DELPHI

ELECTRICAL DESIGN SPECIFICATIONS FOR TOOLING AND MACHINERY

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Reference Drawing Set – "Widget Assembly Machine H5008492ME001" found in CAD Library section.

This Electrical Design Specification is designed as exceptions/deletions to the Delphi Electrical Specification for Industrial Machinery (DA-2004 - Version 5- May 2009).

1 General

1.1 Electrical Controls shall be designed and built using the following standards and specifications:

a. IEC 60204-1: Fifth Edition, 2005-10 Safety of Machinery International Standard
b. DA-2004 Electrical Specification for Industrial Machinery, Version 5.0, May 2009, Addendum to IEC 60204-1
c. DA-2001 Specification for the Application of Safety Circuits, Revision 3.0, February 2007.
d. The Delphi Thermal Preferred Electrical Components List, see Section 3
e. Delphi Design-In Environmental Health and Safety Specification, DA-2006 Version 2.0 June 2013
f. Lean Equipment Controls Design DA-2005
g. Delphi pneumatic spec DA-2003 ver. 1.0 September 1998
h. Delphi hydraulic spec DA-2002
i. Delphi sound level specification SL-1 November 2009**j.** Federal, state, and local regulations that apply.
k. NFPA 70, 70E, 79 – Electrical safe work practices (North America only, check with Controls Engineer)

1.2 The Controls Engineer shall provide the latest and proper formats for both ACAD drawing documentation and PLC programming.

1.3 All enclosures shall be rated NEMA 12 or IP55.

1.4 The main disconnecting means shall be flange mounted, cable operated, and rated for 65,000 amps interrupting capacity. According to DA-2006 Design-In Health and Safety Spec **9.2, Hazardous Energy Control-Lockout** "The main lockable disconnects for all hazardous energy sources shall be located outside the safeguarded area. Through-the-door electrical disconnect switches with rod actuators that allow the operating handle to become disengaged from the switch when the panel door is open are NOT permitted." Any deviation must be approved by the Controls Engineer. Robots will have separate, lockable servo disconnects that do not interrupt controller power.

1.5 Control voltage and safety circuits shall be 24VDC and shall utilize IEC components. Machines delivered to Europe shall have the CE mark. All individual components used should also have the CE mark.

1.6 E-Stops and safety circuits shall use 24VDC safety relays.

1.7 AC transformer primary shall be universal input type (380-480 VAC and 50/60 Hz) and use multiple secondary voltages if needed. (example: use one transformer for 240VAC and 120VAC if both are required.)

1.8 Wiring Terminations – The supplier shall design the control and wiring system for ease of disassembly and reassembly at Delphi facility. All equipment shall be capable of being moved by both supplier and inter-plant, without the need for re-termination of the control wiring to the control panels. This design is achievable through one of the following methods listed from the most preferred:

1.8.1 The preferred method is that the panels shall be mounted directly to the equipment frame or a common base.

1.8.2 The panel and the equipment shall be able to be moved by removing sections of wire duct while leaving all wiring intact and moving the panel and equipment at the same time.

1.8.3 The panel and equipment shall use multi-conductor cables and connectors (example: Phoenix Contact, Harting, Epic) and the cables are simply unplugged and replugged after the move.

1.8.4 Control console location and configurations require Delphi Project Engineer pre-approval.

Note: In designs 1.8.2 and 1.8.3, all wires shall have at least 20 additional feet to accommodate future moves and rearrangements.

1.9 Control Routing

1.9.3 Air lines shall not be run with controls wiring in wire way or wire duct.

1.9.4 There should be different wire ways for AC & signal carrying wires / cables. Wherever possible, this wiring should be separated.

1.9.5 Power wiring shall not pass through control stations.

1.10 PLC power supply shall be 24VDC input.

1.11 Motors and drivers/indexers will be located and wired for quick and easy replacement. I.E.: Accessible & quick connectable.

1.12 I/O field devices (example: motors, sensors, valves) shall have quick disconnects for ease of replacement.

1.13 Paint

For finish colors see Tool Design Section 3F. The outside of the electrical panels shall be the same color as the color of the machine. The inside of electrical panels shall be white. The exterior of the doors of the electrical panels may be painted orange at the request of the Project Engineer.

1.14 Miscellaneous

1.14.1 I/O addresses shall be clearly marked at the device & at each cable/wire termination.

1.14.2 All solenoids shall have individual overcurrent protection.

1.14.3 Point-to-point wiring shall be kept to a minimum by using remote communication blocks where feasible.

1.14.4 Finger-Safe Terminal blocks shall be mounted to provide unobstructed access to the terminals and their conductors.

Input and output wires shall be wired to terminal strips on the back plate. This includes all I/O including unused spares.

Stacking of terminals is not permitted.

Terminal blocks shall not be used in wire ways.

1.14.5 Cables attached to moving details must have a short “sacrificial” cable attached to non-moving I/O block or cable going to controller. These cables are to have quick disconnects on both ends. In the region that these cables flex there is to be generous "loops" to minimize angle of inflection. Use Superflex cabling as needed.

Machine movements and flexing of air, hydraulic and electrical lines must be minimized.

Length of sealtite shall not exceed 3 feet unless Delphi Project Engineer preapproves. Does not apply to cables for flexible connections.

1.14.6 PLC processor memory back-up batteries must be properly sized. PLC processor memory will be backed-up on EEPROM (or other non-volatile memory) set to load if main program is lost.

Non-volatile memory for electronic components (PLC’s, displays, etc.) will be provided. (flash drive is preferred).

1.14.7 All sensor adjustments must be accessible without removing sensor from mounting.

Sensor status shall be visible to operator without guarding removal.

Systems requiring compressed air must have a pressure switch on main line after disconnect. Digital is preferred.

1.14.8 An HMI will be used as primary operator interface. The standard operator panel will consist of an HMI, Power On Button, an Alarm Horn & E-Stop. Push buttons should be minimized. This may vary for specific applications and requires Delphi Project Engineer approval.

1.14.9 Andon stacks will follow DMS standard. Reference the Lean Equipment document

1.14.10 All hardwired power stops (E-stop, interlocked doors, etc.) shall be input to PLC so that problems or disconnections with individual devices can be communicated to operator.

Access doors for back and sides (as needed) of machines will be hinged and interlocked. Full side solid panels will be avoided. Panels requiring tools to gain access will be avoided.

1.14.11 Surge suppression shall be used for all triac output modules with inductive loads.

1.14.12 All analog devices shall have ISO 9000 applicable calibration instructions included in documents. Supplier should provide a current calibration sheet and certifications. Signals will be 0-10vdc unless approved by Delphi Project Engineer.

1.14.13 Each access door of electrical enclosures will be labeled with highest voltage within it. Labeling must also be shown on documents.

1.14.14 Use bulkhead connections to minimize pass throughs. Bulkhead connections must be shown & labeled on documents. If the bulkhead connection is for an IP or I/O connection then the IP or I/O should be listed on label.

1.14.15 Signal lights and horns/sirens should be located within 3 feet of operator.

1.14.16 Outputs on electronic devices shall be protected from short circuit and overload conditions. Circuit breakers are preferred, but if fuses are used they are to have blown fuse indication.

1.14.17 PC's must provide a means for data back-up. PC's should have a UPS available so a controlled shutdown can be completed.

2 Documentation

2.1 - Compatibility and Format

2.1.1 – See Tool – Equipment Specification A for file naming and revision information.

2.2 – Drawing Documentation Standards

2.2.1 - General Setup:

Drawing Limits – Drawing limits will be set at 0,0 by 34, 22. Do not change or scale limits.

Electrical Symbols – Use electrical symbols as supplied by Delphi only. Special vendor symbols, blocks, graphics, etc. will not be added to any Delphi drawings.

Layers – Use layer 0 (Zero) only. Do not create additional layers on the drawing.

Snap – Standard drawing snap will be .125. All work should be done in increments or multiples .125. Do not use a snap below the value of .0625. This includes work on all drawings.

Templates – Use the two templates supplied by Delphi. To start a Bill of Material, use the template supplied by Delphi.

Text Font & Style – The two styles used will be Standard, and STANDIO. Standard will use the font Romans. STANDIO will use the font monotxt.

Text Height – The standard text will be .125. A minimum of .10 can be used. A maximum of .1875 can be used for applications such as important notes.

2.2.2 – Bill of Material Setup:
The Bill of Materials shall be created in an Excel spreadsheet using the template controls design. The Bill of Materials will include electrical, pneumatic and hydraulic components with complete manufacturer and part number information as ordered. Refer to the instruction tab of the template for complete instructions.

Drawing Directory Chart - A drawing directory chart will also appear on the bill of material. Refer to the definitions section of the template for complete instructions.

Item Identification - Items will be identified by their tags in the device identification column. Electrical materials will not be identified by item bubbles or line locations on the bill of material.

2.2.3 – Electrical Schematic and Wiring Diagrams:
(See sheets 1-5 under directory number H5008492ME001: Widget Assembly Machine)

Device Identification – Devices will be identified using an alphanumeric combination, starting with the number one (1) for each type of device. Subsequent device I.D.'s shall be sequential. Devices will not be identified using sheet numbers, line numbers, etc.
E.G.: PB-1, PB-2, FU-1, FU-2, LT-1, LT-2

Electrical Symbols – Use the electrical symbols provided with the Delphi library. Do not explode the blocks. Use the attributes of the blocks to enter tags, ampere ratings, etc.

Line Referencing – Line reference numbers will be spaced at ½ inch to be consistent with the line

spacing. All lines should line up with a reference number. All relay, motor starter, contactor, etc. coils should reference their contacts. Use standard text for line referencing. Do not use text inside a circle, hexagon, etc. for line referencing purposes.

Line Spacing – Line spacing will be done ½ inch, or multiples of ½ inch. Do not use an increment smaller than this.

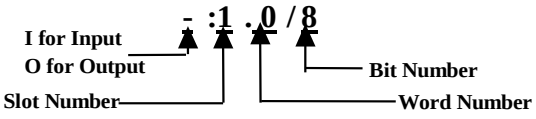
Text – Standard text styles and fonts will be used. Any text referencing to an I/O point will be in STANDIO/monotxt.

Wire Numbering – For 120VAC circuits, use the numbers 1-99 to identify the wires. Each DC circuit will have its own dedicated hundred series. The first DC power supply would use the numbers 100-199, while the second DC power supply would use the numbers 200-299, etc. Wire numbers must be consistent from origin to final termination. A wire number must change when passing through a device.

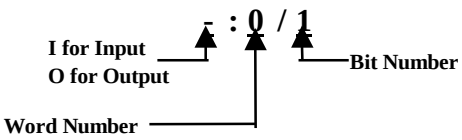
2.2.4 – I/O Wiring Diagrams:
(See sheets 6-13 under directory number H5008492ME001: Widget Assembly Machine)

Addressing and Wire Numbering – PLC addressing will adhere to the manufacturer's specifications for proper syntax. Any wire between a device and an I/O point shall be identified using the I/O address at which it is associated with. Wire numbers must be consistent from origin to final termination. A wire number must change when passing through a device.

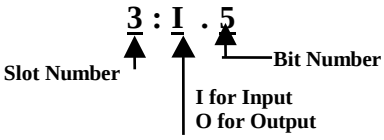
i.e. Allen-Bradley SLC-500 Family:



Allen-Bradley Micrologix Family:



Allen-Bradley ControlLogix and CompactLogix Family:



Details – Details will be included on I/O sheets for specific items. Dip switch settings and IP addresses for all processors, I/O modules, etc. should be included on the drawing in which they appear. Wiring details will also be included on I/O wiring diagrams for devices such as proximity sensors, photoelectric sensors, opto-touch type palm buttons, etc. All I/O communication connections to the processor will be shown. (i.e. Ethernet, RS-232, DH+, DeviceNet)

Device Identification – Devices will be identified using an alphanumeric combination that incorporates the I/O address at which the device is associated with.
i.e. PB-3:I.5, PB-I:1.0/2, SV-4:O.11, SV-0:3.0/1, SS-I:0/12, LT-O:1/6

Electrical Symbols – Use the electrical symbols provided with the DTS library. Do not explode the blocks. Use the attributes of the blocks to enter tags, ampere ratings, etc.

Line Referencing – Do not use line numbers on I/O sheets. I/O points are to be references by address numbers, slot numbers, rack numbers, etc. All relay, motor starter, contactor, etc. coils should reference their contacts.

Text – Standard text styles and fonts will be used. Any text referencing to an I/O point will be in STANDIO/monotxt.

2.2.5 – I/O Communication Connections
(See sheets 14 & 15 under directory number H5008492ME001: Widget Assembly Machine).

Content – A wiring diagram will be used to illustrate all I/O communication connections from the processor to other devices such as digital displays, operator panels, and remote I/O devices. This includes all serial and parallel communications such as Ethernet, RS-232, DH+, DeviceNet, etc. Include all part numbers for connectors or cables that apply specifically to the I/O communications on this

drawing. Also include the ohm and/or watt ratings for devices such as cables or resistors.

Text – Standard text styles and fonts will be used. Any text referencing to an I/O point will be in STANDIO/monotxt.

2.2.6 – Panel Layouts & Assembly Details:
(See sheets 18-25 under directory number 5008492.001: Widget Assembly Machine).

Electrical Symbols – Use the electrical symbols provided with the Delphi library. Do not explode the blocks. Use the attributes of the blocks to enter tags, ampere ratings, etc.
Scale – Do not scale the drawing limits (0,0 x 34,22), or the title block. Do not scale the text on the drawing. Use the standard text height of .125 Layouts should be scaled accordingly to fit within the border of the title block. Use the largest scale possible. Use only these scale factors: 1" = 1", ½" = 1", ¼" = 1", 1/8" = 1", 1/16" = 1". Always include the scale on the drawing. Do not use more than one scale per sheet.

Text – Standard text styles and fonts will be used. Any text referencing to an I/O point will be in STANDIO/monotxt.

2.2.7 – Blank Sheets:
(See sheet 17 under directory number H5008492ME001: Widget Assembly Machine).
Content – Blank sheets will be indicated clearly, and noted on the Electrical Drawing Directory. A drawing file must be created for a blank sheet.

2.2.8 – Drawing Package Order:
(See sheets 1 – 35 under directory number H5008492ME001: Widget Assembly Machine).

The list below indicates the order in which drawings created for DTS will follow.

a.) Power Schematic Diagrams
b.) Control Schematic Diagrams
c.) PLC I/O Wiring Diagrams
d.) Remote I/O Wiring Diagrams
e.) Main Control Enclosure Panel Layout
f.) Main Operator Panel Layout
g.) Miscellaneous Details (Junction Box Layouts, Serial I/O Connections, Terminal Strip Layouts, etc.)
h.) Sequence of Operations
i.) General Overview of major devices

Pneumatic and Hydraulic Drawings will have the prefix 500 for the drawings and will be contained as part of the electrical drawing set. Sheets 100 thru 199 of the Controls drawings will be reserved for Pneumatics, and sheets 200 thru 299 of the Controls drawings will be reserved for Hydraulics.

2.3 – Revisions and Updates

2.3.1 – Standard Format and Description:
All revisions made to the drawing will be clearly indicated with a brief description of what was changed. A revision must be noted in the revision block and the file name must be renamed accordingly to reflect the new revision level anytime a change is made to that file that affects the machine's circuitry or functionality. Changes to the nomenclature describing the operation of the machine also requires a revision. For information on file naming and file structure, see the "Tool – Equipment Design" Section A.

2.4 PLC Programming

2.4.1 Keep programs as simple as possible. Increase program complexity only when required to improve machine functionality; not for programmer ease or originality. Non-proprietary code shall be used to control machine functions (clamps, sensors, and scanners etc. and commands to the HMI).

2.4.2 In rungs that include branches for automatic, manual, step mode, and maintain (latch around) place the auto branch or branches on top, followed by the step mode branches, manual branches, and finally the maintain branches at the bottom.

2.4.3 Incorporate sequence step bits into the logic to simplify instructions on output rungs. Use internal bits (example: B3/xx) to track the sequence and keep all sequence bits turned on until successful completion of the cycle. This allows the sequence memory to remain after the cycle stalls and faults, making it easier to pinpoint what the next step is and what is preventing it from occurring.

2.4.4 Use different program files to keep related program logic grouped together. For example, place all logic for station 1 in ladder file #5, all logic for station 2 in ladder file #6, and all message display logic in ladder file #11.

2.4.5 For tag based systems, use tag names that go from general to specific.
i.e. Station2_AutoSequence_Step3_Complete

For address based systems, use different data tables to logically group data together. For example:

B3**1**/xx→Station **1** internal bit
T4**1**/xx→Station **1** timers
N5**1**/xx→Station **1** integers
B3**4**/xx→Station **4** internal bit
T4**4**/xx→Station **4** timers
N5**4**/xx→Station **4** integers

Typically, The B3 data file is used for operation (system) bits, T4 used for operation timers, C5 for operation counters, B13 for fault bits, T14 for fault timers, and C15 for fault counters. I/O to and from operator interfaces shall use their own data files as well.

2.4.6 For each discrete output address, use only one output instruction. Only one device may be connected to each I/O address.

2.4.7 The following program identification method is to be used.
If Dwg # is 5001234.001 the Program # shall be 0123401A.
Note: If system has more than one PLC incorporated into it, then change the letter "A" to the next alpha character available.

2.4.11 Any use of processor passwords is strictly prohibited.

2.4.12 Any unassigned input or output address shall not be used to disable any logic.

2.4.13 **Step Mode -** A third mode of operation (in addition to Auto and Manual) shall be provided to assist in troubleshooting. Once the machine is placed in step mode, pressing a Single Step pushbutton completes one step of the machine process at a time. The button is pressed again to complete the next step and so on until the cycle is complete and the machine is homed again. The operator interface shall indicate each step in the process through a flowchart type blue box with text. As each step is executed, the box color changes to yellow and the text is updated. If the machine does not progress to the next step after pressing the Single Step pushbutton, the operator interface shall display a "Waiting For" type message that includes an I/O search point to indicate exactly what the machine is waiting for to advance.

2.4.14 **Dry Cycle –** shall be programmed in the PLC logic in order to facilitate Delphi acceptance requirements. This mode will sequence the entire machine, simulating the normal production but without production parts. Any logic that requires the sensing of production parts will be bypassed and similarly, any "part not present" faults shall be disabled. The cycle will be started and stopped using the normal start and stop pushbuttons. A selection, on a password protected screen, on the HMI shall be provided to enable Dry Cycle and will display the run time and cycle count.

2.4.15 **Operator Interface** – (HMIs) shall be utilized instead of the traditional discrete pushbuttons and indicators when appropriate for the machine size. The operator interface shall include manual functions for each machine movement and a step mode that allows the machine to complete one movement or operation at a time by pressing a single pushbutton. Comprehensive fault messages and diagnostics shall be displayed. The use of HMIs does not preclude hard wiring such functions as E-stop, cycle stop and start, as required per the specification. All error messages shall include an I/O address as a search point in the message. HMIs shall have screens that display the current state of all discrete inputs and outputs with descriptor names to aid in troubleshooting.

2.4.16 **Software and Programming Keys** – The supplier shall provide all software and hardware (or software) keys necessary to change the programs in all programmable devices unless notified in writing by the responsible Controls Engineer. (example: it may not be necessary to provide PLC programming software.)

2.4.17 If HMI screens are limited by license, the minimum screen license must be approved by the Project Engineer

2.4.18 Where limits are set empirically (not per product specification) the machine will have the ability to "learn" limits for audit based on bogey(s) cycled in it. **This does not apply to any leak test applications.**

2.4.19 Audit mode will supply audit results to operator, via the display, in both objective (pass / fail) as well as subjective (what aspects passed/failed and at what value) forms.

2.4.20 A complete machine reset (and homing) after machine failure or jam up must be

accomplished through use of the reset button on the control panel of a particular station after clearing the reason for failure. The exception would be where there may be an irresolvable operator or machine safety issue.

2.4.21 To minimize cycle time, as soon as the requirement for test or assembly is complete, the program should move to the next step and not wait for time out.

2.4.22 There should be no motion at power on.

Motions should not take place when switching from mode to mode. (i.e. manual to auto).

Manual mode buttons should allow for only safe movements. Do not over inhibit manual movement.

Automatic and manual cycles shall be deactivated on power loss. Modes must be selected independent of other functions and not be entered by default. Machine to start up in a null mode

All lifts and transfers must recover and complete transfer of partially transferred pallets when starting machine after: 1) E-stop, 2) when switching from manual to auto, 3) if pallet is delayed or jammed, and 4) auto cycle stop. In the third case a traverse fault message will be displayed and the station will fault, light the red beacon, sound alarm, and require reset before auto cycle will resume in that station or section.

2.4.23 The status of the network(s) including all nodes/stations and I/O should be shown on the HMI.

2.4.24 A light/lamp test will be provided that will illuminate all lights at once allowing a full operation check.

2.4.25 A bypass will be provided for all individual functions & sensors provided in auto mode given that the bypass will not cause injury or machine damage.

2.4.26 Errors must display correctly with no errors missed. All faults shall have individual messages.

2.4.27 Error proof controls and sensors for all device/machine failure modes.

2.4.28 Buttons must function only in mode(s) intended. Project Engineer approval of functions required. Button function must be documented in manual.

2.4.29 All equipment shall have automatic energy conservation shutdown. All sources of energy shall be shut off, including compressed air. The shutdown shall occur after a predetermined time of inactivity. The time must be adjustable in "set-up" menu.

2.4.30 A manual mode will be provided and controlled using the HMI to allow the machine to cycle through all the functions. Switches to be linked to manual display function buttons. Button changes state when action is completed.

2.4.31 PLC logic using cascading timers (one timer that starts another timer) should be avoided.

2.4.32 Self-contained proximity switches and photoelectric switches are to be used extensively to verify the exact location of all moving machine details, tools and/or cylinders at all times during motion. This eliminates the timing of flow controls and assumptions that tooling is clear or unit assembly is correct. It also provides exact operation and sequence control. All quick tooling changes must be verified through sensors and PLC logic.

2.4.33 PLC / PC controls must be synchronized to master clock.

2.5 PLC Program Documentation

2.5.1 All addresses listed in the PLC shall have proper descriptions associated with the address. See general format that follows. Instruction-based descriptions shall not to be used.

2.5.2 For all I/O that indicates STATUS (limit switches, prox switches, photoeyes, indicator lights, etc.) use PAST TENSE verb. For all I/O calling for MOTION (selector switches, pushbuttons, solenoid valves, etc.) use PRESENT TENSE (action) verb.

2.5.3 For I/O wired to other programmable devices such as servos, message displays, testers, etc., the last line of the description shall read "To" or "From" followed by the device name.
i.e. To Servo, From Tester, To Display, To Emerson

The following examples are provided as a guide on description format.

Line #1 Sta # or Operation
Line #2 Input/Output Action or State
Input (Note #1)/Output (Note #2)
Line #5 Type of Input or Output Device. Standard device abbreviations shall be used (i.e. SV, LT, PLS, PER, etc.)

Note #1: - Input action uses past-tense verbs
Examples: - Advanced (not in or out)
- Retracted
- Servo Homed
Note #2: - Output action use present verb tense
Examples: - Retract SV
- Advance SV
- Move to Home to Emerson

Example #1	Example #2
#2 Header	#1 Header
Open	Pick Up
Pick Up	Fingers
Fingers	Opened
Retract SV	

3 Preferred Electrical Components

Note: Use common components existing at Delphi on other machines and in spare parts inventory. Request list from Project Engineer.

Bar Code Readers
Cognex, Jadak, Banner
Check with Project Engineer

Capacitors – Power Factor Correcting
Motors 10HP and above:
Calmount
General Electric
Sprague

Circuit Breakers
Merlin Gerin/Square D
Siemens
ECC Controls
Allen-Bradley

Connector Cords
General Purpose:
Brad Harrison, Banner, Turck
Oily and Flexing Applications:
Brad Harrison SOO or PUR jacket
TCP
Olflex

Counters
Controller:
ATC
Eagle Signal
Red Lion
Totalizer:
American LEDgible
Durant
Red Lion
Veeder Root

Disconnect Switches
120V:
Allen Bradley 194E
460V Fusible safety switch:
Square D H36*AWK
Transformer:
Square D 9070, specify F30 & G13 forms
GE, Acme, Heviduty

Displays
Alphanumeric:
Adaptive
Uticor

HMI:
Allen-Bradley PanelViewPlus6 w Ethernet

Enclosures
General Purpose, NEMA 12, IP 64:
Hammond
Hoffman
Rittal
Air Conditioners:
Top-mount – check with Engineer

Ethernet Switches
Managed:
N-Tron
Phoenix Contact
RJ LNXX
Turck
Unmanaged: – check with Controls Engineer

Fuse Blocks
IEC style-preferred
Panel mounted, rejection type:
Bussman
Gould Shawmut
Terminal strip mounted, 300V:
Allen-Bradley 1492-H4
Terminal strip mounted, 600V:
Allen-Bradley 1492-UF8250

Fuses
250V:
Class RK1 LPS RK
600V:
Class RK1 LPS RK
600V, IEC:
Class J LPJ

Legend Plates
22mm general purpose:
Royal Oak FS-278 white/black or equivalent
22mm stopping device:
Royal Oak FS-278 red/white or equivalent
E-Stop requires yellow background
Allen-Bradley 800F-15YSE112 or equivalent

Machine/Operator Station Lighting
Do not use incandescent lights.
LED lighting is preferred.
Fluorescent as a second choice.

Light Curtains
Banner EZ Screen
Allen-Bradley Guardmaster Safe 4
Keyence - check with Project Engineer

Limit Switches
Lever, push roller, wobble stick, etc.:
Allen Bradley 802T
Micro Switch
Square D 9007, type C
Rotary cam – mechanical presses
Gemco
Rotary cam – other
Autotech
C & A
Electro Cam
Gemco
Air Pressure
Allen Bradley 836E-DA1EN4D4

Motor Controls
AC variable frequency:
Allen-Bradley PowerFlex70 or 755 with safe-off
DC – 1HP or less
Danfoss
ABSmart Drive
DC – greater than 1HP
ABSmart Drive
Check with engineer
Servo Positioning
Emerson
A-B Ultra 3000
A-B Kinetix 6500 with safe-off

Motor Starters
IEC-preferred:
Allen-Bradley 100/193
Cutler-Hammer AE16

Photo-eyes
Banner
Cutler-Hammer Perfect Prox
Keyence

Pilot Lights (LED Only)
24VDC preferred
Allen Bradley 800F

Power Supplies
Allen-Bradley
SOLA

Programmable Controllers
Large Applications:
A-B ControlLogix (L7x series) w/Ethernet
Small Applications:
A-B MICROLOGIX 1100/1400 w/Ethernet
A-B CompactLogix (5370 series) w/Ethernet

Programming device interface:
Requires both Ethernet and power
- Mencom
- Grace

Proximity Switches
Cylinder position, plug-in type:
- PHD 15901-1
- SMC
- Turck
- Halleffect

Tubular, plug-in type:
- Cutler-Hammer
- Micro Switch
- Turck

Pushbuttons
E-Stop:
- Allen-Bradley 800FM-LMP44

Palm button:
(Two-hand control requires safety relay)
- Allen-Bradley
- Banner OPTO-TOUCH

22mm – preferred
- Allen-Bradley 800F

Relays
General purpose IEC – preferred:
- Allen-Bradley 700F

Pneumatic timing NEMA-with approval:
- Allen-Bradley 700PT

Special Purpose:
- Opto 22 w/ appropriate mounting strip
- Potter & Brumfield tube base w/ retainers
- Phoenix DIN rail mount

Safety (minimum 3 protected outputs):
- Banner
- Pilz PNOZ
- Allen-Bradley Guardmaster
- Phoenix Contact
- Sick

Safety Switches
Telemecanique
Allen-Bradley Guardmaster
Tapeswitch safety mats

Selector Switches
22mm preferred
- Allen-Bradley 800F

Software
Computer Aided Design:
- AutoCAD 2008 or higher

PLC Programming and documentation:
- Allen-Bradley RSLogix 500/5000
- Allen-Bradley RSLinx

Motion/Servo/ VFD
- Check with Controls Engineer

Distributed I/O Networking
- Allen-Bradley RSNetWorx

HMI
- FactoryTalkView

Stack Lights (LED Only)
- Allen-Bradley
- Federal Signal

Temperature Controls
- Allen-Bradley 837
- Barber-Colman
- Honeywell
- Leeds & Northrup
- Square D 9025

Terminal Blocks
Din Rail Mount
600V - IEC preferred:
- Allen-Bradley 1492-W*
- Wago
- Weidmuller

300V – NEMA-with approval:
- Allen-Bradley 1492-F1

600V – NEMA-with approval:
- Allen-Bradley 1492-CA1

Power Distribution:
- Allen-Bradley
- Bussman
- Gould Shawmut

Vision Systems
check with Project Engineer
ONLY TO BE USED IN VERY SPECIALIZED APPLICATIONS

Wireways
NEMA 12 – lay-in type hinged:
- Hammond
- Hoffman

Panel
- T&B
- Panduit

Exceptions List to NFPA-79 Controls Device Designations

It is specificed that the electrical controls shall be designed and built using IEC 60204-1:Fifth Edition, 2005-10 Safety of Machinery International Standard. Control device symbols and designations should still follow NFPA-79 E.
The purpose of this list is to provide consistent designations for controls components not covered by NFPA-79.

The format is to be the lettered designation followed by a dash and then either a serial number or the I/O number. E.G.: CB-1, CB-2, etc. E.G.: PB-I:4.03, PB-I:4.04, etc. No Spaces. Below "X" represents the serial number or the I/O number.

If you have any questions or additions to this list then please contact tool design. New designations require Delphi Project Engineer pre-approval.

Device	**Designation**
Bar Code Reader / Scanner	BCS-X
Cabinet / Enclosure Fan	CF-X
Cable	CBL-X
Distribution Block	DB-X
Emitter	PEC-X EMITTER
Ethernet Switch	ESW-X
Guard Door Switch	GS-X
Hall Effect Switch	HES-X
Light Curtain Emitter	LCE-X
Light Curtain Receiver	LCR-X
Magnetic Reed Switch	MRS-X
Palm Button (Same as Push Button)	PB-X
Proximity Sensor, Analog	PRS-X
Pump	CONTROLS-WISE THIS WOULD NOT BE LABELED - THE CONTACTOR OR SOLENOID FIRING PUMP WOULD BE.
Receiver	PEC-X RECEIVER
Valve Bank	VB-X
Power Supply	PS-X
Pressure Switch	PSW-X
Screw Driver	SD-X
PLC Slot	SLOT-X
Programming Port	PP-X