SILGAN ELECTRICAL EQUIPMENT SPECIFICATION

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1 General

This document defines the electrical requirements for equipment supplied to Silgan Containers Manufacturing Corporation, manufacturing facilities and its installation. The intent is to provide electrical control systems designed for safety, reliability, and consistency.

1.1 Deviations

Any deviations from this specification shall require approval, in writing, by Silgan Containers Manufacturing Corporation.

1.2 Definitions

Silgan Containers Manufacturing Corporation	A physical plant location or an authorized company representative responsible for the procurement of the electrical control equipment.
Electrical Equipment	Individual components and systems including electrical, electro-mechanical, electronic devices, enclosures, and associated wiring.
Supplier	The provider of said electrical equipment.

1.3 Electrical Standards

All electrical equipment shall be supplied to Silgan Containers Manufacturing Corporation in compliance with current versions of applicable national codes and standards including but not limited to the following:

National Electrical Code (NEC)
National Electric Safety Code (NESC)
National Fire Protection Association (NFPA)
American National Standards Institute (ANSI)
Underwriters Laboratory (UL)
Occupational Safety and Health Administration (OSHA)

All electrical equipment shall also be supplied in accordance with all applicable state and local electrical codes and statutes where the equipment is to be installed.

Equipment shall be UL compliant and labelled accordingly in destinations where this is a requirement.

1.4 Project Organization

Within two (2) weeks upon receipt of an order, the supplier shall provide Silgan Containers Manufacturing Corporation with a project schedule. Said schedule shall identify target dates such as: start of design, design completion, start of assembly, assembly completion, equipment acceptance, shipment, and delivery. Any changes to the schedule shall be communicated to Silgan Containers Manufacturing Equipment in a timely manner.

2 Electrical Requirements For Control Panels

2.1 Incoming Power

Electrical power supply of the destination facility (unless otherwise noted) is as follows: 480 VAC, 3PH Delta-Wye, 3W, 60Hz with an approximate available fault current of 22kA.

2.2 Enclosures

Electrical enclosures (including all perforations) shall be rated Type 12 (NEMA or UL where applicable) if located indoors, rated Type 4 (NEMA or UL where applicable) if located outdoors, where codes and standards (per section 1.3) do not require an enclosure of greater integrity.

2.3 Heating/Cooling

The supplier shall provide heating and/or cooling equipment to maintain components within their specified operational temperature limits or 50 C (122°F) whichever is lower.

2.4 Disconnects

For each piece of equipment rated above 125 volts the supplier shall furnish a flange-mounted disconnect, mechanically interlocked with the opening of the enclosure door(s). It must be mounted in clear view from outside of the enclosure and clearly marked indicating both on and off positions. The disconnect switch shall have a mechanism allowing defeat/entry into the enclosure where the handle is in the on position. Disconnect shall be capable of being locked in the off position by means of a lock hasp and a minimum of three (3) locks.

For each piece of equipment rated below 125 volts, a fused disconnect switch or circuit breaker of suitable size and rating shall be provided. Operating handle shall be external and lockable; however, not need be mechanically interlocked with the enclosure door(s).

2.5 Main Circuit Breaker

Main panel over current and disconnect shall be provided by a circuit breaker with both magnetic and thermal trip.

2.6 Circuit and Motor Over Current Protection

Fuses of any kind shall be avoided wherever possible. The preferred means of circuit protection is by circuit breaker.

Both the primary and secondary windings of a control transformer shall be protected by means of circuit breaker (wherever possible).

All 3-phase motor starters shall be supplied with a manual reset thermal type overload relay.

2.7 Lighting

24VDC LED lamp fixture(s) of appropriate length and quantity shall be mounted on the inside surface of the top of the enclosure(s). The fixture(s) shall be controlled by a door switch (for each door).

2.8 Grounding

All grounding shall be done in accordance with Article 250 of the NEC (or local code) whichever is more stringent. Including but not limited to: Bonding of multiple door enclosures to form a common ground and proper grounding of all electronic equipment to the manufacturer's recommendations.

2.9 Grounded Neutrals

All 120-Volt AC control systems shall have a grounded neutral. Any equipment requiring an isolated/floating neutral shall only be approved in writing from Silgan Containers Manufacturing Corporation.

2.10 Safety/Emergency Stop

All electrical control systems shall be designed to SIL2 / PLd safety performance levels unless risk assessment proves more stringent control means are necessary.

Emergency stop circuits including but not limited to emergency stop push buttons, light curtains, gates, and guard monitoring shall utilize two (2) channel safety where each channel is continually monitored / tested for reasonable single point failure modes (including but not limited to shorts, mis-wire, and open circuits). Circuits and therefore machine operation shall fail safe upon said monitored single point failure modes.
Monitoring / testing of said emergency circuits shall be provided by equipment such as safety rated control relays or by a safety rated PLC and its' respective safety rated I/O peripherals.

Safety rated means of power disconnect from controlled output devices shall be provided upon operation of any emergency stop (Cat 0). The delay of power removal, or the act of non-removal of power (Cat 1 and Cat 2 stops respectively) are permissible where deemed necessary by risk assessment.

Emergency stop push buttons shall be of the palm or mushroom push button type and shall be maintained.

2.11 Wiring

RED	Ungrounded AC control circuit conductors, 120 volts and lower.
WHITE	Neutral circuit conductors, 120 volts or lower.
BLACK	Line and load circuits, AC or DC, above 120 volts. DC circuits shall have polarity (+ and -) marked on both ends of their respective wires.
BLUE	Ungrounded DC control circuit conductors, 120 volts and lower.
WHITE/BLUE	Grounded current carrying DC circuit conductor, 120 volts and lower.
LIGHT BLUE	Intrinsically safe wiring.
GREEN	Equipment grounding conductors (non-current carrying)
GREEN/YELLOW	Equipment grounding conductors (non-current carrying)
WHITE/YELLOW	Grounded separately derived AC control circuit conductors
YELLOW	Separately derived control circuit conductors (external interface typ.)

Enclosures that contain separately derived wiring or is powered by means of external power sources shall be labeled accordingly near the main disconnect external to the enclosure(s).

2.12 Wire and Terminal Identification

All wires more than six (6) inches long shall be permanently labeled on both ends.

Wires six (6) inches or less in length shall be permanently numbered on a minimum of one (1) end.

Terminal blocks shall be clearly marked with the same number as the wire terminated to it.

2.13 Terminal Blocks

Terminal blocks shall be mounted to provide unobstructed access to the terminals and their respective conductors.

Ten (10) percent spare terminals shall be provided in every electrical enclosure. A minimum of eight (8) spare control terminals, and three (3) spare power terminals shall be provided.

No more than two (2) conductors shall be terminated at any terminal connection, only one (1) where multiple conductors are not permitted per manufacturer specification.

All enclosures used for operator interface (i.e. push button, pilot light or HMI) shall include terminal blocks for ease of termination.

All cords and cordsets shall be terminated at terminal blocks.

2.14 Receptacles

Enclosures that house (a) programmable electronic device(s) (i.e. PLCs) shall provide a GracePort (or similar device) in compliance with the intended enclosure environmental rating (per section 2.2). Such device will provide a circuit breaker protected 120VAC receptacle and a communication port (i.e. Ethernet RJ45) granting access to said programmable electronic device(s) externally.

2.15 Programmable Controllers (PLC)

If the equipment is to use programmable controllers (PLC), Silgan Containers Manufacturing Corporation shall approve the hardware configuration proposed, in wiring, before purchase.

The supplier shall provide 20% spare I/O capacity (may include spare I/O slots for which I/O modules are not supplied), and 20% available memory.

Wire numbers of wires between the device and the input / output module shall be defined by the originating page and position within the electrical schematics. (i.e. page 5, line 21 = 521 etc..). If multiple devices are connected in series to an input / output, letter suffixes (A, B, C…) shall be added to differentiate.

2.16 Operator Interface Terminals

Approval of all operator interface terminals shall be done in writing and approved by Silgan Containers Manufacturing Corporation.

3 Machine Wiring

3.1 Junction Boxes

Junction boxes larger than 8” x 10” shall use rigid conduit to assist in wire routing.

Terminal blocks shall have a minimum of 1.5” clearance to the rigid conduit hub and 3” to the side of the junction box.

Junction boxes 8” x 10” and smaller shall have enough terminal blocks to sufficiently terminate all wires in the box.

All junction boxes shall have 10% extra terminals or two (2) extra, whichever is greater.

All junction and terminal boxes shall be mounted such that they are readily accessible.

3.2 Conduit

All conduit shall be of rigid type (steel or aluminum) with a minimum of 10% spare wires or two (2), whichever is greater.

All conduit shall use Myers hubs or equivalent.

3.3 Equipment Wiring

Conductors and their connections, external to the enclosure, shall be totally enclosed in rigid type conduit.

Where a control panel and machine are physically separated, wires shall be terminated at terminal blocks, or plugs and receptacles at both locations.

Conductors used for instrumentation, data communication, or other sensitive / low power systems shall be separated from AC conductors or other noise generating sources. Such conductors shall be run in separate conduit where enclosures are physically separated.

3.4 Device Tags

Control and power devices shall have an identifying tag attached on or near the device that corresponds to the electrical schematic. The tag should list the device I/O number and a short description consistent with control system documentation un characters not less than 0.125” in height.

4 Approval Drawings

Electrical equipment suppliers shall submit system concept drawings to Silgan Containers Manufacturing Corporation for approval. The time frame for this activity shall be no later than one-third (1/3) of the time frame specified in the project schedule.

Drawings approved by Silgan Containers Manufacturing Corporation constitute only a concurrence in the general design layout concepts and indicate that the drawings appear to conform to Silgan Containers Manufacturing Corporation standards.

Drawing approval does not constitute Silgan Containers Manufacturing Corporation approval of design details, dimensions, or the capability of the equipment to perform the operational requirements as specified. *The responsibility for the capability of the design, and function of the equipment remains solely with the supplier.*

Required approval drawings include, as appropriate:

Block diagram(s) of control functions and/or major system interconnections, when warranted by the complexity of the control system.

Equipment layout showing the control panel enclosure (with exterior dimensions) and externally mounted components, including operator interface devices.

Sub-panel layout drawing(s), showing the general physical arrangements of major control components.

Electrical connection diagram(s), showing the electrical power wiring from the main disconnect to the major electrical components. Electrical devices shall be shown with voltage and current ratings, motor horsepower and speed ratings, fuses and circuit breaker sizes where known, etc.

Preliminary Bill of Material with all purchased parts identified by the original equipment manufacturer's name and part number.

5 Documentation

The supplier shall furnish one complete set of documentation as listed below within thirty (30) days of equipment final project acceptance.

5.1 As-Built Drawings

Drawing sheets shall be a minimum B size, 11 by 17 inch nominal, with drawing numbers and title blocks provided by Silgan Containers Manufacturing Corporation.

A copy of drawing files in AutoCAD release 14 format or newer, or an AutoCAD convertible format (i.e., DXF or IGES) shall also be supplied on two (2) physical media devices (i.e. USB Flash drive). Drawing objects shall consist only of lines, arcs, and text.

Drawings shall include, as appropriate:

Block diagram(s) of control functions and/or major system interconnections, when warranted by the complexity of the control system.

Equipment layout showing the control panel enclosure (with external dimensions) and externally mounted components, including operator interface devices.

Sub-panel layout showing the physical arrangement of all control components, including all hardware configuration settings (e.g., dip switches, rotary switches, jumpers) or software configuration for devices, as appropriate.

Electrical connection diagram(s) or physical wiring layout(s) shall show the electrical power wiring from the main disconnect to all major electrical components.

Electrical devices shall be shown with voltage and current ratings, motor horsepower ratings and rated speeds, fuses, and circuit breaker sizes, etc.

Interconnection diagram showing wiring between devices, including I/O wiring to/from the programmable controller. Hardware configuration settings (e.g., dip switches, rotary switches, jumpers, etc.) shall be clearly indicated on the drawing.

The rack and slot location of all modules in a programmable controller system shall be clearly indicated on the drawing.

5.2 Programmable Controller Documentation

Programmable Controller logic shall be documented (i.e. tag descriptions, rung comments, descriptive tage names, etc…) utilizing RSLogix software.

All programming software files shall be provided on two (2) physical media devices (i.e. USB flash drive).

5.3 Other Programmable Device Documentation

Programmable devices, other than programmable controllers (Section 5.3), shall be documented appropriately, documenting programs, configurations (hardware and software), parameter settings, etc. Two (2) copies of appropriate documentation shall be supplied on both hard copy (i.e. Print) and on two (2) physical media devices (i.e. USB flash drive).

5.4 Operating and Maintenance Manual

One set of operating and maintenance manuals including, as applicable: The supplier’s name, telephone number, and project identification number.

Basic machine start-up and operating instructions for both manual and automatic operation.

Recommended preventive maintenance program (including equipment calibration or adjustment procedures and battery replacement guidelines).

Complete list of consumable items (batteries, etc.). Guidelines for General Maintenance:

Final Bill of Material for all devices with all purchased parts identified by the original equipment manufacturer's name and part number. The Bill of Material shall be cross-referenced to the drawing of the device or subassembly.
One copy of each original equipment manufacturer's manual and/or data sheet for all purchased components as supplied with the material.

Recommended spare parts list, including complete ordering information and suggested quantities.

6 Recommended Component List

COMPONENT	MANUFACTURER(S)	MODEL OR ADDITIONAL DETAIL
Air Conditioners	Hoffman, Rittal	
Circuit Breakers	AB	
Control Relays & Timers	AB	
Disconnects	AB	
Drives, AC/DC Freq	AB	PF 525, PF 753, PF 755
Drives, Servo	AB	Kinetix 5500, 5700, 6500, 350
Drives, Stepper	Superior	
Motors, Induction	Baldor, Toshiba, Marathon, WEG	
Motors, Servo	AB	Pref VPL, Alt MPL
Counters	Red Lion	
Enclosures	Hoffman, Saginaw	
Encoders	AB, BEI	
Light Curtains	Sick, AB, Banner	
Message Displays	AB	
Motor Starters	AB	Bulletin 500 (NEMA), 100 (IEC)
Operator Interface Terminals	AB	PVP7, PV 5000
Switches, Limit	AB, Microswitch	802T
Switch, Photoelectric	AB	
Switch, Proximity	AB	
Pilot Lights	AB	800T
Push Buttons	AB	800T
Selector Switches	AB	800T
Temperature Controllers	Honeywell	
Terminal Blocks	AB	
Transformers	SOLA / Hevi-Duty	
PLC, Safety	AB	5069-L3XXER(M)S2, 1756-L8XES
PLC, Standard	AB	5069-L3XXER(M), 1756-L8X

APPENDIX A

Additional Requirements for Equipment

Electrically Classified Hazardous.

1) Equipment Requirements for Hazardous Classification of spray application equipment, ovens and furnaces shall comply with, but not limited to, the NFPA Standard NFPA 33-1995, NFPA 86-1995, NEC Articles 500, 501,504, 505, 516 and the following (Note: The following is a summary of some of some of the Codes and Standards listed above.)

A) Definitions:

I) Spray Area – Any Area in which dangerous quantities of flammable or combustible vapors, mists, residues, or deposits are present due to the operation of spray processes.

The Spray Area Includes:

(a) The interior of any Spray Booth or Spray Room.

(b) The interior of any Exhaust Plenum and any Exhaust Duct leading from the process.

(c) Any area in the direct path of a spray application process.

II) Spray Booth – A power-ventilated structure that encloses a spray application operation or process, and confines and limits the escape of the material being sprayed, including vapors, mists, dusts, and residues that are produced by the spraying operation and conducts or directs these materials to an exhaust system. Spray Booths are manufactured in a variety of forms. Some of these forms are as follows: downdraft, open face, traveling, tunnel, and updraft booths.

III) Flash point – The Flash Point of a liquid is minimum temperature at which the liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

IV) Ignition Temperature or (Auto-Ignition Temperature) - The lowest temperature at which a gas-air mixture can ignite and continue to burn.

V) Explosive Range

(a) Lower Explosive Limit (LEL)

(b) Upper Explosive Limit (UEL)

The range of concentration of a flammable gas in air within which a flame can be propagated. The lowest flammable concentration is the Lower Explosive Limit (LEL). The highest flammable concentration is the Upper Explosive Limit (UEL).

VI) Intrinsically Safe Systems – Intrinsically safe apparatus and wiring shall be permitted in any hazardous (classified) location for which it is approved. Installation of Intrinsically safe apparatus and wiring shall be in accordance with the requirements of the NEC Article 504.

VII) Purged and Pressurized – This protection technique shall be permitted for equipment in any hazardous (classified) location for which it is approved. NFPA 496-1998, Standard for Purged and Pressurized Enclosures for Electrical Equipment, covers purged and pressurized enclosures for electrical equipment in Class I hazardous (classified) locations and pressurized enclosures for electrical equipment in Class II locations.

VIII) Nonincendive – A protective technique where, under normal operating conditions, any arcing or thermal effects are not capable of igniting the flammable gas, vapor, or dust-in-air mixture.

This protection technique shall be permitted for equipment in those area's classified as Class I, Div. 2; Class II, Div. 2; and Class III locations for which it is approved.

IX) Hermetically Sealed – A hermetically sealed device shall be sealed against the entrance an external atmosphere and the seal shall be made by fusion, e.g., soldering, brazing, welding, of the fusion of glass to metal.

This protection technique shall be permitted for current interrupting contacts in Class I, Div. 2.

X) Utilization Equipment – Equipment that utilizes electrical energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes.

2) Construction of Spray Areas per the NFPA 33-1995

A) The sides and top that intersect or enclose the spray area shall be constructed of a noncombustible or limited-combustible materials or assemblies and securely and rigidly mounted or fastened. The interior of the spray area shall be smooth, designed to prevent pockets that can trap residues, and designed to facilitate ventilation and cleaning.

The bottom of the spray area shall be constructed of noncombustible material, limited-combustible material, or combustible material that completely covered by noncombustible material.

Aluminum shall not be used.

B) Conveyor openings (Material Transition Openings into the spray area)

Conveyor openings that are necessary for transporting or moving the work into and out of the spray area shall be as small as practical.

C) Ventilation of spray area. The spray area shall be equipped with a ventilation system that is interlocked with the operation of the equipment so as to shutdown and prevent the energization of the equipment.

3) Identification of the Spray Application Equipment's Hazardous Classification.

A) Areas that shall be consider as Class I, Div. 1, are the following:

I) The area defined by the enclosure around the spray nozzle (The spray area) shall be considered as Class I, Div. 1.

II) The area directly below the spray area (The inside of the enclosure that constitutes the base of the machine).

III) The interior of the oven shall be considered.

IV) The interior of exhaust or ventilation ducts

B) The Areas that shall be consider as Class I, Div. 2, are the following:

I) The area that will be classified as Class 1, Div. 2, is the area that extends 5 feet horizontally and 3 feet vertically from the perimeter of any area that has been defined as Class I, Div. 1.

4) Wire Methods for classified areas: Shall comply with the NEC Article 501. (Refer to Appendix B)

A) Wiring methods for fixed wiring in a Class I, Div. 1, location shall comply with the requirement of the NEC Article 501-4(a)(1).

B) Wiring methods for flexible connections in a Class I, Div. 1, location shall comply with the

requirement of the NEC Article 501-4(a)(2).

C) Wiring methods for Class I, Div. 2, location shall comply with the requirement of the NEC Article 501- 4(b).

5) Motors for classified areas:

A) Motors shall comply with the 1999, National Electric Code (NEC) Article 501-8(a), for a Class I Div. 1, and shall be approved for Class I, Div. 1 locations.

Motors shall be approved for Class I, Div. 1, locations or of the totally enclosed type supplied with positive-pressure ventilation from a source of clean air with discharge to a safe area, so arranged to prevent energizing of the machine until ventilation has been established and the enclosure has been purged with at least 10 volumes of air, and also arranged to de-energize the equipment when the air supply fails. Totally enclosed type motors shall have no external surface with an operating temperature, in degrees Celsius, in excess of 80% of the ignition temperature of the gas or vapor involved. There shall be no arcing or sparking devices or apparatus contained within or on the motor.

B) Motors shall comply with the 1999, National Electric Code (NEC) Article 501-8(b), for a Class I Div. 2, Shall be approved for Class I, Div. 2 locations.

Motors shall be approved for Class I, Div. 2, locations and of the totally enclosed type with an approved temperature code listed on the nameplate of the motor. There shall in no case be any surface temperature of the motor in excess of 80%, in degrees Celsius, of the ignition temperature of the gas or vapor involved.

6) Utilization Equipment that is located within a classified area shall comply with the NEC Article 501-10.

A) Control Panels that are within a Classified Area shall be sealed and purged.

7) Fans that are with in a Class I, Div. 2, Location shall be of the non-sparking type.