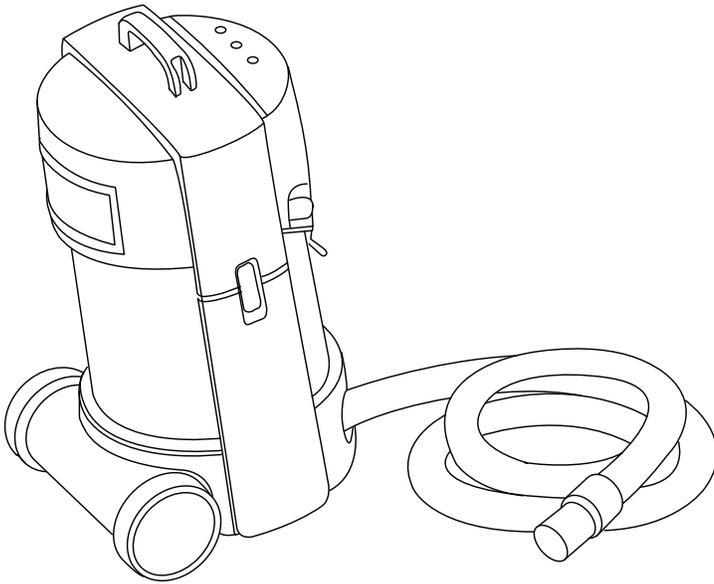


Operator's Manual

MINIFLEX[®]



For use with machines having Product Numbers:
K2376-1, K3972-1 & K3973-1



Register your machine:
www.lincolnelectric.com/register

Authorized Service and Distributor Locator:
www.lincolnelectric.com/locator

Save for future reference

Date Purchased

Code: (ex: 10859)

Serial: (ex: U1060512345)

Need Help? Call 1.888.935.3877
to talk to a Service Representative

Hours of Operation:
8:00 AM to 6:00 PM (ET) Mon. thru Fri.

After hours?
Use "Ask the Experts" at lincolnelectric.com
A Lincoln Service Representative will contact you
no later than the following business day.

For Service outside the USA:
Email: globalservice@lincolnelectric.com

THANK YOU FOR SELECTING A QUALITY LINCOLN ELECTRIC PRODUCT.

PLEASE EXAMINE CARTON AND EQUIPMENT FOR DAMAGE IMMEDIATELY

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, Claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

SAFETY DEPENDS ON YOU

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation ... and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

WARNING

This statement appears where the information must be followed exactly to avoid serious personal injury or loss of life.

CAUTION

This statement appears where the information must be followed to avoid minor personal injury or damage to this equipment.



KEEP YOUR HEAD OUT OF THE FUMES.

DON'T get too close to the arc. Use corrective lenses if necessary to stay a reasonable distance away from the arc.

READ and obey the Material Safety Data Sheet (MSDS) and the warning label that appears on all containers of welding materials.

USE ENOUGH VENTILATION or exhaust at the arc, or both, to keep the fumes and gases from your breathing zone and the general area.

IN A LARGE ROOM OR OUTDOORS, natural ventilation may be adequate if you keep your head out of the fumes (See below).

USE NATURAL DRAFTS or fans to keep the fumes away from your face.

If you develop unusual symptoms, see your supervisor. Perhaps the welding atmosphere and ventilation system should be checked.



WEAR CORRECT EYE, EAR & BODY PROTECTION

PROTECT your eyes and face with welding helmet properly fitted and with proper grade of filter plate (See ANSI Z49.1).

PROTECT your body from welding spatter and arc flash with protective clothing including woolen clothing, flame-proof apron and gloves, leather leggings, and high boots.

PROTECT others from splatter, flash, and glare with protective screens or barriers.

IN SOME AREAS, protection from noise may be appropriate.

BE SURE protective equipment is in good condition.

ALSO, WEAR SAFETY GLASSES IN WORK AREA AT ALL TIMES.



SPECIAL SITUATIONS

DO NOT WELD OR CUT containers or materials which previously had been in contact with hazardous substances unless they are properly cleaned. This is extremely dangerous.

DO NOT WELD OR CUT painted or plated parts unless special precautions with ventilation have been taken. They can release highly toxic fumes or gases.

ADDITIONAL PRECAUTIONARY MEASURES

PROTECT compressed gas cylinders from excessive heat, mechanical shocks, and arcs; fasten cylinders so they cannot fall.

BE SURE cylinders are never grounded or part of an electrical circuit.

REMOVE all potential fire hazards from welding area.

ALWAYS HAVE FIRE FIGHTING EQUIPMENT READY FOR IMMEDIATE USE AND KNOW HOW TO USE IT.



WARNINGS



CALIFORNIA PROPOSITION 65 WARNINGS

DIESEL ENGINES

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

GASOLINE ENGINES

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACE-MAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.



FOR ENGINE POWERED EQUIPMENT.

- 1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.



- 1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

- 1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.



- 1.d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.



- 1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.
- 1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.
- 1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.
- 1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS



- 2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines.
- 2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.
- 2.c. Exposure to EMF fields in welding may have other health effects which are now not known.
- 2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:
- 2.d.1. Route the electrode and work cables together - Secure them with tape when possible.
- 2.d.2. Never coil the electrode lead around your body.
- 2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.
- 2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.
- 2.d.5. Do not work next to welding power source.



ELECTRIC SHOCK CAN KILL.



- 3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.
- 3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- Semiautomatic DC Constant Voltage (Wire) Welder.
 - DC Manual (Stick) Welder.
 - AC Welder with Reduced Voltage Control.
- 3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.
 - 3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.
 - 3.e. Ground the work or metal to be welded to a good electrical (earth) ground.
 - 3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
 - 3.g. Never dip the electrode in water for cooling.
 - 3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
 - 3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.
 - 3.j. Also see Items 6.c. and 8.



ARC RAYS CAN BURN.



- 4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87.1 standards.
- 4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.
- 4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.



FUMES AND GASES CAN BE DANGEROUS.



- 5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and within applicable OSHA PEL and ACGIH TLV limits using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**
- 5.b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.
- 5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
- 5.d. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.
- 5.e. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices. MSDS forms are available from your welding distributor or from the manufacturer.
- 5.f. Also see item 1.b.



WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION.



- 6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.
- 6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.
- 6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
- 6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).
- 6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
- 6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.
- 6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.
- 6.h. Also see item 1.c.
- 6.i. Read and follow NFPA 51B "Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from NFPA, 1 Batterymarch Park, PO box 9101, Quincy, Ma 02269-9101.
- 6.j. Do not use a welding power source for pipe thawing.



CYLINDER MAY EXPLODE IF DAMAGED.

- 7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition. 
- 7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.
- 7.c. Cylinders should be located:
 - Away from areas where they may be struck or subjected to physical damage.
 - A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.
- 7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.
- 7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- 7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.
- 7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.



FOR ELECTRICALLY POWERED EQUIPMENT.



- 8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.
- 8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.
- 8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

Refer to
<http://www.lincolnelectric.com/safety>
 for additional safety information.



Welding Safety
 Interactive Web Guide
 for mobile devices

Get the free mobile app at
<http://gettag.mobi>

As a rule of thumb, for many mild steel electrode, if the air is visibly clear and you are comfortable, then the ventilation is generally adequate for your work. The most accurate way to determine if the worker exposure does not exceed the applicable exposure limit for compounds in the fumes and gases is to have an industrial hygienist take and analyze a sample of the air you are breathing. This is particularly important if you are welding with stainless, hardfacing or Special Ventilation products. All Lincoln MSDS have a maximum fume guideline number. If exposure to total fume is kept below that number, exposure to all fume from the electrode (not coatings or plating on the work) will be below the TLV.

There are steps that you can take to identify hazardous substances in your welding environment. Read the product label and material safety data sheet for the electrode posted in the work place or in the electrode or flux container to see what fumes can be reasonably expected from use of the product and to determine if special ventilation is needed. Secondly, know what the base metal is and determine if there is any paint, plating, or coating that could expose you to toxic fumes and/or gases. Remove it from the metal being welded, if possible. If you start to feel uncomfortable, dizzy or nauseous, there is a possibility that you are being overexposed to fumes and gases, or suffering from oxygen deficiency. Stop welding and get some fresh air immediately. Notify your supervisor and co-workers so the situation can be corrected and other workers can avoid the hazard. Be sure you are following these safe practices, the consumable labeling and MSDS to improve the ventilation in your area. Do not continue welding until the situation has been corrected.

NOTE: The MSDS for all Lincoln consumables is available on Lincoln's website: www.lincolnelectric.com

Before we turn to the methods available to control welding fume exposure, you should understand a few basic terms:

Natural Ventilation is the movement of air through the workplace caused by natural forces. Outside, this is usually the wind. Inside, this may be the flow of air through open windows and doors.

Mechanical Ventilation is the movement of air through the workplace caused by an electrical device such as a portable fan or permanently mounted fan in the ceiling or wall.

Source Extraction (Local Exhaust) is a mechanical device used to capture welding fume at or near the arc and filter contaminants out of the air.

The ventilation or exhaust needed for your application depends upon many factors such as:

- Workspace volume
- Workspace configuration
- Number of welders
- Welding process and current
- Consumables used (mild steel, hardfacing, stainless, etc.)
- Allowable levels (TLV, PEL, etc.)
- Material welded (including paint or plating)
- Natural airflow

Your work area has adequate ventilation when there is enough ventilation and/or exhaust to control worker exposure to hazardous materials in the welding fumes and gases so the applicable limits for those materials is not exceeded. See chart of TLV and PEL for Typical Electrode Ingredients, the OSHA PEL (Permissible Exposure Limit), and the recommended guideline, the ACGIH TLV (Threshold Limit Value), for many compounds found in welding fume.

Ventilation

There are many methods which can be selected by the user to provide adequate ventilation for the specific application. The following section provides general information which may be helpful in evaluating what type of ventilation equipment may be suitable for your application. When ventilation equipment is installed, you should confirm worker exposure is controlled within applicable OSHA PEL and/or ACGIH TLV. According to OSHA regulations, when welding and cutting (mild steels), natural ventilation is usually considered sufficient to meet requirements, provided that:

1. The room or welding area contains at least 10,000 cubic feet (about 22' x 22' x 22') for each welder.
2. The ceiling height is not less than 16 feet.
3. Cross ventilation is not blocked by partitions, equipment, or other structural barriers.
4. Welding is not done in a confined space.

Spaces that do not meet these requirements should be equipped with mechanical ventilating equipment that exhausts at least 2000 CFM of air for each welder, except where local exhaust hoods or booths, or air-line respirators are used.

Important Safety Note:

When welding with electrodes which require special ventilation such as stainless or hardfacing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce hazardous fumes, keep exposure as low as possible and below exposure limit values (PEL and TLV) for materials in the fume using local exhaust or mechanical ventilation. In coned spaces or in some circumstances, for example outdoors, a respirator may be required if exposure cannot be controlled to the PEL or TLV. (See MSDS and chart of TLV and PEL for Typical Electrode Ingredients.) Additional precautions are also required when welding on galvanized steel.

BIBLIOGRAPHY AND SUGGESTED READING

ANSI Z87.1, Practice for Occupational and Educational Eye and Face Protection, American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

Arc Welding and Your Health: A Handbook of Health Information for Welding. Published by The American Industrial Hygiene Association, 2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031-4319.

NFPA Standard 51B, Cutting and Welding Processes, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9146, Quincy, MA 02269-9959.

OSHA General Industry Standard 29 CFR 1910 Subpart Q. OSHA Hazard Communication Standard 29 CFR 1910.1200. Available from the Occupational Safety and Health Administration at <http://www.osha.org> or contact your local OSHA office.

The following publications are published by The American Welding Society, P.O. Box 351040, Miami, Florida 33135. AWS publications may be purchased from the American Welding Society at <http://www.aws.org> or by contacting the AWS at 800-443-9353.

ANSI, Standard Z49.1, Safety in Welding, Cutting and Allied Processes. Z49.1 is now available for download at no charge at <http://www.lincolnelectric.com/community/safety/> or at the AWS website <http://www.aws.org>.

AWS F1.1, Method for Sampling Airborne Particulates Generated by Welding and Allied Processes.

AWS F1.2, Laboratory Method for Measuring Fume Generation Rates and Total Fume Emission of Welding and Allied Processes.

AWS F1.3, Evaluating Contaminants in the Welding Environment: A Strategic Sampling Guide.

AWS F1.5, Methods for Sampling and Analyzing Gases from Welding and Allied Processes.

AWS F3.2, Ventilation Guide for Welding Fume Control

AWS F4.1, Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances.

AWS SHF, Safety and Health Facts Sheets. Available free of charge from the AWS website at <http://www.aws.org>.

LISTED BELOW ARE SOME TYPICAL INGREDIENTS IN WELDING ELECTRODES AND THEIR TLV (ACGIH) GUIDELINES AND PEL (OSHA) EXPOSURE LIMITS

INGREDIENTS	CAS No.	TLV mg/m ³	PEL mg/m ³
Aluminum and/or aluminum alloys (as Al)*****	7429-90-5	1.0	15
Aluminum oxide and/or Bauxite*****	1344-28-1	1.0	5**
Barium compounds (as Ba)*****	513-77-9	0.5	0.5
Chromium and chromium alloys or compounds (as Cr)*****	7440-47-3	0.5(b)	0.5(b)
Hexavalent Chromium (Cr VI)	18540-29-9	0.05(b)	.005(b)
Copper Fume	7440-50-8	0.2	0.1
Cobalt Compounds	7440-48-4	0.02	0.1
Fluorides (as F)	7789-75-5	2.5	2.5
Iron	7439-89-6	10*	10*
Limestone and/or calcium carbonate	1317-65-3	10*	15
Lithium compounds (as Li)	554-13-2	15	10*
Magnesite	1309-48-4	10	15
Magnesium and/or magnesium alloys and compounds (as Mg)	7439-95-4	10*	10*
Manganese and/or manganese alloys and compounds (as Mn)*****	7439-96-5	0.02	5.0(c)
Mineral silicates	1332-58-7	5**	5**
Molybdenum alloys (as Mo)	7439-98-7	10	10
Nickel*****	7440-02-0	0.1	1
Silicates and other binders	1344-09-8	10*	10*
Silicon and/or silicon alloys and compounds (as Si)	7440-21-3	10*	10*
Strontium compounds (as Sr)	1633-05-2	10*	10*
Zirconium alloys and compounds (as Zr)	12004-83-0	5	5

Supplemental Information:

(*) Not listed. Nuisance value maximum is 10 milligrams per cubic meter. PEL value for iron oxide is 10 milligrams per cubic meter. TLV value for iron oxide is 5 milligrams per cubic meter.

(**) As respirable dust.

(****) Subject to the reporting requirements of Sections 311, 312, and 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40CFR 370 and 372.

(b) The PEL for chromium (VI) is .005 milligrams per cubic meter as an 8 hour time weighted average. The TLV for water-soluble chromium (VI) is 0.05 milligrams per cubic meter. The TLV for insoluble chromium (VI) is 0.01 milligrams per cubic meter.

(c) Values are for manganese fume. STEL (Short Term Exposure Limit) is 3.0 milligrams per cubic meter. OSHA PEL is a ceiling value.

(****) The TLV for soluble barium compounds is 0.5 mg/m³.

TLV and PEL values are as of October 2013. Always check Safety Data Sheet (SDS) with product or on the Lincoln Electric website at <http://www.lincolnelectric.com>

	Page
Installation	
General Description.....	9
Technical Specifications.....	9
Installation	10
Operation	
Safety Precautions	11
Recommended Uses.....	11
Operating Instructions	11
Maintenance	13
Troubleshooting Guide	15
Accessories	16
Wiring Diagram	17
Parts List	parts.lincolnelectric.com

Content/details may be changed or updated without notice. For most current Instruction Manuals, go to parts.lincolnelectric.com.

GENERAL DESCRIPTION

The MINIFLEX® is a portable, high vacuum welding fume extractor designed for the removal and filtration of welding fumes from light duty welding applications. Its compact size permits the MINIFLEX to be used in confined spaces and other locations that are not accessible with other welding fume extractors.

The convenient automatic start/stop function can extend the life of the motor brushes and reduces energy consumption. (Note: welding current must be at least 50 amps to activate sensor). The optional wall mounting bracket allows the unit to be mounted to a wall, freeing up floor space.

The MINIFLEX can be completely disassembled in a matter of minutes for cleaning and maintenance.

Unit includes:

- 8 ft. (2.5 m) extraction hose with 1-3/4 in. (45mm) I.D. hose adapter.
- Two sets of seals and carbon brushes.

USE WITH NOZZLES AND HOSES

The MINIFLEX is not supplied with a nozzle. Nozzles and extra hoses can be ordered separately. The recommended nozzles and hoses are:

- **Extraction Nozzles:** EN 20 or 40 (K2389-5, K2389-6)
- **Nozzle Kits:** NKT or NKC (K2389-3, K2389-4)
- **Fume Exhaust Guns**
- **Extraction Hoses:**
 - 8 ft. (2.5m) long x 1-3/4 in. (45mm) I.D. (K2389-9)
 - 16 ft. (5m) long x 1-3/4 in. (45mm) I.D. (K2389-8)
- **Hose-to-Hose Adapter (K2389-10)**
- **Hose Connection Outlet (K2389-2)**

See Accessories section for more information.

Note: Recommended maximum hose length is 24 ft. (7.5m) on extraction side of unit. Consult Lincoln Electric Automation Department at 1.888.935.3878 before using any other size or length of hose.

TECHNICAL SPECIFICATIONS

GENERAL

INPUT VOLTAGE	115V, 1Ph, 60Hz 230V, 1Ph, 60Hz
RATED CURRENT DRAW	115V - 14.6A 230V - 8.8A
POWER RATING	2.4 HP (1.2 HP PER MOTOR)
OPERATING SOUND LEVEL	< 70 DB(A)

FILTER TYPE

STAGE ONE	SEPARATE MESH SCREEN PRE-FILTER
STAGE TWO	INTEGRATED MESH/SCREEN PRE-SEPARATOR
STAGE THREE	LONGLIFE-HT™ PRETREATED CELLULOSE FILTER
STAGE THREE SURFACE AREA	130 SQ. FT. (12 M ²)
STAGE FOUR (OPTIONAL)	ACTIVATED CARBON FILTER
STAGE FIVE	HEPA (HIGH EFFICIENCY PARTICULATE AIR) FILTER ⁽²⁾
UNIT EFFICIENCY	99.7% @ 0.3 m ⁽¹⁾

AMBIENT CONDITIONS

MINIMUM TEMPERATURE	40°F (5°C)
MAXIMUM TEMPERATURE	104°F (40°C)
MAXIMUM RELATIVE HUMIDITY	80%

OPERATING CAPACITY

EXTRACTOR TYPE	HIGH VACUUM, LOW VOLUME
AIRFLOW RATE	LOW MODE: 94 CFM (160 M ³ /HR) HIGH MODE: 135 CFM (230 M ³ /HR)

PHYSICAL DIMENSIONS

HEIGHT	29.0" (730 MM)
DIAMETER	16.5" (420 MM)
INLET/OUTLET OUTER DIAMETER	1-3/4" (45 MM)
WEIGHT	38 LBS. (17 KG)

⁽¹⁾ Particle size: 0.3 μm. Testing method: Flat-sheet tested according to EN 1822-3:2009 @ 190 m³/h with test aerosol generated according to EN 1822-2:2009.

⁽²⁾ Meets Integral Collection Efficiency Value for Filter Class E12 per EN 1822-1:2009.

NOTE: Technical specifications are subject to change without prior notice. Specifications and guarantees are valid only when specified replacement parts and filters are used.

INSTALLATION

The optional wall bracket provides an easy and practical way to free some floor space. It can be easily installed onto any sturdy wall. The bracket does not include any hardware, therefore the user must supply their own screws, anchors, etc. because of the different types of walls the bracket can be installed on.

NOTE: WALL CONSTRUCTION SHOULD BE STURDY ENOUGH TO SUPPORT MINIFLEX UNIT.

⚠ WARNING

The installer is responsible for following Federal, State and Local safety codes and regulations.

Before drilling, verify locations of existing gas, water, or electrical conduits.

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts such as internal wiring.
- Turn the input power off at the fuse box before working on this equipment.
- Have a qualified person install and service this equipment.



MOVING PARTS can injure.

- Do not operate with covers open or filter removed.
- Keep away from moving parts.



ONLY QUALIFIED PERSONNEL SHOULD INSTALL, USE OR SERVICE THIS EQUIPMENT.

MOUNTING THE WALL BRACKET ON A WALL

1. Using the bracket and a level as a guide, mark the four holes at the desired location on the wall.
2. Drill holes at each location.
3. Set anchors and align bracket with holes.
4. Screw bracket into wall using appropriate screws.

MOUNTING THE MINIFLEX ON A WALL BRACKET

1. The wheel side of the MINIFLEX should be facing the wall (see Figure 1).
2. Push in the silver metal plate (see Figure 2) while inserting the lip of the bracket between the top of the canister and the filter.
3. When the lip of the bracket is in place, release the silver plate to attach bottom portion of the MINIFLEX into the bracket.

Push in silver metal plate and pull up on MINIFLEX to release from wall bracket.

FIGURE 1



FIGURE 2



ELECTRICAL INSTALLATION

⚠ WARNING

K2376-1, K3972-1: Requires 115V AC, single phase, 60Hz grounded receptacle suitable for 15 amp service.

K3973-1: Requires 230V AC, single phase, 60Hz grounded receptacle suitable for 7.5 amp service.

RECOMMENDED USES

Read and understand this entire section before operating your MINIFLEX.

WARNING

Always operate this equipment with the filters installed and covers in place as these provide maximum protection from moving parts and insure proper vacuum operation and cooling air flow.

The MINIFLEX is a portable, high vacuum welding fume extractor designed for the removal and filtration of welding fumes released from the following welding processes:

- MIG/MAG solid wire (GMAW)
- MIG/MAG flux cored wire (FCAW)*
- Stick welding (SMAW)
- TIG (GTAW) welding

*For light duty flux-cored applications only.

WARNING

Use of the product for extracting and/or filtering fumes and/or gases that are released from the following processes is not recommended:

- Welding applications with intensive use of anti-spatter spray, paste or solution.
- Autogenic or plasma cutting spray/molten metal.
- Arc-air gouging.
- Welding that produces the release of a dense oil mist.
- Paint spraying.
- Extraction of hot gases [more than 104° F (40° C)].
- Extraction of aggressive fumes (such as acids).
- Grinding aluminum and magnesium.
- Flame spraying.
- Extraction of cement, saw dust, wood dust, etc.
- Extracting cigarettes, cigars, tissues and other burning particles, objects and acids.
- Any dangerous situations where there is a risk of an explosion or fire.

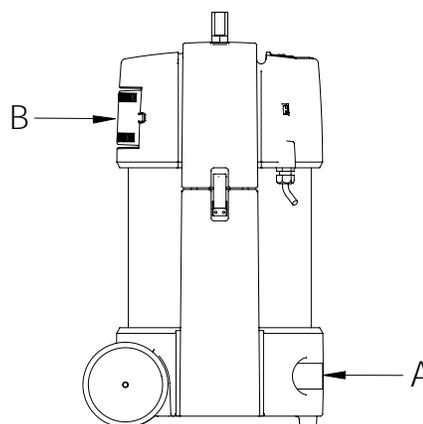
Note: The MINIFLEX does not filter any shielding gases. Gases pass through the filter. MINIFLEX used with optional carbon filter may reduce vapors and gases.

OPERATING INSTRUCTIONS

The MINIFLEX provides enough suction for one fume gun or small suction nozzle. Do not attach more than one fume gun or suction nozzle to the MINIFLEX unit.

1. Connect the extraction hose at one side to the air inlet of the machine (Figure 3, Item A) and at the other side to the welding torch or small suction nozzle.
2. Lay the work cable of the welding machine into the slot on top of the machine (Figure 4, Slot) (when using Automatic Start/Stop mode).
3. Start up the machine by pressing the switch, located on the side of the machine.
4. At the top of the unit, there is a High/Low button and an Automatic Start/Stop Button (See Manual Vs. Automatic Start/Stop Operation for further instructions).

FIGURE 3



Recommended Positioning: Upright

For optimal performance, unit is designed to operate in upright position.

WARNING

If unit is operated in an upright or horizontal position, air inlet and outlet (Figure 3, Items A and B) must be free from obstruction.

HIGH AND LOW MODE

In high mode, both motors are working at 100% capacity, extracting 135 CFM (230 m³/hr). See Figure 4, item S1.

In low mode, both motors operate at 70% capacity, extracting 94 CFM (160 m³/hr).

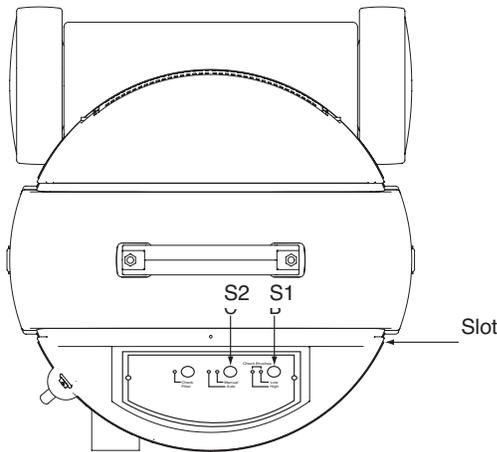
MANUAL VS. AUTOMATIC START/STOP OPERATION

Use the Automatic Start/Stop feature to extend the life of the carbon brushes.

In the "auto" setting (see Figure 4, item S2), the unit automatically starts and stops when the work cable of the welding machine is positioned in the slot located on top of the machine. See Figure 4. The unit continues to operate for 15 seconds after welding is completed before automatically shutting off.

In the manual setting, the unit runs continuously.

FIGURE 4

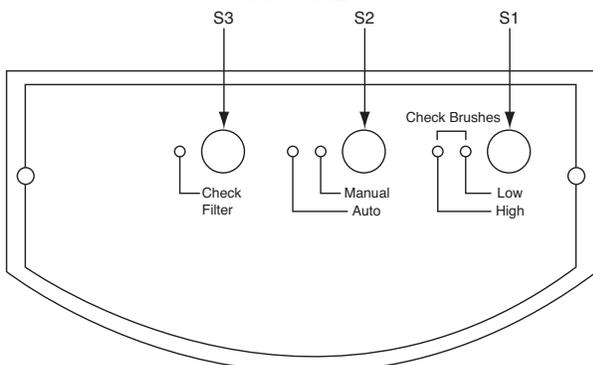


Worn Carbon Brushes Early Warning System Operation*

The worn carbon brushes warning system will inform the user when 80% of the carbon brushes have been used (equals approximately 750 hours motor running time). The unit will indicate this condition with the Low and High speed LED's blinking alternately with a sequence of one second on and one second off. This indicator does not affect the performance of the unit, but merely indicates that maintenance should be performed.

After the carbon brushes have been replaced, the warning system is reset by pressing buttons Low/High (S1) and Manual/Auto (S2) simultaneously and holding for five seconds. See Figure 5.

FIGURE 5



Total System Airflow / Static Pressure Control System*

This feature allows the user to check the extraction performance of the unit. In order to check this performance (Flowcheck), follow the procedure indicated below:

Flowcheck tests for a minimum airflow of approximately 80 CFM.

Flowcheck Procedure

1. Remove all connected apparatus such as hoses, nozzles, etc. from inlet and outlet.
2. Switch unit to "On", main switch O/I.
3. When unit starts running press and hold the Low/High (S1) button on the panel until the unit stops running.
4. Press and hold the "Check Filter" (S3) switch for five seconds.
5. Unit will automatically start in "High" speed mode and runs for about 10 seconds.
6. The software checks the static pressure switch S4 (not visible, switch is mounted on the circuit board).
7. When S4 = "open", unit stops and goes to "Off" mode and the "check filter" LED remains off. This indicates that the system airflow is acceptable (above 80 CFM).
8. When S4 = "closed", unit stops and goes to "Off" mode and the "check filter" LED flashes with the frequency of one second on / one second off. This indicates that the extraction volume is less than 80 CFM.
9. Reset by pressing and holding S2 and S3 for five seconds.

In the case that the indicator communicates that the unit is extracting less than 80 CFM, proceed as follows to find the filter resistance that is causing this low airflow:

- A. Check condition of pre-filter (Perform Flowcheck Procedure without pre-filter to check if this is the cause of the low airflow).
Recommended Action: Wash or replace if necessary.
- B. Check condition of the main filter (Perform Flowcheck Procedure without main filter to check if this is the cause of low airflow).
Recommended Action: Replace if necessary.
- C. Check condition of the HEPA post filter (Perform Flowcheck Procedure without HEPA post filter to check if this is the cause of the low airflow).
Recommended Action: Replace if necessary.

*Available on K3972-1 and K3973-1 only.

MAINTENANCE

⚠ WARNING

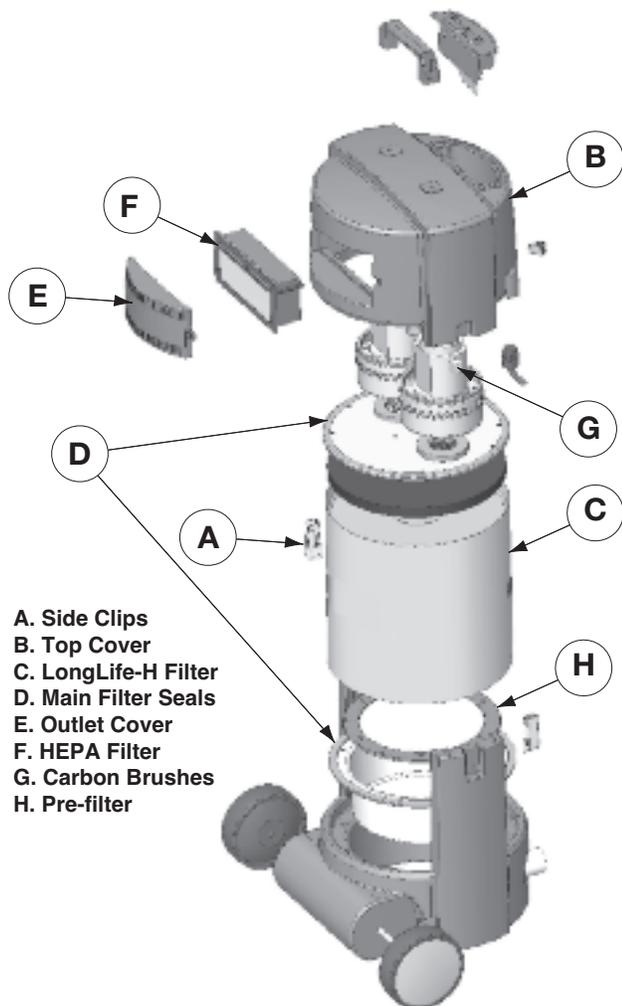
ELECTRIC SHOCK can kill.

Unplug MINIFLEX before changing filter or replacing carbon brushes.



- The aluminum collection pan should be inspected, cleaned and emptied on a monthly basis.
- The pre-separator (located on the bottom of the main filter) should be inspected and cleaned on a monthly basis, using an industrial vacuum cleaner.
- The pre-filter should be inspected and cleaned on a bi-monthly basis, using compressed air or an industrial vacuum cleaner.
- Frequency of cleaning and emptying depends on a number of factors such as the type of welding process and the frequency of use.
- The main filter should be checked every month to ensure that there is no damage.
- The seals of the main filter should be checked every 12 months.

FIGURE 6



Refer to Figure 6 for the following instructions.

EMPTYING THE ALUMINUM COLLECTION PAN

1. Remove electrical cord of MINIFLEX unit from electrical outlet.
2. Loosen the side clips (A).
3. Remove the top cover (B) from the machine.
4. Remove LongLife-H Filter (C) by lifting the filter out of the bottom compartment of the unit.
5. Remove pre-filter (H)
6. Empty the collection pan (D) and dispose of waste properly*.
7. Replace the pre-filter and the LongLife-H Filter to the bottom unit and reattach top cover by fastening the side clips (A).

*Check with local authorities for regulations governing the proper disposal of used filters and particulate matter.

⚠ WARNING

The particulate matter collected in the unit may be dangerous to your health. Take necessary precautions so that you and your fellow workers do not breathe dust and particulate. Wear a suitable respirator when disposing of the particulate. Follow local Environmental regulations for disposal of filters and particulate matter.

REPLACING THE FILTERS

The main LongLife-H filter and the HEPA filter cannot be cleaned and therefore they have to be replaced periodically. It is recommended to replace all filters at the same time.

⚠ WARNING

A saturated filter often contains dust and dirt particles which could form a health hazard upon inhalation. When replacing the filters, always wear a high-quality and approved face mask or respirator. Wrap the filters in a properly closed plastic bag and dispose of it in compliance with local regulations.

Replace the filters in case of damage or when the extraction capacity has become insufficient due to the amount of particulate in the filter.

Periodic check of the filters is required to maintain optimal performance and life of unit. Filter performance/life is dependent on variables such as:

- Welding application/processes
- Oil involved in weld processes
- Dust/grinding particulate
- Proper usage and maintenance

Note: There is no filter clog indicator on this machine.

Replacing/Cleaning the Pre-filter

1. Remove electrical cord of MINIFLEX unit from electrical outlet.
2. Loosen the side clips (A).
3. Remove the top cover (B) from the unit.
4. Remove LongLife-H Filter (C).
5. Remove the pre-filter (H).
6. Clean pre-filter with industrial vacuum cleaner or replace if necessary. Use caution and proper personal protection equipment when cleaning pre-filter.
7. Reposition the pre-filter (H) and LongLife-HTM Filter (C) and reassemble unit.

Replacing the LongLife-H Filter and Integrated Aluminum Mesh Pre-filter

1. Remove electrical cord of MINIFLEX unit from electrical outlet.
2. Loosen the side clips (A).
3. Remove the top cover (B) from the machine.
4. Remove LongLife-H Filter (C).
5. Check the main filter seals (D) before replacing the filter. If the seals need to be replaced, contact your Lincoln Electric representative.
6. Place the new filter (mesh pre-separator side down) into the bottom section and reassemble unit.

Replacing the HEPA Filter

1. Remove electrical cord of MINIFLEX unit from electrical outlet.
2. Remove the outlet cover (E) by loosening the two screws.
3. Remove the HEPA filter (F).
4. Place a new HEPA filter in the correct position (open side at the top).
5. Remount the outlet cover by fastening the two screws. Make sure that the outlet cover is in the right position; the open side of the HEPA filter should correspond with the smallest opening of the outlet cover.

CAUTION

ATTENTION: Removing the HEPA filter will cause the seals to deform. For this reason, never replace an old HEPA filter with a used HEPA filter, but always replace it with a new one.

Replacing the Carbon Filter (if applicable)

1. Remove electrical cord of MINIFLEX unit from electrical outlet.
2. Loosen the side clips (A).
3. Remove the top cover (B) from the machine.
4. Place carbon filter directly on top of LongLife-H Filter, either side up.
5. Replace top cover (B).

CARBON BRUSHES

The carbon brushes in both motors should be replaced after approximately 750 hours motor running time (see *Worn Carbon Brushes Early Warning System Operation* section for more information).

CAUTION

Carbon brush life depends on how unit is operated, i.e. continuous operation or automatic start/stop mode. If carbon brushes are not replaced, damage to motors may result.

Note: Two sets of carbon brushes and seals are included with unit.

Carbon Brush Replacement

1. Remove electrical cord of MINIFLEX unit from electrical outlet.
2. Remove top cover (B) of MINIFLEX unit by releasing the side clips (A) on both sides of unit.
3. To remove the housing plate at bottom of top cover, place top cover with housing plate facing upward. Remove 8 screws holding the housing cover plate using a Phillips head screwdriver. Remove two bolts holding the housing cover plate in place. An 8 mm socket is required. After removing 8 screws and 2 bolts, use a flat blade screwdriver to remove housing cover plate.

CAUTION

To avoid motors from dislodging, the MINIFLEX top cover (B) must remain facing upward after removing housing cover plate.

4. Slowly pull one motor out at a time, until sufficient room is allowed to remove and inspect carbon brushes (G).
5. Disconnect yellow and black wires from each motor connection terminal. Remove carbon brushes by using a flat head screwdriver.
6. To insert new carbon brushes, carbon side of brush must be inserted first into plastic housing with brass connection terminal in upright position to connect yellow and black wires. After inserting new carbon brushes, connect yellow and black wires.
7. Reposition motors and reattach housing cover plate.
8. Place top cover on MINIFLEX unit using the two side clips.
9. Operate unit to make sure carbon brushes have been properly installed.

TROUBLESHOOTING GUIDE



Service and Repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid ELECTRICAL SHOCK, please observe all safety notes and precautions detailed throughout this manual.

PROBLEMS / SYMPTOM(S)	POSSIBLE CAUSE(S)	RECOMMENDED COURSE(S) OF ACTION
MOTOR DOES NOT START.	Ensure 115 VAC (K2376-1, K3972-1) or 230 VAC (K3973-1) input power is available.	Verify 115 VAC/60Hz, 1ph (K2376-1, K3972-1) or 230 VAC/60Hz, 1ph (K3973-1) input power at the machine.
	Circuit breaker tripped.	Reset circuit breaker.
	Carbon brushes worn.	Check brushes, replace if necessary.
MOTOR STOPS AUTOMATICALLY	Thermal protection is activated.	Check that the cooling underneath the top cover and/or the outlet are not obstructed.
POOR SUCTION.	Leakage.	Check hose connections and integrity.
	Filter dirty.	Replace both LongLife-H Filter and HEPA filter.
	Pre-filter dirty.	Check pre-filter and replace or clean using an industrial vacuum cleaner. Use caution and proper personal protection equipment when cleaning pre-filter.
	Improper application.	Check hose diameter and maximum length 24 ft. (7.5 m), check filter for oily conditions.
	Brushes worn in one of the motors.	Contact your local Lincoln Authorized Field Service Facility.
UNIT WILL NOT SENSE CURRENT.	Welding current too low.	Loop cable two or three times on current sensor.
	Current sensor or PC board damaged.	Replace sensor or PC board.
UNIT AUTOMATICALLY CYCLES BETWEEN LOW AND HIGH SPEEDS.	Loose connections.	Check connections from PC board to motors.
	Control panel/PC board damaged.	Replace control panel and PC board.



If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.

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ACCESSORIES

The following accessories are available for your MINIFLEX Portable Fume Extractor from your local Lincoln Electric Authorized Distributor.

EN 20 Extraction Nozzle - Order K2389-5

The EN 20 nozzle is designed for a wide array of welding applications. With its funnel extraction opening and magnetic mounting stand, it gives the welder a great amount of versatility. Includes a 1-3/4 in. I.D. hose adapter.

EN 40 Extraction Nozzle - Order K2389-6

The EN 40 extraction nozzle is designed for stick electrode applications. With its L-shaped tube and an elongated slotted opening, the EN 40 nozzle is designed to coincide with the time it takes the welder to use one stick electrode. This design alleviates the welder from having to continuously reposition the nozzle. Magnetic mounting stand and 1-3/4 in. I.D. hose adapter are included.

NKT Nozzle Kit - Order K2389-3

The NKT nozzle kit provides extraction capacity to standard welding guns. It is designed for mounting the extraction hose on top of the welding gun. Hose dimension is 8 ft. (2.5 m) x 1 in. (25 mm) I.D. Includes a 1-3/4 in. (45 mm) I.D. hose adapter.

NKC Nozzle Kit - Order K2389-4

The NKC nozzle kit provides extraction capacity to standard welding guns by circular extraction which attaches and wraps around the gun nozzle. Hose dimension is 8 ft. (2.5 m) x 1 in. (25 mm) I.D. Includes a 1-3/4 in. (45 mm) I.D. hose adapter.

Other Nozzles

A variety of other nozzles are available. Contact your local Lincoln Electric Authorized Distributor for more details.

Fume Extraction Guns

To extract welding fumes, Lincoln Electric's Magnum® 400XA GMAW gun and the 350A, 500A FCAW-SS guns can be connected to the MINIFLEX and its extraction hose.

Extraction Hoses

Order K2389-8 for the 16 ft x 1-3/4 in. hose and Order K2389-9 for the 8 ft x 1-3/4 in. hose.

For longer hose applications, flexible high temperature hoses with spring steel reinforcement are optional. Two optional hose lengths are 8 ft. (2.5 m) x 1-3/4 in. (45mm) I.D. and 16 ft. (5 m) x 1-3/4 in. (45 mm) I.D. The optional extraction hoses can be used to connect to or replace the hose already included with MINIFLEX base unit. To ensure effective performance level, it is recommended that a maximum hose length of 24 ft. (7.5 m) be used on extraction side of the MINIFLEX. Two hose adapter ends are included.

Hose-to-Hose Adapter - Order K2389-10

To connect 1-3/4 in. hoses together, a 1-3/4 in. (45mm) hose-to-hose adapter screws over hose ends, providing a tight connection and seal.

Hose Connection Outlet - Order K2389-2

The hose connection outlet replaces the MINIFLEX outlet cover and can be used to exhaust or dispose of welding fume particles, for example when welding stainless or galvanized steel.

Activated Carbon Filter - Order K2389-1

To reduce the recirculation of odors or vapors into the environment, the optional activated carbon filter can be placed on top of the LongLife-H main filter.

Wall Mounting Bracket - Order K2389-7

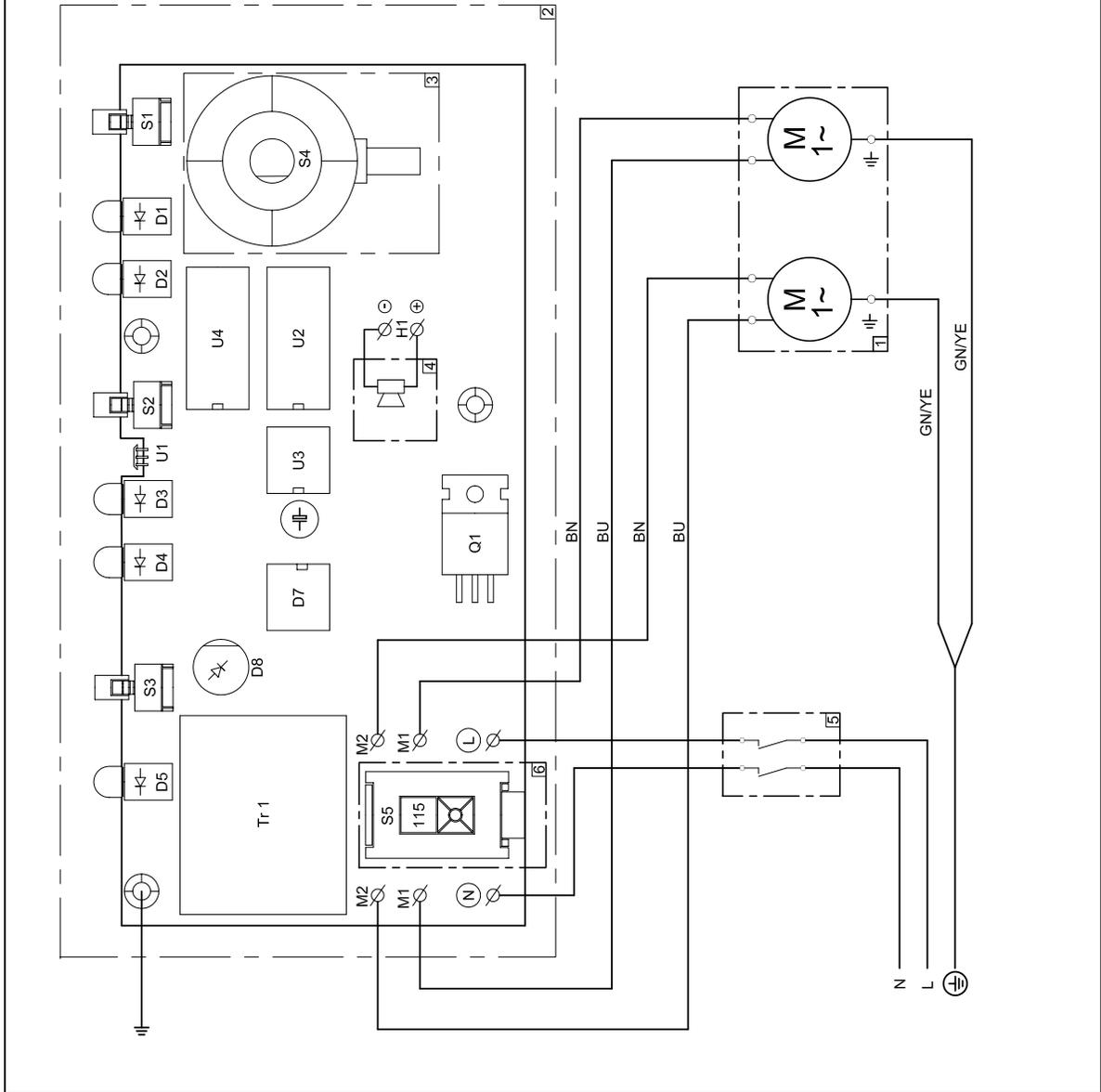
The wall-mounting bracket allows for the MINIFLEX to be placed off the work floor and on the wall, out of the welder's workspace.

Replacement Filters

Turn to parts page P-517.

WIRING DIAGRAM

#	Description	Remarks
1	Motor - 2 per Unit	115-120 V 50/60 Hz. Max. 7.3 A per motor 230 V 50/60 Hz. Max. 4.4 A per motor
2	Print + Panel 4	115-120 or 230 V 50/60 Hz.
3	Pressure switch	-
4	Buzzer	-
5	Main switch	-
6	Voltage selector 115-230 V	-



Color code (iff. app.)

IEC 60757	Color
BK	Black
BN	Brown
BU	Blue
GN	Green
GN/YE	Green/Yellow
WH	White
RD	Red
GY	Grey
OG	Orange

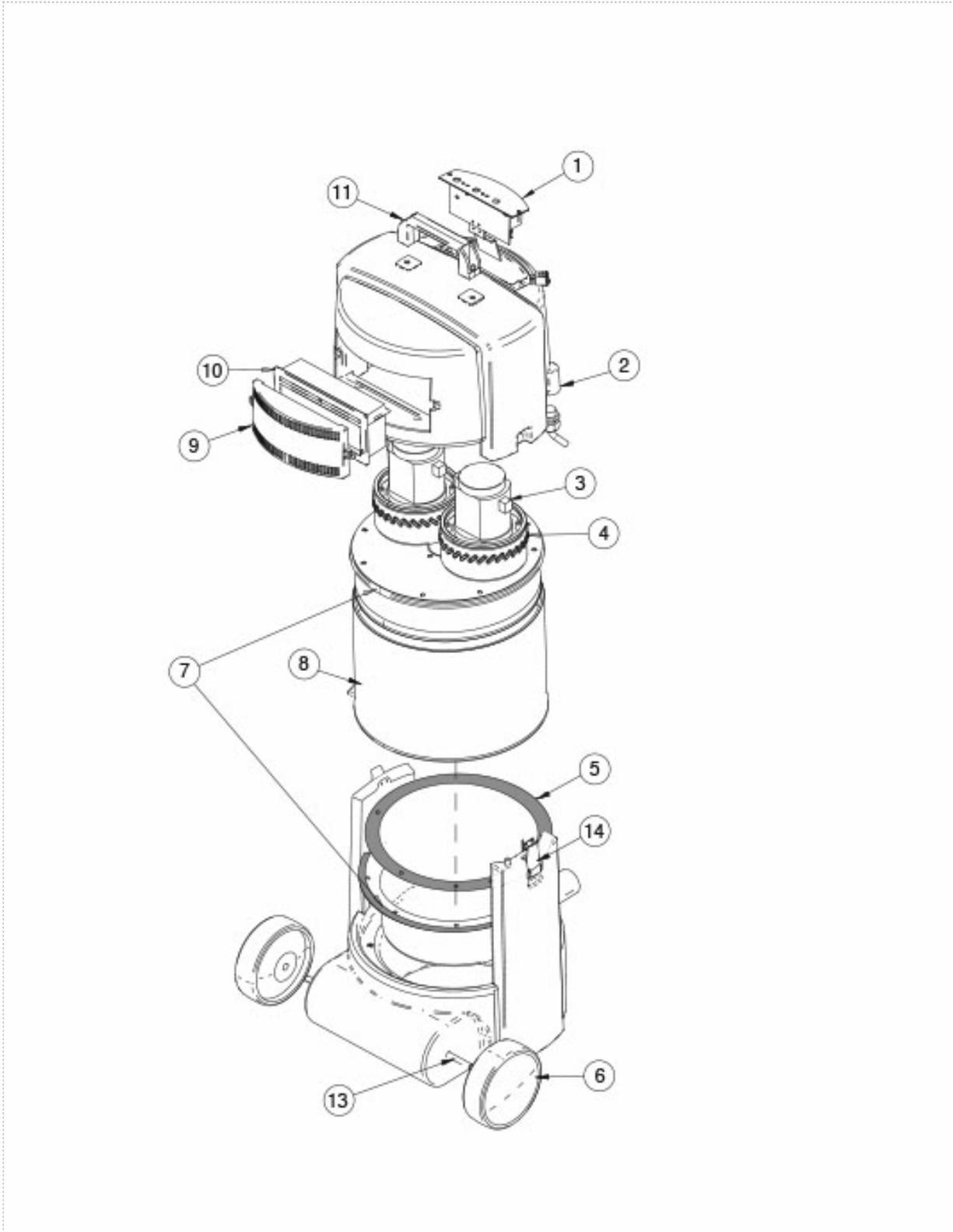
Datum : 08-10-2013
 Model: 115/230 V 1-50/60 Hz.
 Electrical Diagram: 0517000840
 Rev.: F

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The specific diagram for a particular code is pasted inside the machine on one of the enclosure panels. If the diagram is illegible, write to the Service Department for a replacement. Give the equipment code number.

General Assembly

KEY	PART NUMBER	DESCRIPTION	QTY
	K3973-1	Miniflex Portable Fume Extractor	1
1	9SS23384-66	CONTROL PANEL	1
2	9SS23384-23	SWITCHMINIFLEX(US/CANADA ONLY)	1
3	9SS23384-64	CARB. BRUSH 230V W/SEALS	1
4	9SS23384-65	MOTOR 230V INCLUDES SEALS	1
5	KP2390-3	MINIFLEX PRE-FILTER	1
6	9SS23384-27	WHEELSMINIFLEXSETNO COVERS	1
	9SS23384-56	MINIFLEX RED WHEEL COVER PAIR	1
7	9SS23384-26	SEALSMINIFLEXMAIN FILTERSET	1
8	KP2390-1	LONG LIFE-H FILTERMINIFLEX	1
9	9SS23384-49	OUTLET COVER CPL MINIFLEX	1
10	KP2390-2	HEPA FILTERMINIFLEX	1
11	9SS23384-50	MINIFLEX TRANSPORT HANDLE	1
	9SS23384-67	PC BOARD 115V OR 230V	1
13	9SS23384-54	MINIFLEX WHEEL AXLE AND STARLOCKS	1
14	9SS23384-55	MINIFLEXHOUSING LATCH AND CLIP	1

General Assembly



P-517-C.jpg

CUSTOMER ASSISTANCE POLICY

The business of The Lincoln Electric Company is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for advice or information about their use of our products. We respond to our customers based on the best information in our possession at that time. Lincoln Electric is not in a position to warrant or guarantee such advice, and assumes no liability, with respect to such information or advice. We expressly disclaim any warranty of any kind, including any warranty of fitness for any customer's particular purpose, with respect to such information or advice. As a matter of practical consideration, we also cannot assume any responsibility for updating or correcting any such information or advice once it has been given, nor does the provision of information or advice create, expand or alter any warranty with respect to the sale of our products.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to www.lincolnelectric.com for any updated information.

WELD FUME CONTROL EQUIPMENT

The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.



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