

SHAMROCK AUTOMATION

SAFETY PRECAUTIONS

AUTOMATIC LADLERS

INGOT LOADERS

Revision 1.0

4/16/2001

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FOREWORD

The objective of this Safety Precautions Document is to emphasize the safety precautions that pertain to robotics equipment and handling molten metal. These precautions should be considered the **minimum** to be followed.

It is the industry standard, and a requirement by OSHA, to properly guard moving machinery. Furthermore, Shamrock Pouring Systems, Ladlers, may be considered as robotic equipment, and, therefore, must comply with OSHA, Pub. 8-13, Guidelines for Robotics Safety, and ANSI/RIA safety requirements. It is, therefore, imperative that the Shamrock ladlers and ingot loaders are properly guarded prior to startup.

Section 1.0 explains the general foundry and die casting precautions. More information may be obtained from sources such as AFS and NADCA.

Section 2.0 describes the safety precautions for operational personnel and Section 3.0 is related to safety precautions for maintenance personnel.

Appendix A is a source of information and contacts to help you with providing proper and adequate guarding for the ladlers and ingot loaders.

Appendix B lists a number of sources where you may obtain proper safety clothing to protect your personnel while working with or near molten metal.

Appendix C is a list of organizations that recommend the Industrial Safety Standards, such as OSHA and ANSI/RIA or can provide the Industry Safety Standards in a particular industry, AFS and NADCA.

The sources of information are provided as reference for your convenience.

INTRODUCTION

Shamrock Automation systems are efficient units designed with interlocks and circuit protection modules. Operators, however, should be cognizant of all potential hazards involving industrial robots and machines and general foundry and die casting operations. The following Safety Precautions must be read and understood by all operating, maintenance and safety personnel. The management must also read and enforce these Safety Precautions.

The purpose of this document is to familiarize operation and maintenance personnel with safety precautions that pertain to foundry and die casting operations in general, and to the automatic ladling and charging system in particular. The safety precautions listed should be observed and complied with at all times. These precautions should be considered the **minimum** to be followed.

It is not the purpose of this document to list every precaution which should be followed under every circumstance. Rather, these general safety precautions form a minimum set from which each safety officer can establish precautions and procedures tailored to his individual circumstances. Nothing in these precautions can substitute for properly qualified and trained operators and maintenance personnel exercising good judgement.

Copies of these safety precautions should be posted at conspicuous locations throughout the operational area of the equipment, in order that operations and maintenance personnel can become thoroughly familiar with them. These Safety Precautions must be **periodically** reviewed and expanded, as needed.

1.0 GENERAL FOUNDRY AND DIE CASTING PRECAUTIONS

The precautions which follow here should be well known to foundrymen and die casters. They are common to all metal melting operations. They are offered as general precautions and should not be construed to cover all types of operations. They should be evaluated in light of your particular operation and expanded or modified as appropriate. The Occupational Safety and Health Administration (OSHA) publishes Federal Regulations that are mandatory for all industries. The American Foundrymen's Society (AFS) and the North American Die Casting Association publish information that pertains to foundry and die casting operations. *Refer to Appendix C for information on OSHA and AFS.*

CAUTION

Working with molten metal is a serious business. People not directly involved with the set-up and operation of the automatic pouring or ingot loader systems must be kept out of the immediate area. Those involved in these operations must wear appropriate safety gear.

The SHAMROCK POURING EQUIPMENT and INGOT LOADERS are designed with personnel safety in mind, however, it is not possible to foresee and prevent all mechanical and electrical failures. DO NOT operate the equipment without appropriate physical guarding installed and interlocked. It is the CUSTOMER'S RESPONSIBILITY to design, install and maintain adequate guarding to prevent personnel intrusion into the working envelope of the equipment. A list of companies which specialize in this area is provided in Appendix A. You may also contact Shamrock for assistance.

DANGER

**DO NOT operate the equipment without adequate physical guarding.
DO NOT allow personnel into the working space of the equipment.**

- **Do not operate the equipment if any safety devices are jumpered, bypassed, or non-operational.**

- Access to melting and pouring operations should be limited to **authorized personnel** only.
- Personnel should wear safety glasses, with side shields, at all times and should use special light reducing glasses when viewing metals at high temperatures.
- Heat and flame retardant clothing should be worn by personnel who work at or near furnaces. Clothing made of flammable materials (nylon, polyester, etc.) should not be worn near furnaces.
- Furnace linings should be inspected frequently at regular intervals to protect against the danger of "run-through's". The lining should always be inspected after cooldown.
- A new furnace lining must be of the correct material, compatible with the metal to be melted and should be thoroughly dry before the furnace is charged for a melt. The sintering procedure for this material must be strictly adhered to.
- Charge materials should be dry and free of combustibles, excessive rust, and/or liquids. Violent vaporization of liquids or combustibles can cause boil-overs or explosions in the metal bath.
- Furnaces should be charged carefully to avoid metal splash.

DANGER

Ladle coating must be thoroughly dry before the ladle cup is installed on the automatic ladler. Immersion of wet ladle coating into the metal bath can cause an explosion with possible injury to personnel.

- Removable crucibles should be used only for metals and furnace sizes for which they are suitable. They are not designed for high temperatures required for melting ferrous metals. The crucible manufacturer's specifications should be the guide for crucible use.
- Areas provided to receive runouts or spills must be kept free of accumulations of liquids. Hot metal in contact with liquids can cause violent explosions resulting in personal injuries. Other debris can prevent the flow of molten metal into the runout pit or ignite, causing a fire.

2.0 SAFETY PRECAUTIONS FOR OPERATIONAL PERSONNEL

2.1 Electrical

The Shamrock Automatic Pouring Equipment and Ingot Loaders are designed to provide consistent and reliable pouring and charging of non-ferrous metals. For satisfactory results it is important that the equipment be properly installed and maintained. All operators must be trained in the correct operating procedures and must be instructed in the fundamentals of working safely around molten metal and robotic equipment.

NOTE: It is the **RESPONSIBILITY OF THE PURCHASER** to provide, install, and maintain adequate guarding to prevent the intrusion of people into the operating area of the Automatic Pouring Equipment or the ingot loader.

DANGER

Due to the hazards associated with moving equipment, Shamrock automatic pouring units and ingot loaders must be installed and operated in a manner which prevents the intrusion of people into the work space area of the equipment. In the case of pouring units, Ladlers, any intrusion into the work space of the unit shall interrupt the automatic cycle of the equipment.

All automatic pouring units and charging equipment use potentially dangerous electrical and hydraulic power. Shamrock equipment is designed for safe, efficient, reliable operation and easy maintenance. Operator safety is enhanced by several design features built into the equipment. Deliberately defeating these safeguards can expose the operator to hazards. The following precautions should always be observed:

- **Do not operate the equipment if any safety devices are jumpered, bypassed, or non-operational.**
- **Before starting the equipment operation, check the work space visually to make sure that no one is present in the work space.**
- Except for visual checks of the meters and lights on the outside of the electrical cabinet, **all troubleshooting, maintenance, and repair must be performed by a qualified maintenance person.** This qualified maintenance person must be able to recognize hazards and be trained in the safety precautions required to avoid possible injury or death.
- An E-stop button is located on the main control enclosure and other E-stops should be installed throughout the work cell. Pushing the E-stop button causes a complete shutdown of hydraulic and control power. For this reason, it should be used in emergencies ONLY.

The controller cannot bring the ladler to a controlled stop under these conditions. It is recommended that the CYCLE INTERRUPT or CYCLE PAUSE be used whenever possible to avoid rapid deceleration syndrome (i.e., abrupt stop).

DANGER

Emergency stopping of the system can cause rapid deceleration. If the ladler is carrying metal, it is likely to spill or splatter during an E-stop.

Proper barriers such as wire mesh panels must be used to protect the personnel against accidental metal

- Keep all cabinet doors locked. Make keys available only to those qualified maintenance personnel who require access to the enclosures.
 - Keep shields, covers, and other protective devices in place at all times during equipment operation. Exposed high voltage equipment is a potential hazard to personnel in the work area.
 - **ALWAYS lock the main power disconnect in the OFF position before opening the doors or removing access panels. Do not depend on interlock devices for protection. ALWAYS verify with a test meter that all circuits are de-energized BEFORE proceeding with any other testing.**
 - Use only proven test equipment when troubleshooting a unit or components. Follow manufacturer's recommended procedure.
 - Prevent inadvertent application of power to the equipment while work is in progress in cubicles, on furnaces or the automatic pouring or charging equipment, by **locking out** the main power disconnect.
- S** Always follow recommended Lock Out/Tag Out procedures.
- S** Yellow wires inside the control cabinet indicate that these circuits may be energized from another source with the disconnect turned off.

CAUTION

Never attempt to change a ladle cup or work on the ingot loader arm over an open metal bath. Dropping parts into the metal bath will cause an extreme splash hazard.

2.2 Hydraulics

- Only fire resistant hydraulic fluids should be used in Shamrock Automatic Ladling Systems and Ingot Loader Systems.
- More than one disconnect may be required to remove all electrical power to the system.
- Hydraulic tank heaters are usually powered from secondary sources and may require additional lockouts before servicing.

DANGER

Use of petroleum base oils or fluids will constitute a severe fire hazard.

- All piping and hose used on pressure lines must be checked to insure that they are properly rated for the application.

WARNING

Check to insure that the proper rated hose or pipe is used on pressure lines.

WARNING

Any air in a hydraulic system can result in sudden and unexpected movement. Whenever the hydraulic circuit is broken (by removing a hose or valve, etc.) always bleed any remaining air from the system by carefully actuating the manual valve overrides or the manual controls. Insure that all perimeter guarding is closed and the area is clear. Stand well away from the equipment until all air is bled out of the system.

3.0 SAFETY PRECAUTIONS FOR MAINTENANCE PERSONNEL

- All troubleshooting, maintenance, and repair must be performed by a qualified maintenance person.
- **Always make sure all safety devices are fully operational before allowing the operator to use the equipment.**
- **Always make sure that all awareness signals such as buzzers, beacons, and flashing lights on the equipment are fully operational.**
- Study the maintenance procedures.
- Become familiar with the equipment and its operations before attempting maintenance of any kind.
- **Regularly check the operation of awareness signals, E-stops, perimeter guarding interlocks and other Safety devices.**
- Before performing any maintenance on your Shamrock ladler or ingot loader, the ladler or ingot loader arm should be returned to the home position as far away from the furnace and the molten metal bath as possible and completely powered down, locking the main disconnect breaker in the **OFF** (de-energized) position.
In case of hydraulic maintenance, move the ladler or the ingot loader arm to the fully lowered position. In this position the arm cannot fall due to gravity during maintenance operations.
- Always follow recommended lockout/tagout procedures.

CAUTION

NEVER attempt to change a ladle cup or work on the ingot loader arm over an open metal bath. Dropping parts into the metal bath will cause an extreme splash hazard.

- **Never enter the working space of the ladler or the ingot loader arm without powering down the machine and tagging and/or locking the main disconnect breaker in the OFF (de-energized) position.**
- Be careful around high pressure lines, fittings, and equipment.

DANGER

NEVER tighten or loosen couplings, fittings, packings, gauges etc. when system is pressurized.

- Yellow wires inside the control cabinet indicate that these circuits may be energized from another source with the disconnect turned off.

CAUTION

More than one power source is used to supply energy to the equipment.

VITON SEAL SAFETY ADVISORY

Operators and maintenance staff working with Shamrock equipment should take careful note of an urgent safety hazard associated with oil seals and "O" rings made of a substance called VITON. VITON seals are used in Shamrock equipment.

While safe under designed operating conditions, VITON has been found to decompose into dangerous **hydrofluoric acid** if exposed to high temperatures. **HYDROFLUORIC ACID IS EXTREMELY CORROSIVE AND ALMOST IMPOSSIBLE TO REMOVE, PARTICULARLY FROM HUMAN TISSUE.**

When inspecting equipment which has been exposed to a high temperature, check if any gaskets have suffered from decomposition. These will appear as a charred or black sticky mess. ***DO NOT TOUCH THIS SUBSTANCE!!***

You must not, under any circumstances, touch either the seal or the equipment until a substantial cooling period has been allowed and the equipment has been decontaminated. Disposable, heavy-duty plastic gloves approved to withstand contact with hydrofluoric acid, safety glasses, and a face shield should be worn and the affected area should be cleaned using wire wool and a detergent solution. The gloves must be safely discarded immediately after use.

Appendix A

SOURCES OF INFORMATION REGARDING ROBOT SAFETY GUARDING AND DEVICES

The following is a listing of some companies which manufacture or sell robot safety equipment and/or services. The listing was taken from reference sources and represents just some of the companies offering these products or services. It is not a recommendation or endorsement of any company's particular products or services. It is offered simply as a starting point for those seeking these products.

Wire Crafters

Tel: 800-626-1816

Fax: 502-361-3857

www.wirecrafters.com

Tapeswitch Corporation

100 Schmitt Boulevard

Farmingdale, NY 11735

Tel: 800-234-8273

E-mail: sales@tapeswitch.com

Smartscan Inc.

32841 Eight Mile Road

Livonia, MI 48152

Tel: 248-477-2900

Fax: 248-477-7453

www.smartscan.com

Banner Engineering Corp.

PO Box 9414

Minneapolis, MN 55440

Tel: 888-373-6767

612-544-3164

Fax: 612-544-3213

E-mail: Sensors@baneng.com

Sick, Inc.

Safety Controls Division

6900 West 110th Street

Bloomington, MN 54438

Tel: 800-325-7425

612-941-6780

Fax: 612-941-9287

www.sickoptic.com

Jesco Industries, Inc.

950 Anderson Road @ Robotic Drive

PO Box 388

Litchfield, MI 49252-0388

Tel: 800-609-8293

517-542-2903

Fax: 517-542-2501

www.jesco-wipco.com

Leuze-Lumiflex, Inc.

300 Roundhill Drive

Unit 4

Rockaway, NJ 07866

Tel: 973-586-2500

Fax: 973-586-1590

www.leuze-lumiflex.com

Scientific Technologies, Inc.

6550 Dumbarton Circle

Fremont, CA 94555-3611

Tel: 800-527-0593

888-510-4357

Fax: 510-744-1442

www.sti.com

Appendix B

DIRECTORY OF SAFETY CLOTHING & EQUIPMENT VENDORS

The following is an alphabetical listing of some companies which manufacture or sell personal protective clothing and equipment for foundry workers. The listing was taken from reference sources and represents just some of the companies offering these products. It is not a recommendation or endorsement of any company's particular products or services. It is offered simply as a starting point for those seeking these products.

Allied Glove Corp.
431 N. 5th Street
Milwaukee, WI 53203
Tel: 414-272-0301
Fax: 414-272-0362

Cabot Safety Corp.
90 Mechanic St.
Southbridge, MA 01550-2555
Tel: 800-225-9038
Fax: 508-765-9305

Comasec Safety Inc.
PO Box 1219
8 Niblick Road
Enfield, CT 86082
Tel: 800-333-0219

DiVall Safety Equipment Inc.
1721 Niagra Street
Buffalo, NY 14207
Tel: 800-343-1354
Fax: 716-874-4686

Elwood Safety Co., Inc.
2180 Elmwood Avenue
Buffalo, NY 14216
Tel: 800-445-8946
Fax: 716-874-2110

Lab Safety Supply
PO Box 1368
Janesville, WI 53547
Tel: 800-356-0783
Fax: 800-543-9910

National Safety Apparel
3865 W. 150th Street
Cleveland, OH 44111
Tel: 800-553-0672
Fax: 216-941-1130

Northern Safety Co., Inc.
1914 Dwyer Avenue
Utica, NY 13501
Tel: 800-631-1246
Fax: 800-635-1591

PGI
PO Box 307
550 Commercial Avenue
Green Lake, WI 54941
Tel: 800-558-8290
Fax: 414-294-4307

Safepro Safety Products
3865 West 150th St.
Cleveland, OH 44111
Tel: 216-941-9400
Fax: 216-941-1130

Saf-T-Gard Corp.
205 Huehl Road
Dept. B
Northbrook, IL 60062
Tel: 800-548-4273
Fax: 708-291-1610

Safety Services, Inc.
5286 Wynn Road
PO Box 3539
Kalamazoo, MI 49003
Tel: 800-632-2955
Fax: 616-382-6277

Steel Grip Inc.
700 Garfield Street
PO Box 747
Danville, IL 61832
Tel: 217-442-6240
Fax: 217-442-9370

Tempex Safety Products
Div. Of Gaskets, Inc.
301 Highway 16
Rio, WI 53960
Tel: 800-558-1833
Fax: 414-992-3124

Appendix C

SOURCES OF INFORMATION REGARDING ROBOTS AND ROBOT SYSTEMS, SAFETY REQUIREMENTS AND GENERAL FOUNDRY SAFETY INFORMATION

OSHA, 3067, Concepts and Techniques of Machine Safeguarding

OSHA, Pub. 8-1.3, Guidelines for Robotics Safety

ANSI/RIA R15.06-1999, American National Standard for Industrial Robots and Robot Systems. This standard may be obtained from the Robotic Industries Assoc. or the American National Standards Institute.

Robotic Industries Association

P.O. Box 3724
Ann Arbor, MI 48106
Tel: 734-994-6088
Fax: 734-994-3338
www.robotics.org

National Fire Protection Association

1 Batterymarch Park, P.O. Box 9101
Quincy, MA 02269-9101
Tel: 617-770-3000
Fax: 617-984-7110
www.nfpa.org

American Foundry Society

505 State Street
Des Plaines, IL 60016-8399
Tel: 847-824-0181
Fax: 847-824-7848
www.afsinc.org

North American Die Casting Assoc.

9701 West Higgins Road, Suite 880
Rosemont, IL 60018-4721
Tel: 847-292-3600
Fax: 847-292-3620
E-mail: nadca@diecasting.org

American National Standards Institute, Inc.

11 West 42nd Street
New York, NY 10036
Tel: (212) 642-4900
Fax: (212) 398-0023
www.ansi.org

U.S. Department of Labor

Occupational Safety & Health
Administration (OSHA)
Office of Public Affairs - Room N3647
200 Constitution Avenue
Washington, D.C. 20210
Tel: 202 693-1999
www.osha.gov

GLOSSARY

- **Actuator:** A power mechanism used to effect motion of the machine.
- **Awareness Signal:** A device that warns a person of an approaching or present **hazard** by an audible or visible means.
- **Cycle Interrupt:** An operating mode in which the machine is brought to a controlled stop and hydraulic power remains available to the actuators.
- **Emergency Stop:** Overrides all other functions, removes power from the actuators. Reset does not initiate re-start.
- **Emergency Stop Circuit:** A discreet electro mechanical circuit which, when de-energized, removes all power from machine actuators. Provisions for additions of other emergency stop devices are provided in this circuit.
- **Hazard:** A source of possible injury or damage to health.
- **Industrial Robot:** An automatically controlled, reprogrammable multipurpose manipulator **programmable** in three or more axes which may be either fixed in place or mobile for use in industrial automation applications.
- **Interlock:** An arrangement whereby the operation of one control or mechanism allows or prevents the operation of another.
- **Interlock (for safeguarding):** An arrangement that interconnects guards or devices with the control system which distributes energy to the machine.
- **Personnel Barrier:** A physical means of separating persons from a **hazard**.
- **Qualified Person:** One familiar with the construction and operation of the equipment and the hazards involved.
- **Safeguard:** A barrier guard, device or safety procedure designed for the protection of personnel.

GLOSSARY - Continued

- **Safeguard:** A guard or protective device used as a safety measure to protect persons from a present or impending hazard.
- **Safeguarding:** Those safety measures consisting of the use of safeguards to protect persons from hazards that cannot be reasonably removed or sufficiently limited by design
- **Work Space:** The three dimensional volume encompassing the movements of all robot parts through their axes.

CAUTION

Working with molten metal is a serious business. People not directly involved with the set-up and operation of the automatic pouring or ingot loader systems must be kept out of the immediate area. Those involved in these operations must wear appropriate safety gear.

DANGER

DO NOT operate the equipment without adequate physical guarding. **DO NOT** allow personnel into the working space of the equipment.

DANGER

Ladle coating must be thoroughly dry before the ladle cup is installed on the automatic ladler. Immersion of wet ladle coating into the metal bath can cause an explosion with possible injury to personnel.

DANGER

Due to the hazards associated with moving equipment, Shamrock automatic pouring units and ingot loaders must be installed and operated in a manner which prevents the intrusion of people into the work space area of the equipment. In the case of pouring units, Ladlers, any intrusion into the work space of

DANGER

Emergency stopping of the system can cause rapid deceleration. If the ladler is carrying metal, it is likely to spill or splatter during an E-stop.
Proper barriers such as wire mesh panels must be used to protect the personnel against accidental metal

CAUTION

Never attempt to change a ladle cup or work on the ingot loader arm over an open metal bath. Dropping parts into the metal bath will cause an extreme splash hazard.

DANGER

Use of petroleum base oils or fluids will constitute a severe fire hazard.

WARNING

Check to insure that the proper rated hose or pipe is used on pressure lines.

WARNING

Any air in a hydraulic system can result in sudden and unexpected movement. Whenever the hydraulic circuit is broken (by removing a hose or valve, etc.) always bleed any remaining air from the system by carefully actuating the manual valve overrides or the manual controls. Insure that all perimeter guarding is closed and the area is clear. Stand well away from the equipment until all air is bled out of the system.

CAUTION

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DANGER

NEVER tighten or loosen couplings, fittings, packings, gauges etc. when system is pressurized.

CAUTION

More than one power source is used to supply energy to this equipment.

