) is designed for plug-and-play use on machines with a simple on/off switch and no pre-existing electronic controls. If your machine has any other controls, electronic indicators, digital displays, forward/reverse switches, electronic dials, electronic speed controls, magnetic switches, or variable frequency drives - additional wiring and consideration may be required. Contact MAKESafe Tools for assistance and we'll help you to determine the best way to proceed with the installation.

Alternatively, you can disconnect any existing controls and wire the IMB directly to the machine motor.

Warning: Below are some examples of existing controls that would prevent a plug-and-play installation. If your machine has any of the following controls, please contact MAKESafe Tools before proceeding with your installation:

Note: this is a list of examples but does not represent every possible control. If in doubt, contact MAKESafe Tools.

Magnetic Switch

Note: Many of the switches shown above could be a magnetic switch or a simple on/off switch as they look similar. The following section provides a simple procedure to determine if your machine has a magnetic switch installed.

Starter



Reversing Switch

Variable Frequency Drive (VFD), Inverter, or Electronic Speed Control


How to Check for a Magnetic Switch

If your machine utilizes spring-loaded or momentary push buttons for start and/or stop operations (as opposed to a toggle switch or other mechanical switch), follow the procedures below to confirm that your power tool switch is not a magnetic switch.

Note: This evaluation is for machines with relatively simply on/off controls and not for evaluating larger control systems. Before proceeding, confirm that the working area is free of hazards and that it is safe to operate the machine.

Step 1: Turn the machine ON.

Step 2: While the machine is ON and running, remove power by unplugging the power tool or by switching-off power at an electrical disconnect switch or circuit breaker.

Step 3: Count to 5 then restore power by plugging-in the machine or by switching-on power at the disconnect switch or breaker.

Evaluate:

- If the power tool automatically turns ON when power is restored, then your power tool does not have protection from unintentional restarts. You do not have a magnetic switch.

If the power tool remains off when power is restored and requires manual turn-on to restart, then your machine does have protection from unintentional restarts. It is likely that you have a magnetic switch, starter, or other type of control installed. Contact MAKESafe Tools before proceeding with your installation.

Preparing For Installation

1. Make plans for this machine to be completely off-line for the entirety of this installation.
2. Ensure that the machine has been disconnected from all sources of energy (electrical plugs, compressed air, etc.) then lockout and tagout any connections that could supply energy to the machine.
3. Have spare fuses on hand (see later section for fuse locations).
4. Ensure the installation site has adequate circuit protection for the IMB supply cable and the panel itself (see panel ratings).
5. Verify that the IMB electrical ratings match the machine the panel is being installed on.
6. Plan the physical mounting of the IMB. Additional mounting hardware and mounting flanges have been provided.
7. Open the IMB and gently remove any shipping materials or filler.
8. Once shipping materials have been removed, visually inspect the IMB interior for parts, wires, or connections that may have been damaged during shipping.
9. If the machine is three-phase, take note of the machine's existing direction of rotation.
10. Review this entire manual before beginning work.

Warning: *This guide is meant as a helpful aide but is not a replacement for electrical expertise or qualifications. All electrical work should be performed by someone qualified to do the work. It is the installers sole responsibility to perform the installation in compliance with all local codes and standards.*

Physical Installation

1. Decide where to mount your new IMB and the 3-button control panel. Select locations that satisfy the following requirements:
    - the IMB door is free to swing open
    - sufficient length of portable cord is available to route from the power source to the IMB and from the IMB to the machine motor
    - the 3-button control panel are easily accessible by the machine operator
    - sufficient length of control cable is available to route from the IMB to both the forward/reverse switch and the 3-button control panel.
    - the IMB and wiring do not pose a tripping hazard and do not obstruct movement of personnel
2. Once you've confirmed the locations, use the provided mounting flanges to rigidly mount the IMB, and the 3-button control panel to the machine frame or other solid surface.

Electrical Installation

1. Disconnect the existing forward/reverse switch from the motor.
2. Connect the primary power output of the IMB directly to the machine motor. See the device diagram above and the attached IMB schematic for additional information.

   Note: *After installation we'll check to make sure the motor is spinning the correct direction. If it isn't, you can swap any two of the motor power wires in the motor junction box to correct the problem.*

3. Connect the primary power input of the IMB to power (e.g. NEMA plug, disconnect, etc.).
4. Connect the 3-button control panel to the IMB via the M12 connector.
5. Adjust the current setting on the Motor Protection Circuit Breaker (MPCB) to match the FLA rating of the motor.

Note: This panel replaces **ALL EXISTING CONTROLS** on the machine. Please contact us for assistance if any other controls are present on the machine.

Occupational Safety Standards

ANSI B11.19-2010, Performance Criteria for Safeguarding, states the following:

Code Excerpt (Requirement)	**Code Excerpt (Explanation)**	**Relevance & Applicability***
"The user shall ensure that guards are installed, maintained, and operated so as to protect against: unauthorized adjustment or circumvention;" (ANSI B11.19-2010 7.2.6)	*"Guards installed in such a manner that tools are necessary for their adjustment or removal may satisfy this requirement."* *"Examples of some types of fasteners that should not be used are: slotted or Phillips head screws; wing nuts; Magnets; latches and hasps; hooks and eyes."* (ANSI B11.19-2010 E7.2.6)	After the installation of your **IMB**, MAKESafe Tools recommends the following in order to comply: **1)** Cover the original tool switch on your **machine** to prevent tampering and to maintain its 'on' position. **2)** Use a plug lockout enclosure or other fastening means to prevent the unauthorized unplugging of the **machine** from the **IMB**.

**It is the end user's responsibility to read and interpret all occupational safety requirements along with their local authority having jurisdiction. Interpretations provided here are the opinion of MAKESafe Tools.*

Testing & Calibration

Note: *If anything unexpected occurs during the power-up or testing phase, immediately turn off then unplug the machine.*

1. Ground Continuity

1.1. Using a multimeter, check for continuity from the power supply ground to each of the following: the steel backplate inside the IMB and the motor chassis. Each reading should be less than 1 ohm of resistance.

2. The first power-up

2.1. Remove any temporary tooling from the machine.

2.2. Ensure that the machine, the machine table, and the surrounding area is free of loose tools, debris, tripping hazards, and other secondary hazards.

2.3. Ensure you are wearing safety glasses and any other appropriate PPE and that others are nearby and available to assist if needed. Notify nearby machine operators that you are testing a new electrical installation.

2.4. Open the IMB, identify the control PCB, and ensure the braking torque and braking time potentiometers are at their lowest setting (full counter-clockwise, see Calibration section).

2.5. Ensure that the MPCB in the IMB is in the ‘on’ position.

2.6. Close the IMB.

2.7. Remove the lockout mechanism you put in place at the beginning of this project. If you need to leave before testing and validation is complete, ensure that the machine is locked out again before leaving.

2.8. Connect the primary power input of the IMB to power.

2.9. Be attentive for any out-of-place sounds or smells.

3. Machine Testing

3.1. Turn the machine ‘on’ by pressing the ‘start’ button on your 3-button panel. Pause for a few seconds while the machine runs

3.2. Observe the direction of rotation of the machine. If the machine is operating in the correct direction, move to the next step. If the machine is rotating backwards, disconnect all power then return to the Electrical Installation section to swap any two motor wires. After that is complete, start again from the beginning of this section.

3.3. Turn the machine spindle off by pressing the ‘stop’ button on your button panel. Pause for a few seconds while the machine stops.

> ***Note:*** *It’s ok if you don’t notice braking when the machine is turned off. We’ll calibrate and test the braking feature later.*

Calibration

While the IMB is capable of stopping your machine's motor near instantly, this sudden action should be avoided. The purpose of this calibration section is to find an optimal braking setting for your machine. You have two primary means of adjustment on this safety device, described below:

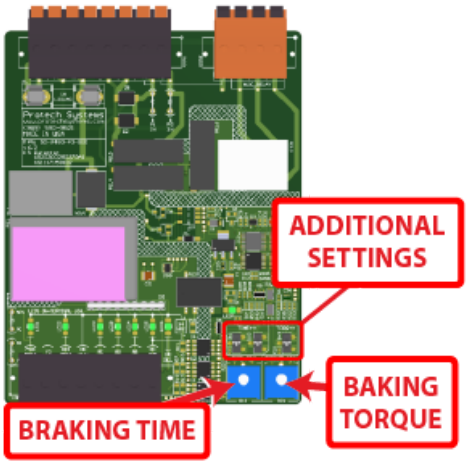
Braking Torque	**Braking Period**
Controls how strong of a braking force is applied to your motor during braking.	Controls how long the braking torque is applied.

Notes on Calibration:

- Consider the different gearing and tooling that will be used with this machine and perform this calibration with the machine configured for a 'maximum inertia' condition. This is typically the tooling with the largest mass and/or diameter and at the highest speed setting.
- The first calibration step will apply a very small braking torque for a very short time and may not be noticeable. This is normal. Proceed with calibration, making only incremental changes for each braking attempt.
- We recommend finding a braking torque and braking time combination that brings your machine to a complete stop in roughly 1-3 seconds. A good rule of thumb is to aim for a braking time equivalent to or greater than the time it takes your machine to come up to speed during normal operation.
- You will hear an audible buzzing sound during and after braking. This is normal. Calibrate the device such that there is a buzzing sound for approximately 0.5 seconds after the machine has come to a complete stop.

Making Adjustments:
The braking torque and braking time adjustments on your IMB are not externally accessible. They are accessible on the printed circuit board (PCB) inside your IMB.

Adjustments are made by rotating small potentiometers on the control PCB. Use the knob on the potentiometer (or the provided screwdriver) to gently turn the potentiometer counter-clockwise (to turn down) or clockwise (to turn up) the respective setting. You will feel the adjustment hit a stop at the maximum and minimum values. This only requires gentle turning force - excessive force can damage the device.



Warning: Remove power from the entire IMB before making any adjustments.

Calibration Steps:

1. Find the braking torque and braking time adjustment potentiometers and confirm that both settings are turned counter-clockwise as far as they will go. This will set the braking torque and braking time to the minimum for your first test. This only requires gentle turning force - excessive force on the adjuster can damage the device.
2. Turn on your machine by using the green start button on the control panel. It should start normally.
3. Once your machine has come up to speed, press the red stop button on the 3-button control panel. This will immediately disconnect power from the machine and apply a braking torque for a set period of time.
4. If this braking action does not bring your machine to a complete stop, increase your braking period or braking torque, making small incremental adjustments. Never turn an adjustment more than 1/8 of a turn at any one time.
5. Repeat until you achieve the desired result.

Additional Settings: If you need additional time or additional braking torque to meet your requirements, we have additional settings that can expand the available range. Please contact us for guidance on how to do this.

Inspections & Maintenance

1. Inspections

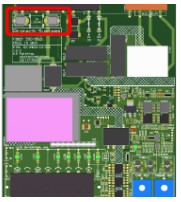
MAKESafe Tools recommends that the Safety Feature Testing described above be performed regularly, with the inspection interval determined by the risk assessment.

2. Maintenance

2.1. Re-calibrate the motor brake any time new tooling is introduced or the machine is serviced.

Circuit Protection

Your IMB has multiple levels of circuit protection. Refer to the table and image below for more information.

Image	Description	Reset / Replacement
	**Motor Protection Circuit Breaker (MPCB)** Provides protection against short-circuit and motor overload	Reset manually by rotating THE handle CCW to the 'OFF' position then CW back to the 'ON' position. Dial on MPCB should be set to match the FLA rating of the motor.
	**Braking Fuses (qty 2)** Provides protection for the electronics that perform braking.	**Spares recommended.** Replace only with the exact same fuse. Contact us for part numbers if necessary. ** Note: If these fuses are tripped, they will disable the entire panel until they are replaced
	**Transformer Primary Fuses (qty 2)** Protects the transformer from short circuits.	**Spares recommended.** Replace with fuses of the same rating. ** Typical Ratings: • UL Class CC • Time-Delay • 600VAC • 0.5A
	**PCB (qty 1)** Protects the transformer secondary and low-voltage electronics.	**Spares recommended.** Replace with fuses of the same rating. Typical Ratings: • 5x20mm • Slow-Blow • 240VAC • 1A

*** In the event of a fault, always replace both fuses in a pair (even if only one tripped).*

Troubleshooting

Problem	Potential Solution(s)
Your machine will not start.	Solution 1: Reset the emergency stop button by pressing it down then twisting it gently clockwise until you feel it pop out. Solution 2: Remove power from the IMB and check all circuit protection elements. See previous section for locations. If any elements have tripped, identify the fault before resetting.
The circuit breaker or motor overload trips often.	Solution 1: Check the motor and identify faults. Solution 2: Adjust the motor overload setting on the MPCB. Solution 3: Reduce the braking torque. You can compensate for the reduction in torque by slightly increasing the braking time.

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Service & Support

If you have any questions or your device needs service, please contact us!
A real person will always answer the phone (or promptly call you back).

(415) 937-1808

(this number accepts both calls and text messages)

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www.makesafetools.com

(live chat available on website)