

Quality Metalcraft Assembly Standard

Revisions:

- 7-17-17 – 5.3) Completion file (MUST BE COMPLETED BEFORE SHIIPPING BUY-OFF):
- 4.5.9.6.2 Laser must be attached with steel brackets (No plastic allowed)
 - 4.5.9.4 All Sensors must be secured with lock washer and nut.
 - 5.3.3 2D and 3D CAD Data for fixture and cell drawings
 - 5.2.3.2 Or one palm button with light curtains
 - 5.2.3 Vendor to repeat the 24 dry run on QMC floor. It must add up to 24hrs and does not have to be continuous.
 - 7.1.7.2.3 Weld gun supplier (~~Center Line, Grosse~~, Milco, Savair, PICO)
 - 4.12.4.1 Cell must be completely grounded back to the main ~~building~~–Electrical panel
- 7-17-18-
- 6.3.18. Operator work instruction (SWI)
 - 6.3.18.1 Must have detail info for each set.
 - 6.3.18.2 Must have picture showing correct load information
 - 6.3.18.3 Must be created using QMC format
- 4-19-18
- 4.8.13.4 QMC Part Marking Scribing Information
 - 4.8.13.4.1 First line: Customer Part Number
 - 4.8.13.4.2 Second Line:
 - XXXXYYZZWW
 - X – Year (4 – Digits)
 - Y – Julian Date (3 – Digits)
 - Z – Hour Military (2 – Digits)
 - W – Serial Number of Part within that hour. (2 to 4 – Digits)
 - 4.5.8 Fixture Access
 - 4.5.8.1 For tool access to all fasteners must have 50mm clearance
- 6-18-18
- 4.3.3.4 All water fittings must be brass.
- 6-25-18
1. Added GM requirement for nut and stud verification
 2. Updated and correct many areas of the Standard
- 10-14-19
- 4.3.3.6.1 Water flow limiter added
 - 4.3.3.8.2 Added check valve and solenoid
 - 4.3.3.5.2 Removed gate shuts off water
 - 4.8.2.3 Added SD card installed
 - 4.8.17.2 Added RAFT & SoftQ
 - 4.8.17.3 Added ForceQ for aluminum welding
 - 4.8.20 Changed manufacturer to C&D
 - 4.8.22 Removed
 - 4.16 Added Part pass table requirements

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7.2.12 Removed Air over Oil not allowed

7.8.1 Air over oil cylinders for projection welding

7.16.1.1 Replaced servo gun with air over oil

7.16.1.3 Added LVDT

7.16.2.1 Changed to Dengsha

8-31-20

1.4 Refer to version of QMC Standard

4.5.10.5 Any sensor for "Class A" surface must have 15mm sensing range

4.8.22.2 Changed water flow sensor to IFM SM2601

5.5 Pins must be mounted separate from any other locating pin.



Assembly Cell Standard

- 1 Quote Generation
- 2 Design Concept
- 3 Electrical, air and Water Drawing design and buy-off.
- 4 Cell Structure Requirements
- 5 Shipping buy-off / Final buy-off
- 6 PM Plan/ Spare parts / Consumables
- 7 Welding Requirements
- 8 All other Questions

Appendix A – Pictures of specs

Created by QMC Engineering Team

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1 Quote generation

- 1.1 All Quotes must follow Quality Metalcraft assembly standards.
- 1.2 Must have signed approval if concept does not follow QMC Assembly Standard.
- 1.3 Equipment must follow the GM Standard CG4460 (GM1927 03a Structures Stampings CG4460 GM)
- 1.4 Quote must refer version of QMC Assembly Standard (this document).

2 Design Concept

- 2.1 Equipment design must follow QMC assembly standard. Anything that is outside of the standard must be individually approved for each change by QMC Engineers.
- 2.2 Cell must be designed in Metric. (Cell layout, all equipment, fasteners, fixturing and Drawings)
- 2.3 Must review HMI location and have signed approval. HMI must be placed in a best location per each layout designed.
- 2.4 Must create and provide simulation files. Must understand Robot path and weld gun path at every point of the program/process.
- 2.5 Part marking location must meet the customer print. If customer info is not present, QMC personnel must determine the best location. See 4.8.13.4 QMC Part Marking information
- 2.6 Buy off Requirements
 - 2.6.1 40% is the first review of the design.
 - 2.6.2 100% is the last review before design is kicked off for manufacturing.
 - 2.6.3 Sign – off document must be scanned and saved in QMC server.
 - 2.6.4 Must have signed off approval if design does not follow QMC Assembly Standard.
- 2.7 Provide detail drawings to QMC file prior to final payment. Must include all changes prior to 100% buy-off on QMC floor.
- 2.8 Important Details to be reviewed during the design review:
 - 2.8.1 Process flow, total cycle time, Takt Time, operator movements, number of operators.
 - 2.8.2 Detailed fixture clamping sequence.
 - 2.8.3 Compare fixture locators and surface net to the customers GD & T.
 - 2.8.4 Must have detailed power requirements (Air, water and electrical).
 - 2.8.5 Safe operator range calculation(movement of equipment when operator enters cell)
 - 2.8.6 Ergonomics must be documented in detail for each operation.
- 2.9 Need an understanding of the foot print of the cell/machine.
- 2.10 Laser and Cameras are not recommended unless approved by QMC

3 Electrical, Air and Water Drawing design and buy-off.

- 3.1 Cell/machine electrical wiring schematics must be in approved CAD software.
- 3.2 PLC program and HMI template will be provided by QMC.

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- 3.3 Must have detailed power requirements available for each energy source (air, water and electrical).
- 3.4 Air flow must be design to run the entire cell at 80psi.
- 3.5 Water flow requirements must meet manufactures recommendation.
- 3.6 Design Buy off stages.
 - 3.6.1 40% is the first review of the design.
 - 3.6.2 100% is the last review before design is kicked off for build.
 - 3.6.3 Sign – off document must be scanned and saved in QMC server.
 - 3.6.4 Must have signed off approval if design does not follow the QMC Assembly Standard
- 3.7 Must follow the NEMA standards (National Electrical Manufacture Association) when designing all QMC equipment.

4 Cell Structure Requirements:

- 4.1 Load station requirements for design and construction
 - 4.1.1 Must have light over fixture with light switch, air connection within 3ft of each fixture and 110 volt outlet.
 - 4.1.2 Safety Scanner per load station or a set of light curtains is acceptable. Must be located near the fixture and be installed with a steel guard to protect from being damaged.
 - 4.1.3 Cycle Start stand located on one side of the load area. A second cycle start stand may need to be added to improve process and flow. (Will review at first design review.)
 - 4.1.3.2 Must contain the following – See Appendix A
 - 4.1.3.2.1 Banner EZ-light Dome light - K50LGRYB4PQ (4 color)
 - 4.1.3.2.2 Finger swipe – Banner (OTBVR81L)
 - 4.1.3.2.3 E-Stop with the ability to lock in active position –
- 4.2 Fencing and Trays
 - 4.2.1 Automated Guarding Systems - 8ft yellow frame fence must completely surround the work zone. The fence must have red weld curtain to protect from dangerous weld Flash and weld expulsion.
 - 4.2.2 All wire and hoses must be ran in cable tray. Cable tray located on the floor must have steel diamond plate cover. Spacers must be added to the bottom of tray to keep it off of the floor.
 - 4.2.3 36'' access door must be located near the back of the cell or where QMC finds appropriate.
 - 4.2.3.2 Door must swing out or can be a sliding door
 - 4.2.3.3 Must be lockable with a standard lock - PILZ(540050V1.3)
 - 4.2.3.4 When the door is opened, it must cut output power, air and water
 - 4.2.3.4.1 Fixture air can be energized through teach pendent switch on robot.
- 4.3 Electrical cabinet and main supply feeds info and locations around the cell
 - 4.3.1 Electrical cabinets
 - 4.3.1.2 Must have a 110 volt outlet and Ethernet plug on main panel

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- 4.3.1.3 Fold down work station on door
- 4.3.2 Pneumatic Requirements
 - 4.3.2.2 Main air distribution panel must be at back outside of cell. QMC must approve location.
 - 4.3.2.3 Main Air Valve and Regulator connections must have a manual shut off valve. Must be able to be locked out
 - 4.3.2.4 The Cell must be set with 80psi.
 - 4.3.2.5 Must use Blue 1" feed line to cell.(Must be sized to meet the cells requirements)
 - 4.3.2.6 Feed line to clamps, valves and cylinders
 - 4.3.2.6.1 Supply line needs to be blue hose. (Must be sized to manufacture spec)
 - 4.3.2.6.2 Return line needs to be black hose. (Must be sized to manufacture spec)
- 4.3.3 Water Requirements
 - 4.3.3.2 Water main supply feeds and return lines must be at the back outside of cell. QMC must approve a different location.
 - 4.3.3.3 Both the supply and return lines must have a manual shutoff valve. Must be able to be locked out.
 - 4.3.3.4 All water fittings must be brass.
 - 4.3.3.5 Water flow valve
 - 4.3.3.5.1 Water flow at Main supply and weld guns must be controlled. Must read flow and shut off when flow changes. (example: Weld cap comes off)
 - 4.3.3.5.2 Water flow limiters (I.E. Gate Valve or flow control) must be installed to control flow to each device (I.E. Weld Control, Weld Gun, ETC.)
 - 4.3.3.6 Main Supply
 - 4.3.3.6.1 This is more for the main water supply to and from chiller. $\frac{3}{4}$ " to robot is fine as long as we maintain 1 gpm to each tip and 2 gpm to transformer.
 - 4.3.3.6.2 Water must be gauged to show flow
 - 4.3.3.6.3 2" supply must be Green
 - 4.3.3.7 Main Return
 - 4.3.3.7.1 Water Must be gauged to show flow
 - 4.3.3.7.2 2 $\frac{1}{2}$ " return must be Red
 - 4.3.3.8 Weld Gun/Transformer
 - 4.3.3.8.1 Must use a min of $\frac{3}{4}$ " hose $\frac{1}{2}$ " is fine as long as we maintain 1 gpm to each tip and 2 gpm to transformer
 - 4.3.3.8.2 Weld guns must have solenoid valve on the supply line and check valve mounted on the return line. These valves must be located as close to the gun as possible. Base of robot is acceptable.
 - 4.3.3.9 Weld Controller

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- 4.3.3.9.1 Must use a min of 3/8" hose
- 4.3.4 HMI location determined for best fit at design review. QMC must approve the location to best fit the cell and process.
 - 4.3.4.2 Must have a 110volt outlet and Ethernet plug.
- 4.3.5 Robot cabinet
 - 4.3.5.2 Must be located closest to door. Pendant must reach the farthest point of the robot. If pendant cannot reach Robot through door, then a window with a shelf must be added.
- 4.3.6 Weld control
 - 4.3.6.2 Must be located over robot cabinet (Will work for WTC air cooled weld cabinet)
- 4.3.7 Emhart control cabinet and feeder
 - 4.3.7.2 Must be placed next to each other. Must be easily accessed by QMC personal to load Fasteners into the unit.
- 4.3.8 Projection nut welders
 - 4.3.8.2 Must be easily accessed by QMC personal to load Fasteners into the unit.
 - 4.3.8.3 Nut and stud feeders
 - 4.3.8.3.1 Mechanical Turnkey Solutions feeders are recommended.
- 4.4 Flex Fixture Base
 - 4.4.1 See Link for correct base sizes(L:\Engineering_Ops\Standard)
 - 4.4.1.2 We have two fixture sizes
 - 4.4.1.2.1 Cell 17(Accubilt design)
 - 4.4.1.2.2 Cell 5,8,9 and 10(Nachi design)
 - 4.4.1.3 Cone locator prints
 - 4.4.2 Must have 2 clamps (one on each side) to hold down the fixture plate.(SMC #: CKZ2N63-90DB, Clamp arm#: CKZ63A023)
 - 4.4.3 Blocks and values must be attached to back of the base.
 - 4.4.4 Minimum of two male cone locators with a minimum of 6 machine net surfaces. QMC will provide the male and female cone locators. The female cone locators and shims will be installed on the fixture.
- 4.5 Assembly Fixture:
 - 4.5.1 Fixture must follow the latest GD & T provide by QMC
 - 4.5.2 Fixture must be designed & built in Metric
 - 4.5.3 All PLP pins must be painted Green to indicate the importance.
 - 4.5.4 Fixture must verify all previous operation to be completed
 - 4.5.4.2 Sub-assemblies
 - 4.5.4.3 Fastener installation
 - 4.5.4.4 Verify adhesives and sealers
 - 4.5.5 Locating Pins must be shim-able in a min of 2 directions (NAAMS standard Pins). Pins must be mounted separate from any other locating pin. Must have a minimum of 50mm above the fastener to be accessible with standard tools without having to removing other details. Blocks must be located with a minimum of two dowels and one or two bolts. Must be shimmed with a 5mm grind spacer and 5mms of shims.(1 –

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- 2mm, 1 – 1mm, 3- .5mm and 2-.25mm). All locating pins will be NAAMS (SAE 8620 steel or equivalent), Hardened to Rockwell C-58-62 to a depth of 0.5 mm -2.0 mm. Locating pins in and around weld areas shall be coated with titanium nitride P.V.D.
- 4.5.6 Nets must be shim-able in three directions (NAAMS standard blocks). Must have a minimum of 50mm above the fastener to be accessible with standard tools without having to removing other details. Nets must be located with minimum of two dowels and one or two bolts. Must be shimmed with a 5mm grind spacer and 5mms of shims. (1 – 2mm, 1 – 1mm, 3- .5mm and 2-.25mm). Nets must be coated with Black Oxide. All net blocks will be SAE 4140 with a hardness of Rockwell C-52-60, 1.5 mm deep. If the block is located in the field of weld it may be made of non-magnetic stainless steel at the option of the platform/plant.
- 4.5.7 Pin / Net combo must be shim-able in three axis (NAAMS standard Pins) Must be accessible with standard tools. Must be shimmed with a 5mm grind spacer and 5mms of shims. (1 – 2mm, 1 – 1mm, 3- .5mm and 2-.25mm). All locating pins will be NAAMS (SAE 8620 steel or equivalent). Hardened to Rockwell C-58-62 to a depth of 0.5 mm -2.0 mm. Coating of titanium nitride P.V.D. to minimize weld splatter on pin. Nets must be coated with Black Oxide.
- 4.5.7.2 Nets blocks for Class A surfaces must not mar the surface. (No-Mar surfaces)
- 4.5.7.2.1 The urethane is to be between A-90-96 durometer in order that the blocks can be next to, within 0.2mm, tolerance for the surface and yet not hard enough to cause surface damage.
- 4.5.8 Fixture Fastener
- 4.5.8.2 Fasteners
- 4.5.8.2.1 All threaded blocks must be through the entire block
- 4.5.8.2.2 Must be torque to standard bolt torque and marked with the mark for confirmation and anti-rotation
- 4.5.8.3 Tool Access
- 4.5.8.3.1 For tool access to all fasteners must have 50mm clearance
- 4.5.8.3.2 All fasteners must be accessible without removing anything
- 4.5.8.4 Fasteners
- 4.5.9 Slotted Shims must follow NAAMS standard only (NO WASHER SHIMS)
- 4.5.9.2 3 Slot – NAAMS – Part# ASH3
- 4.5.9.3 4 Slot – NAAMS – Part# ASH4
- 4.5.9.4 5 Slot – NAAMS – Part# ASH5
- 4.5.9.5 3 Slot short – NAAMS – Part# ASH3N
- 4.5.9.6 4 Slot short – NAAMS – Part# ASH4N
- 4.5.10 Sensor placement
- 4.5.10.2 Part must be located correctly without being loaded incorrectly
- 4.5.10.3 Sensor must be adjusted to the proper distance from part per manufacture specs.

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- 4.5.10.4 Sensors must not interfere with the fixture or part during any step of the process.
- 4.5.10.5 Any sensor for detecting "Class A" surface must have at least 15mm detection range
- 4.5.10.6 All Sensors must be secured with lock washer and nut.
- 4.5.10.7 When parts can be nested together and able to be loaded into the cell, the fixture must be sensed properly to stop the process
- 4.5.10.8 Lasers and Camera must be pre-approved by QMC during the 50% buy-off.
- 4.5.10.9 Lasers are not preferred but acceptable with QMC approval.
 - 4.5.10.9.1 When a laser must be used then it must be part of a red rabbit program.
 - 4.5.10.9.2 All Lasers must be attached with steel brackets (No plastic brackets allowed)
- 4.5.10.10 All cylinders must have sensors for home and work positions.
- 4.5.11 Clamps
 - 4.5.11.2 The Clamps must be secured per manufactures requirements.
 - 4.5.11.3 The Net block attached to clamp arm must be set to part material thickness minus .25mm. Part must not be able to move when clamp is at work position.
- 4.5.12 Fixture risers
 - 4.5.12.2 Risers must be manufactured from steel with structural gussets.
 - 4.5.12.3 Rough surfaces must be painted in QMC Blue.
 - 4.5.12.4 Risers must contain 2 dowels and be secured with minimum of two bolts to the fixture base and any other brackets / clamps.
- 4.5.13 All valve packs and Ethernet blocks must be covered by weld curtain. Must mount the unit in a vertical position.
- 4.5.14 Part marking unit must have separate regulated air supply from the main.
- 4.5.15 Flex fixture connections
 - 4.5.15.2 Air quick disconnect
 - 4.5.15.2.1 Valve pack
 - 4.5.15.2.2 Marker/ Etcher unit
 - 4.5.15.3 One power connection for Ethernet block
 - 4.5.15.4 One communication connection for Ethernet Block
 - 4.5.15.5 If part marking/ Etcher / Scriber is present, it must have a quick disconnect Connector
- 4.5.16 CAD Drawings
 - 4.5.16.2 Details must have the same drawing number etched on them as the corresponding drawing file.
 - 4.5.16.2.1 Example of Component markings: Fixture- unit – Detail part. – OP10-unit 1 – 20
 - 4.5.16.2.2 CAD files must be loaded to the QMC FTP site before final payment.
 - 4.5.16.2.3 Must provide to QMC all 2D and 3D CAD Data and Drawings at final home line buyoff.

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- 4.5.17 Weld protection
 - 4.5.17.2 All sensor cables must be made with weld protection covering.
 - 4.5.17.3 All sensors must be steel face for weld protection.
 - 4.5.17.4 All air supply and returns must have weld protection covering(Double walled)
 - 4.5.17.5 Valve blocks and communication blocks must be covered with weld curtain.
Blocks must be installed standing perpendicular to top of fixture.
- 4.5.18 Fixture Certification
 - 4.5.18.2 All fixtures must be certified to match GD&T and assembly data prior to integrator and QMC buyoff.
- 4.6 Paint Colors
 - 4.6.1 QMC Blue(RAL 5015 – Sky Blue) : Fixture base, Fixture plate, Fixture risers, stands
 - 4.6.2 QMC Red (RAL 3001 – Signal Red) : Rough locators, Red Rabbits
 - 4.6.3 QMC Orange (RAL 2010 – Signal Orange) : Anything moving during the process(Clamp arms, spiders, slides)
 - 4.6.4 QMC Gray (RAL 7004 – Signal Grey) : Electrical Cabs, HMI
 - 4.6.5 QMC Yellow (RAL 1016 - Sulphur Yellow)
 - 4.6.6 QMC Green (RAL 6032 – Signal Green)
- 4.7 Safety Requirements
 - 4.7.1 When load area safety curtain is broken the robot(s) must not enter the fixture zone. All valves must lose output power.
 - 4.7.2 The fixture load height must meet ergonomic requirements.
 - 4.7.3 When the robot is working in the fixture zone and the operator enters that zone the robot must stop. The Robot must meet the safe distance industry requirements
 - 4.7.4 When Entry Door is opened it must drop auto power and air.
 - 4.7.5 Lock out points must be available on:
 - 4.7.5.2 Main air supply
 - 4.7.5.3 Electrical cabinets containing (110, 220 and 480volts)
 - 4.7.5.4 Main Water supply (feed and return lines)
 - 4.7.5.5 Lock out and tag out Diagram showing each location located on gate.
- 4.8 Cell Hardware/ Software Requirements
 - 4.8.1 Power Supply: Sola
 - 4.8.2 HMI
 - 4.8.2.2 Allen Bradley - 2711P-T10C22D9P or 2711P-T15C22D9P(Recommended)
 - 4.8.2.3 SD card must be installed
 - 4.8.3 Light Curtain Keyence: GL-RHseries
 - 4.8.4 Floor Scanner: Keyence SZ- 04(Multi –function)
 - 4.8.5 PLC Allen Bradley: Compact Logix or Control Logix Systems
 - 4.8.6 Sensors:
 - 4.8.6.2 Standard Prox: Turck
 - 4.8.6.3 Laser prox sensor: Keyence and Banner
 - 4.8.6.4 All sensors should be PNP
 - 4.8.7 Manifold banks: SMC Part number VV5QC41-0603TSD0 (built by Barnum)

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- 4.8.8 Ethernet
- 4.8.9 Fixture Clamps
 - 4.8.9.2 SMC for all power clamps and Shot pins
 - 4.8.9.3 Numatics for all manual / power clamps
 - 4.8.9.4 Pin Clamps: NOT ALLOWED unless approved by QMC
 - 4.8.9.5 Destaco clamps must be approved by QMC
- 4.8.10 Output logic: PNP
- 4.8.11 Safety PLC: Allen Bradley Guardlogix
- 4.8.12 Safety Gate Latch: Pilz - 540050
- 4.8.13 Etcher unit – Technifor or other approved by QMC
 - 4.8.13.2 If unit is installed to etch in the vertical position, it must have a dust cover installed.
 - 4.8.13.3 Recommend that the part etching must be marked at the end of the cycle of a completed part.
 - 4.8.13.4 QMC Part Marking Scribing Information
 - 4.8.13.4.1 First line: Customer Part Number
 - 4.8.13.4.2 Second Line:
XXXXYYZZWW
X – Year (4 – Digits)
Y – Julian Date (3 – Digits)
Z – Hour Military (2 – Digits)
W – Serial Number of Part within that hour. (2 to 4 – Digits)
- 4.8.14 Robot: Nachi preferred and Fanuc as a second choice. (Only New Robots) The robots must be sized per the manufacturing requirements.
- 4.8.15 Robot Controller: Tool change capabilities
- 4.8.16 Robot Dress Pack: Leoni
- 4.8.17 Weld Controller: WTC
 - 4.8.17.2 Must have RAFT and SOFTQ licenses
 - 4.8.17.2.1 Tip sense wires must be installed between weld gun and weld controller. WTC part number: 830-0970BVR
 - 4.8.17.3 Aluminum spot welding must have ForceQ license and compatible servo motor with force feedback
- 4.8.18 Weld Gun: Milco
- 4.8.19 Gun servo motor: Tolomatic
- 4.8.20 Tip dresser: Changers and Dressers: CD-R480-S1000R1-H-C22G1R (Ram Solutions)
- 4.8.21 Cap Changer: CD-KEL16R1-S1000-H-E2M (Ram Solutions)
- 4.8.22 Water Flow control: IFM
 - 4.8.22.2 Main Return: IFM SM2601
 - 4.8.22.3 Weld Gun Return: IFM S15000
- 4.8.23 Swipe button: Banner – OTBVR81L
- 4.8.24 Stack light: Banner K50L – 3 colors. K70 when able

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- 4.9 Power Requirements
 - 4.9.1 Main power – 480 volts and 3 phase
 - 4.9.2 Accessories power – 120 volts
 - 4.9.3 Cabinet power – 24 volts
- 4.10 Robot
 - 4.10.1 Cell must be built using a Nachi or Fanuc
 - 4.10.2 What programs needed in robot (Standard, Tool change capabilities if needed(review at quoting stage)
 - 4.10.3 Robot program
 - 4.10.3.2 Home must be #100
 - 4.10.3.3 Home position must not be over a Motor
 - 4.10.3.4 Weld numbers referenced in Program (must match customers supplied number)
 - 4.10.3.5 Reposition step – must reference clamp and valve number.
 - 4.10.4 Ability to have ATI's for tool change/weld change (Add spacer if ATI is not used)
 - 4.10.5 The robot shall be shown in the following positions:
 - 4.10.5.2 Pounce
 - 4.10.5.3 Work
 - 4.10.5.4 Fully extended
 - 4.10.5.5 Fully retracted
 - 4.10.5.6 Maximum Height
 - 4.10.6 TCP 6 point verification
- 4.11 End of Arm Tooling(EOAT)
 - 4.11.1 Where applicable, robotic EOAT should be protected from damage through the use of a mechanical or pneumatic breakaway device, mounted between the robot tool mounting flange and the EOAT.
- 4.12 Electrical
 - 4.12.1 Logic requirements – QMC to provide
 - 4.12.1.2 Part counters shall be provided on each line and/or machine. Part counters shall not increment the count until the automatic machine cycle has been completed with parts.
 - 4.12.1.2.1 Must be one paged on HMI
 - 4.12.1.3 Part Cycle time
 - 4.12.1.3.1 Must show at least 10 of the last cycles.
 - 4.12.1.3.2 Must be one paged on HMI
 - 4.12.2 IO Link Communication – Must be pre-approved during design review.
 - 4.12.3 PNP for all sensing
 - 4.12.4 Cell Grounding
 - 4.12.4.2 Cell must be completely grounded to the main Electrical Panel
 - 4.12.4.2.1 Including cabinets, Flex bases and fence

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- 4.13 Manual load stations
 - 4.13.1 Load stations with PLC controls shall include a "Parts Loaded" light. This light shall be ergonomically located to be visible by the operator during the manual load operation.
 - 4.13.2 Safe load options
 - 4.13.2.2 Must include two finger swipes on a stand to keep operator away from fixture movement.
 - 4.13.2.3 Or one palm button with light curtains
- 4.14 Red Rabbit program:
 - 4.14.1.2 Must check all sensors on weld fixture. (Including standard prox, laser or light beam)
 - 4.14.1.3 Must check all operations during the process.
 - 4.14.1.4 Must run the red rabbit program once a day prior to the start of the first shift.
 - 4.14.1.5 The red rabbit program must be Programmable to determine for time and day. (Cell cannot run parts until this is completed. Before the program starts, the last part must be completed.)
 - 4.14.1.6 Part(s) must be painted red and labeled with step number. Also the parts must be hung on the fence.
- 4.15 Weld masters
 - 4.15.1 Must include weld number marked on panel and which robot made that weld. (Use different colors for each robot. Example: Red for Robot 1, Blue for Robot 2) The Parts must be hung on the fence closest to the front.
- 4.16 Part Pass Table
 - 4.16.1 Must have clamps and part present switches

5 **Shipping Buy – off / Final buy-off**

- 5.1 Must complete the QMC buy-off documents for both shipping buy off and final buy – off on QMC floor.
- 5.2 Machine Run off
 - 5.2.1 24 hour dry cycle run on vendor’s floor if applicable. If not able to complete it on the vendors floor it will have to be completed on QMC floor
 - 5.2.2 2 hour production run must be completed on Vendors floor. Must run at approved Run at rate or better for the whole run.
 - 5.2.3 Vendor to repeat the 24 dry run on QMC floor. It must add up to 24hrs and does not have to be continuous.
 - 5.2.4 300pc production run on QMC floor (Minimum one day of production run). Must run at approved run at rate or better for the whole run.
 - 5.2.5 QMC must be present for some or all of each run off. Also must be documented on an approved document.
 - 5.2.6 Red Rabbit program verification
- 5.3 Completion file (**MUST BE COMPLETED BEFORE SHIPPING BUY-OFF**):
 - 5.3.1 Documented run @ rate form and open issue documented with approved signatures.

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- 5.3.2 Electrical Drawings (2 Hard copies in the electrical cabinet, one copy saved on HMI screen and one electronic copy for the QMC file)
- 5.3.3 2D and 3D CAD Data for fixture and cell drawings
- 5.3.4 HMI program file
- 5.3.5 Cell Layout (One copy saved on HMI and one electronic copy for the QMC file)
- 5.3.6 Air and water Drawings (One copy saved on HMI and one electronic copy for the QMC file)
- 5.3.7 PM plan, Spare parts list and Recommended spares with lead time (2 hard copies, 1 copy saved on HMI and 1 electronic copy for the QMC file)
- 5.3.8 Documents for changeover must be properly documented and reviewed by QMC personnel. (Must have a copy on HMI and one electronic copy for file)
- 5.3.9 Shim log- must be detailed by identifying each location clearly.
- 5.3.10 Back up of weld schedules. (Must have a copy on HMI and one electronic copy for file)
- 5.3.11 Robot backups (Must have a copy on HMI and one electronic copy for file)
- 5.3.12 Simulation file (Must have a copy on HMI and one electronic copy for file)
- 5.3.13 Warranty Information.
- 5.3.14 Manuals (Must have a copy on HMI and one electronic copy for file)
- 5.3.15 LOTO laminated diagram must be located on main door. (Must have a copy on HMI and one electronic copy for file)
- 5.3.16 Weld Fixture certification. (Must have a copy on HMI and one electronic copy for file)
- 5.3.17 Drill panel test must be performed at shipping and final buyoff.
- 5.3.18 Operator work instruction (SWI)
 - 5.3.18.2 Must have detail info for each set.
 - 5.3.18.3 Must have picture showing correct load information
 - 5.3.18.4 Must be created using QMC format

6 PM Plan/ Spare parts / Consumables

- 6.2 PM Plan
 - 6.2.1 Must be created prior to cell completion/ install.
 - 6.2.2 Daily, weekly, monthly and yearly schedules(Must have 1 copy on HMI and 1 electronic copy)
 - 6.2.3 Each schedule must have a defined amount of time for each task to complete it.
 - 6.2.4 Instructions must be written clearly using pictures. (Must have 1 copy in HMI and 1 electronic copy)
- 6.3 Spare Parts / Consumables
 - 6.3.1 Spare Parts
 - 6.3.1.2 Spare parts must be labeled with location in cell. Using the assigned CAD drawing number
 - 6.3.1.3 Each operation should have its own file name.
 - 6.3.1.4 List must be created in Excel (must have 1 copy on HMI and one electronic copy)
 - 6.3.2 Consumables

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6.3.2.2 Must also have some recommended replacement life

6.3.2.3 Well defined list of consumables with part numbers and vendor name to purchase it.

6.3.2.4 List must be created in excel (must have 1 copy on HMI and one electronic copy)

6.4 Lessons learn

6.4.1 After final buy-off a QMC team member will hold a meeting to discuss the highs and lows of the equipment.

6.4.2 Standard must be updated when improvements are needed to be made.

7 Welding Requirements

7.2 General

7.2.1 Weld guns shall be obtained from Milco Manufacturing. Any deviation from this must have Quality Metalcraft (QMC) approval.

7.2.2 The vendor is responsible for the design of weld guns. Weld gun assembly drawings and related details shall be provided by the weld gun design supplier. All original drawings and/or CAD files shall become the property of QMC.

7.2.3 The vendor shall work to the current Quality Metalcraft Process Standard to determine weld force requirements. Consideration shall be given to the material composition, thickness and coatings.

7.2.4 The O.E.M. shall select and/or develop the specific gun for each application. The weld gun selection shall be determined by the geometry of the parts to be welded and the weld schedules required. An existing weld gun design should be utilized for any new application. However, if an improvement in the operation can be accomplished with a new design, then the design may be new or modified.

7.2.5 All weld gun designs (new and existing) shall be considered prior to the design of the tooling.

7.2.6 Design approval for weld guns shall follow the following guidelines:

7.2.6.2 The vendor shall submit to the Quality Metalcraft Process Engineer a complete design proposal package for approval. This package shall include a layout drawing of the weld gun in which the mounting bracket, welding transformer location, composite part sections, and the relative position of the robots' gear train is shown.

7.2.6.3 Upon approval of this proposal the vendor shall submit to the Quality Metalcraft Weld Gun Standards Group a preliminary drawing (2 copies) which includes all known detail part numbers. If new detail components are required, they are indicated as "new design" on the drawing. Every effort shall be made to use existing details to keep the number of new designs to a minimum. Components shall be dimensioned to coincide with established Quality Metalcraft standards.

7.2.6.4 This preliminary drawing shall be returned to the vendor with any Quality Metalcraft requests for modifications. Only Quality Metalcraft Weld personnel shall assign new weld gun numbers and detail part numbers. The vendor shall update and verify the final weld gun drawing. The Quality Metalcraft Weld Engineer must approve any additional changes made to the weld gun.

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- 7.2.6.5 The final documentation of the weld gun assembly and all new details shall be delivered to Quality Metalcraft no later than 60 days following the official vehicle launch date. In addition to the CATIA requirements this documentation shall include two (2) Xerox copies of the following:
- 7.2.6.6 Full sized print of the weld gun assembly shall be shipped to the user plant with the weld gun. New prints shall be furnished to the user plant as changes occur during launch.
- 7.2.7 All new weld gun drawings shall be delivered to Quality Metalcraft Weld Engineer in CATIA format. The drawings shall meet the following requirements:
 - 7.2.7.2 All new Assembly and Detail drawings to be supplied in CATIA by the OEM.
 - 7.2.7.3 One (1) complete drawing shall reside in one (1) model and shall adhere to the following Model Naming Convention:
 - 7.2.7.3.1 Vendor name (Nachi, Wayne Trail, PICO, Kuka)
 - 7.2.7.3.2 Vendor Tracking Number
 - 7.2.7.3.3 Weld gun supplier (Milco)
 - 7.2.7.3.4 Weld gun manufacturer number.
 - 7.2.7.3.5 Phone number of gun manufacturer contact.
 - 7.2.7.3.6 Revision level
 - 7.2.7.3.6.1 Example: Valiant - VLT95678 - Milco - XX-XXX-XXX - (810) 123-4567 rel.
 - 7.2.7.4 Models may consist of "draw" or "space" vector elements. No scanned data.
 - 7.2.7.5 Models may be translated from other CAD systems, provided no data is lost due to the translation process.
 - 7.2.7.6 Store model with a draw window, displaying complete drawing.
 - 7.2.7.7 All models shall be shipped via electronic data transfer. Contact Quality Metalcraft CAD Department at CAD@qualitymetalcraft.com regarding questions concerning the CATIA drawing deliverable.
- 7.2.8 Any new weld gun designs, which are solid modeled in CATIA per platform requirement, shall be delivered to Quality Metalcraft no later than 60 days following the official vehicle launch date.
- 7.2.9 All existing weld gun designs shall be re-evaluated by the Quality Metalcraft Weld Engineer before re-ordering or being ordered for new tooling.
- 7.2.10 Firing of open weld guns shall not be permitted without written approval from a Quality Metalcraft Weld Engineer.
- 7.2.11 Weld guns shall be positioned with serviceability in mind. (See Illustration 6-2.0 and 6-2.1)
- 7.2.12 When increasing the piston area of the welding cylinder on a weld gun, the strength of the weld gun components must be verified using an approved stress analysis program.
- 7.2.13 Cylinder area, bore and stroke, and weld force information shall be noted on the assembly drawing, located on the weld cylinder.
 - 7.2.13.2 Example for portable guns :
 - 7.2.13.2.1 3" Bore X 3" stroke (7.07 sq. in. area) - 565 lbs. @ 80 p.s.i. (Air)
 - 7.2.13.3 Examples for machine type guns:
 - 7.2.13.3.1 3" Bore X 3" stroke (7.07 sq. in. area) - 425 lbs. @ 60 p.s.i (Air)

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- 7.2.13.3.2 1 3/8" Bore X 3" Stroke (1.5 sq. in area) - 600lbs. @ 400 p.s.i. (Hydraulic)
- 7.2.14 Use 1 1/4" diameter shoulder bolts at the main pivot, where possible, for any new weld gun designs and show a section through the pivot area on all weld gun assembly drawings.
- 7.2.15 Do not tolerance reamed or bored holes. Use the terms "slip fit" (S.F.) or "press fit" (P.F.).
- 7.2.16 Do not use limit-type dimensioning (ex. .626/.625). Use basic dimension with tolerance +.001(ex. .625 -.000).
- 7.2.17 All machined electrical contact surfaces shall have a maximum roughness of 32 micro-inches (R.M.S.).
- 7.2.18 Drum locks with screws smaller than 5/16"-18 are not permitted.
- 7.2.19 Heli-coil type inserts shall be used when mounting details to non-ferrous and/or cast components.
- 7.2.20 For 5/8" diameter cap adapters do not use a deflector tube larger than 0.210" O.D.
- 7.2.21 Resistance Welding caps will be size two Luvata (Nippert) part number: FB25Z00. If determining thickness (DT) is greater than 1.8mm than size three Luvata part number: FB26Z00 will be used.
- 7.2.22 All contact surfaces of details carrying secondary weld current shall be portable electroplated Cool-Amp Silver Plating Powder part #1233-500 or equivalent.
- 7.2.23 Grade 8 bolts, screws, nuts and zinc-plated washers shall be used for coppers, jack screws, cables, shunts and all non-magnetic details in secondary fields. On robot or portable type weld guns, Kickless cables shall use supertanium bolts, nuts and washers to attach the cables to the weld guns and to the transformers (Torque to 90 ft/lbs).
- 7.2.24 Design shall provide a minimum of 1/2" over travel on weld guns.
- 7.2.25 Quality Metalcraft standard female electrode caps shall be used wherever possible.
- 7.2.26 A spare cutter assembly shall be provided by the OEM for each tip dresser used for robotic application.
- 7.2.27 Series welding shall not be permitted, except with prior approval from Quality Metalcraft Weld Engineer.
- 7.2.28 Steel piston rods, hardened, and chrome plated are to be used in all cylinders.
- 7.2.29 Provide a protector on the inner & outer most leaf of all leaf style shunts.
- 7.2.30 Weld gun assembly drawings shall show all fittings (air, water, oil).
- 7.2.31 Provide a flash shield to protect the pivot assembly (fulcrum area) on all weld gun assemblies.
- 7.2.32 Adhere to the following weld gun design preferences:
- 7.2.32.2 Pinch type
 - 7.2.32.3 Scissors type
 - 7.2.32.4 C-type
- 7.2.33 Adhere to the following weld type cylinder preferences:
- 7.2.33.2 Servo-actuator
 - 7.2.33.3 Pneumatic

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- 7.2.33.4 Air over oil
- 7.2.33.5 Hydraulic
- 7.2.34 Weld gun suppliers, weld line integrators, Commodity Distributors and Quality Metalcraft shall notify the Quality Metalcraft Weld Engineer of all revisions made to any Quality Metalcraft standard weld gun assembly or weld gun component. The Quality Metalcraft Weld Gun Group shall be furnished with the documentation in CATIA format as soon as the changes are implemented.
- 7.2.35 The maximum stress level on any wrought component shall not exceed 35k.s.i.. The maximum stress on any cast component shall not exceed 16 k.s.i.. The weld gun designer must verify that stress calculations have been performed to the satisfaction of the Quality Metalcraft Weld Engineer.
- 7.2.36 All pneumatic weld guns shall have pre-lubed cylinders.
- 7.2.37 All weld guns shall be checked by a member of the Quality Metalcraft Weld Gun Group before the gun is shipped to the Weld line integrator. It is the responsibility of the weld line integrator to assure that this procedure is followed.
- 7.2.38 All weld gun electrodes must be aligned within .020".
- 7.2.39 All weld guns shall be perpendicular to the surface of the material being welded (+/- 5 degrees off normal allowed only with the approval of Quality Metalcraft).
- 7.2.40 If parts are going to be produced at the OEM, then all weld schedules and steppers must be verified by the Quality Metalcraft Welding Engineer.
- 7.2.41 Aluminum weld guns must not exceed 2.5mm linear deflection and 0.75mm perpendicular deflection at the rated weld force.
- 7.2.42 Water lines must run parallel to each weld tip. If this is not possible, must be approved by Quality Metalcraft Assembly Process or Welding Engineer.
- 7.3 Weld Guns-Robot
 - 7.3.1 Servo Guns (preferred)
 - 7.3.1.1 The mounting of the welding gun to the robot shall provide for the minimum robot cycle time and the smoothest robot operational path.
 - 7.3.1.2 All weld guns including spares shall be supplied as a complete assembly with all the necessary hangers, kickless welding cables, air and water hoses, fittings, etc.
 - 7.3.1.3 The Vendor shall furnish (2) spare sets of all shanks, adaptors, spare holder/adaptor combination per welding gun and ship them with each robot.
 - 7.3.1.4 The Vendor shall pay strict attention to the routing of the secondary welding cable, servo cable and water hoses so as to eliminate any rubbing and/or pinching as the robot performs its assigned program.
 - 7.3.1.5 The Vendor shall determine the size and length of the secondary cable.
 - 7.3.1.6 All manual weld guns without a retraction feature shall have a minimum point opening of 3/4".
 - 7.3.1.7 All robotic & manual welding applications shall utilize grounding reactors on the secondary's of welding transformers.
 - 7.3.1.8 All robot guns shall be installed to the robot with an adaptor plate.

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- 7.3.1.9 Self-equalizing cylinder must be called out separately on the weld gun assembly drawing.
- 7.3.1.10 All robot weld guns shall have a minimum weld stroke tip opening of 1 1/4" and a maximum of 1 3/4" (not including retract stroke) . The stationary jaw shall have a minimum of 3/4" equalizing movement to enhance auto tip dress.
- 7.3.1.11 Aluminum weld gun castings are not to be used unless no other alternative is possible.
- 7.3.1.12 Hardened wear plates and bumpers are to be used on all hanger brackets where self-equalizing cylinders are employed.
- 7.3.1.13 Double bend cap adaptors on "C" type weld guns should be 7/8" minimum diameter.
- 7.3.1.14 Electrode holders or electrode holder/adaptor combinations shall not exceed 6" stickout from the casting, without approval.
- 7.3.1.15 All components requiring maintenance (cylinders, shunts, etc.) must be readily accessible.

7.4 Weld Guns Portable

- 7.4.1 Portable and Robot weld guns shall be sized at 80 p.s.i. All related components shall be able to withstand the force incurred at 100 p.s.i. during production operations. Do not design weld guns to operate under 40 p.s.i. on multiple weld schedules.
- 7.4.2 The Vendor shall furnish (2) spare sets of all shanks, adaptors, spare holder/adaptor combination per welding gun and ship them with each robot and/or portable weld gun.

7.5 Weld Guns-Machine Type

- 7.5.1 Air operated machine type weld guns shall be sized at 80 p.s.i. All related components shall be able to withstand the force incurred at 100 p.s.i. during production operations.
- 7.5.2 Hydraulically operated machine type weld guns shall be sized at 400 p.s.i. All related weld gun components shall be able to withstand the force incurred at 525 p.s.i. during production operations.
- 7.5.3 The Vendor shall furnish (2) spare sets of all electrodes, caps, adaptors, and (2) spare holder/adaptor combination per welding gun and ship them with each machine type weld gun.
- 7.5.4 Interchangeability shall be considered for all weld gun standard components.
- 7.5.5 All weld guns shall be perpendicular to the surface of the material being welded (+/- 5 degrees off normal allowed only with the approval of the Quality Metalcraft Design Coordinator and the Process Engineer).
- 7.5.6 Weld gun assemblies shall be designed with the cylinder side grounded and the rod side insulated (double insulated weld guns are not acceptable).
- 7.5.7 On long-stroke dump units that position the weld guns, the welding transformers shall move with the weld guns.

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- 7.5.8 Rear hairpin mount is the preferred mounting for weld cylinders using straight gun applications. Stud mount to be used only with the approval of Quality Metalcraft.
- 7.5.9 All weld guns shall have cable cross hole connectors wherever possible.
- 7.5.10 Aluminum bronze cast (NP-3500) cradles are preferred to weldments.
- 7.5.11 Standard trunnion brackets shall be used.
- 7.5.12 Clean up a pocket on both sides of cradles to allow mounting of keepers.
- 7.5.13 On close-coupled weld guns, transformer-mounting area shall be machined to prevent distortion of transformer mounting bracket at assembly.
- 7.5.14 Provide access to the snap rings on all hexagon clevises.
- 7.5.15 Straight threaded electrode adaptors employing an o-ring are preferred to tapered threaded electrode adaptors.
- 7.5.16 All machine type equalizing weld guns shall have (3)- way adjustment (See Illustration 6-1.0, 6-1.1 and 6-1.2).
- 7.5.17 Weld cable conditions/design considerations. (See Illustration 6-3.0, 6-3.1 and 6-3.2)
- 7.5.18 Weld cable conditions and transformer service/design considerations (See Illustration 6-4.0)
- 7.5.19 Weld transformer and cable access/design considerations. (See Illustration 6-5.0, 6-5.1 & 6-5.2)
- 7.5.20 Provide adequate clearance for welding cables when designing lugs. (See Illustration 6-1.3)
- 7.5.21 Weld guns with tip opening of 3" or greater must incorporate a retract cylinder
- 7.5.22 All weld gun cylinders for machine type guns to have rod scrapers.
- 7.6 Weld Guns-Servo Type
 - 7.6.1 Servo type weld guns shall be able to achieve and withstand 1,200 lbf. If DT is equal to or greater than 2.0mm the weld gun should be able to achieve and withstand 1,575 lbf.
 - 7.6.2 Servo gun must be able to maintaining weld force within 20 lbf.
- 7.7 Weld Guns-Pedestal
 - 7.7.1 Pedestal type weld guns shall be sized at 80 p.s.i. All related weld gun components shall be able to withstand the force incurred at 100 p.s.i. during production operations.
 - 7.7.2 Pedestal welders used for projection welding must have a surge tank installed with regulated air.
 - 7.7.3 In Pedestal welding applications the weld guns used shall include, but not be limited to, the following:
 - 7.7.3.1 Retract feature with a four (4) port welding air cylinder.
 - 7.7.3.2 Cylinder actuated equalizing, when needed.
 - 7.7.3.3 1.5 gallon per minute cooling water flow.
- 7.8 Weld Guns-Air Over Oil
 - 7.8.1 Air over oil weld guns preferred for projection welding.
 - 7.8.2 Air over oil type weld guns shall follow the recommended sizing and installation procedures from the weld gun manufacturer.

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- 7.9 Weld Guns-Opposing
 - 7.9.1 Machines or fixtures that use opposing weld guns shall have the guns mounted in line in the machine or fixture such that the metal part being welded shall be centered between the weld gun points, being equidistant and symmetrical from either point.
 - 7.9.2 Do not index opposing weld guns.
- 7.10 Welding Transformers
 - 7.10.1 All transformers must be sized on Tap 2, at 65% - 70% heat. Any that fall outside this specification must have a signed deviation by the appropriate Quality Metalcraft representatives.
 - 7.10.2 All transformers must be of the trans-gun type. If this is not possible, designs must be approved with Quality Metalcraft welding and process engineers
 - 7.10.3 Suppliers shall use a Quality Metalcraft approved program for selecting and sizing transformers on all resistance spot welding applications.
 - 7.10.4 Quality Metalcraft shall approve cable and transformer sizing for remote transformer applications.
 - 7.10.5 Balancing of secondary welding current shall be held within 5 %.
 - 7.10.6 All secondary-welding cables used on 70 KVA and 100 KVA transformers shall be minimum 1200 MCM and 16" maximum in length.
 - 7.10.7 Extensions or 90-degree adapters shall not be used in the transformer secondary loops on machine type weld guns unless approved by a Quality Metalcraft Weld Engineer.
 - 7.10.8 Grounding of welding transformer secondary shall use the same ground potential (negative) throughout the system or tool, with applicable sized ground cable.
- 7.11 Welding Cables
 - 7.11.1 Kick less (low reactance) portable gun cables shall be 400 MCM minimum.
 - 7.11.1.1 Maximum length on robot and manual guns is: 400 MCM 10 Feet.
 - 7.11.1.2 Maximum length on machine remote transformers is:
 - 7.11.1.2.1 400 MCM 3-5 Feet
 - 7.11.1.2.2 500 MCM 5-8 Feet
 - 7.11.1.2.3 800 MCM 8-12 Feet
 - 7.11.2 All welding cables shall be held together with straps. Any deviation shall be approved by a Quality Metalcraft Weld Engineer.
 - 7.11.3 When using a welding gun (robot or manual type) the kickless cable bolt assembly shall be torqued down securely.
 - 7.11.4 Robot kick less cable applications that are at, or exceed, 180 degrees gun rotation must utilize high flex Water Edge or Flex-Cable only cables.
- 7.12 Tip Dressers
 - 7.12.1 Tip Dress must have 30 dresses before cap change for steel and 15 tip dresses before caps changes aluminum
 - 7.12.2 Placement of Tip Dresser
 - 7.12.3 Must have equalizer mounts attached to unit
- 7.13 Robotic GMAW & FCAW Production Lines

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7.13.1 General

7.13.1.1 Documentation and pictorials for welding sequence, operation number, weld length, and parameters will be provided by supplier at 50% design review. Changes will be documented as needed. Final documentation will be provided to Quality Metalcraft at buy off.

7.13.2 Tooling

7.13.2.1 Operation number must be identified on each manufactured part. If there are multiple tools doing the same task, a unique number or letter is to be used.

7.13.2.2 A manufacturing date stamp will be provided on each part for tracking and identification.

7.13.2.3 Avoid multiple geometry fixtures. If multiple geometry fixtures are necessary, the Quality Metalcraft program manager must approve the application.

7.13.2.4 Spatter free areas and weld nuts will be protected from debris and weld spatter throughout the entire process.

7.13.2.5 Tooling and equipment in spatter prone areas will be protected.

7.13.3 Maintenance

7.13.3.1 Weld line must have adequate zoning for maintenance during incidental down time.

7.13.3.2 Maintenance personnel must have protected access to each zone. This access must not interfere with the cycle of adjacent zones.

7.13.3.2.1 Adequate accessibility for programming, preventative maintenance, etc. will be provided for each zone.

7.13.3.3 Ability to change contact tips from the outside of the system will be provided where possible.

7.13.4 Welding

7.13.4.1 Keep weld joint positions in proper orientations for welding. Flat welds with minimum torch movement offer the best chance for quality welds.

7.13.4.2 Torch studies must be performed by supplier, and approved by a Quality Metalcraft weld engineer at 50% design review.

7.13.4.3 Torch angles must be able to move +/- 10 degrees off of optimum with clearance for robot arm and cables.

7.13.4.4 Torch contact tip must be able to extend one inch from proper work distance with clearance for robot arm and cables.

7.13.4.5 Mechanical lugs required for ground cables.

7.13.4.6 Proper ground path required. (P.L.P. blocks, back-ups, etc. are not acceptable.)

7.13.4.7 Ground cables will be adequately sized and routed so as not to create a trip hazard.

7.13.4.8 Torch cables must be free from strain and interference.

7.13.4.9 Wire feed conduits must be free from obstruction.

7.13.4.10 Adequate guarding will be provided to protect operators from weld flash.

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7.13.4.11 The supplier will provide a program and necessary equipment for Tool Center Point check for each weld robot.

7.13.5 Equipment

7.13.5.1 Welding power source will be sized for adequate duty cycle.

7.13.5.2 Torch will be properly sized for required workload.

7.13.5.3 The use of a water or air cooled torch will be by the direction of the Quality Metalcraft weld engineer.

7.13.6 Perishables and Consumables

7.13.6.1 The build vender will supply all welding consumables for tryout and buy off.

7.13.6.2 Welding equipment and perishables must be industry standard (off the shelf items).

7.14 Construction/Installation

7.14.1 The cable used for the primary wiring of weld control panels shall be a minimum of 4/0 cable.

7.14.2 Two (2) conductor type W cable sized properly shall be used to connect primary side of weld transformers to 4/0 leads from weld controllers. Provide cord grips with basket weave for flexing applications.

7.14.3 For welding transformer primary connections use Quality Metalcraft approved distribution panels in all installations readily accessible from floor level. Locations are to be approved by Quality Metalcraft. T-taps are not approved for welding transformer primary connections in lay in duct or in areas readily accessible from floor level. Where flexible cable is used for platen movement the cable shall be supported vertically at both ends. Flexible conduit shall NOT be allowed.

7.14.4 Supplier shall take and record the tip forces, transformer tap settings, gun supply pressures, line voltages, and secondary current readings for machine weld certification. Two copies shall be supplied to a Quality Metalcraft Launch Technician.

7.14.5 On PUSH-PULL welding applications the Supplier shall install AWG #4 wire to insure proper grounding of secondary welding circuits. (See Illustration 6-6.0)

7.14.6 Dual weld guns shall use two (2) separate transformers except with prior approval.

7.14.7 Primary electrical cable size for trans-guns shall be three (3) conductor #2 Type W cable for single weld gun and four (4) conductor Type W cable #2 for dual weld gun.

7.14.8 Welding power conductors passing through metal openings shall pass through in pairs with no magnetic material between the conductors.

7.14.9 Each weld gun control firing circuit shall control a unique weld gun circuit to ensure weld guns are retracted immediately after firing. Each timer and phase of a three-phase weld control shall be considered a unique circuit.

7.15 Identification

7.15.1 Supplier shall stencil identification in a contrasting color on the Welding Transformers - The call out A1-A2-A3-A4, B1-B2-B3-B4, etc., with 2" high letters on transformer visible from the floor on the service side of the line where possible. All welding

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transformers shall also be numbered on the mechanical layout sequencing schematics.

- 7.15.2 For Weld cylinder identification procedures see "Section 3", Mechanical, item 3.2.1
- 7.15.3 All weld guns shall have a weld gun identification tag mounted on the weld gun in an area where it is accessible after the weld gun has been mounted. A duplicate tag shall be provided and wired loosely to the gun so that it may be affixed to the fixture by the OEM at the direction of a weld gun group representative. This tag shall be white with 3/16" high letters. (See Illustration 6-7.0)
- 7.15.4 Weld gun supplier shall stencil or stamp Quality Metalcraft Standard Number on the body of all weld gun cylinders.
- 7.15.5 Pre-lubed cylinders shall be identified as such with a 3/4 inch wide gold band on its periphery.
- 7.16 Projection Welding Equipment
 - 7.16.1 Projection Welder
 - 7.16.1.1 Air over Oil
 - 7.16.1.2 Surge Tank (if pneumatic)
 - 7.16.1.3 Upper electrode LVDT
 - 7.16.1.4 Lower Genius Holder
 - 7.16.1.5 Max force at 3000lb force or greater depending on application
 - 7.16.1.6 AC and DC power supply will depend on the application
 - 7.16.1.7 Minimum deflection on weld gun (QMC Weld Engineer to provide number)
 - 7.16.1.8 Fastener Verification
 - 7.16.1.8.1 System must verify installation of correct Fastener
 - 7.16.1.8.1.1 Verify Double fastener
 - 7.16.1.8.1.2 Verify Upside down fastener
 - 7.16.1.8.1.3 Verify Correct ID and OD for nuts and correct OD for studs
 - 7.16.1.8.1.4 Verify correct height of nut
 - 7.16.1.8.1.5 Verify missing stamping
 - 7.16.1.8.2 Fixture verification
 - 7.16.1.8.2.1 Fastener in correct location
 - 7.16.1.8.2.2 The correct fastener installed
 - 7.16.1.8.2.3 Verify correct amount of fasteners
 - 7.16.2 Auto Feeder for Stud and Nut
 - 7.16.2.1 Use only Dengensha nut / stud feeder

8 All Other Questions

- 8.3 Must have QMC approval if it is not listed in this QMC Assembly Standard.

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Appendix A: Photos:

1.) Cell Load station :

