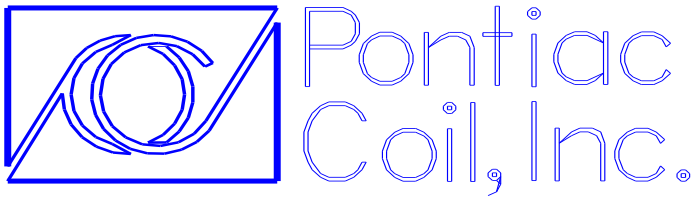

5800 Moody Drive
Clarkston, MI 48462
(248) 922-1100
FAX (248) 922-1315

Equipment and Tooling Specifications and Guidelines

Prepared By:_____

Approved By:_____

Reference Copy: **03-007**_____

I. Statement of Intent

Pontiac Coil, Inc. relies on its vendors of capital equipment and tooling and all suppliers of construction or installation at its plants to help maintain and advance its leading position of quality, technology, productivity and worker safety in the manufacture of their products.

It is our intent to form lasting and mutually beneficial relationships with vendors who can assist and participate in this effort.

The following specification and guidelines have been assembled to help define and clarify equipment, tooling, and gaging design and build requirements as well as outside service requirements that will accomplish our objectives.

It should be evident to the reader that Pontiac Coil, Inc. desires to obtain complete, high capability, high quality, efficient and safe equipment. This document should be carefully examined and **specifically adhered to.**

By design, this document is relatively short and concise, and is not intended to cover every possible situation that may arise during specification, design, build, and tryout of equipment and tooling. Although it does deal in many specific areas, its purpose is to also convey a philosophy to the reader.

We expect all suppliers of both goods and services to Pontiac Coil, Inc. to think of themselves as Pontiac Coil, Inc. employees when quoting; i.e. the supplier must put himself in the position of the person who will operate and maintain the equipment for a long time; and quote, design and build accordingly.

In all business dealings these specifications and guidelines will be used as the basis of discussions and it will be assumed in all cases that any proposal submitted adheres completely, or specifically states area of nonconformance.

However, this specification is not meant to deter any suggestions of alternative methodologies that can increase cost effectiveness while still meeting our stated goals.

A vendor's contribution to meeting these challenges will be a major factor in the awarding of business. Your suggestions and advice are both solicited and welcomed.

II. Quotation/ Requisition Format

All quotations should be complete and consistent in format and information; to the point that the quotation could be "cut and pasted" on our requisition form with no changes; i.e. the quotation should "state back" exactly what was requested to be quoted through conversations, meetings and correspondence with the supplier.

1.	Lead sheet	Include brief description of just what is being quoted/purchased, the verbatim statement - "per Pontiac Coil, Inc., Equipment and Tooling Specifications and Guidelines," reference the vendor's quotation number and Pontiac Coil, Inc. requisition number.
2.	Equipment Description	More detailed description of what is being quoted/ purchased.
3.	Sequence of Operation	Step-by-step description of the actual machine cycle, from part load through part unload.
4.	Part Size/Material	Specification of the complete capability envelope of parts that the equipment will have the physical capability to handle (and/to be tooled for). This information is to be included whether or not actual tooling will be supplied for parts covering the entire capability range.
5.	Specific Tooling	Listed by generic part included with Equipment Description, part number, (or by size and material specification if part numbers do not apply) for which specific tooling will be supplied with equipment.
6.	Production Rate	Specify as the net rate of "x" pieces per hour (including part load/unload time). This is to be defined as "Good" parts off the end of the process
7.	Runoff/Acceptance	Statement that the equipment will be set up and runoff on specific parts (listed by part number or

		size/material) and must net "x" many good parts in the time period; and must meet all requirements of the machine acceptance section XVIII) of the Pontiac Coil, Inc. specifications.
8.	Training	Note specific details (who, when, where, how long, cost) of all training required for our maintenance people, set up people and operators.
9.	Paint	The equipment shall be painted using "Sherwin – Williams" "Marble" code #MC-62
10.	Warranty	Statement that vendor will warrant this equipment for a specific time period and will repair/replace at no cost to Pontiac Coil, Inc.; reference section (XVII) of the Pontiac Coil, Inc. specifications.
11.	Pricing	If complex enough, break out individual costs into individual line items - such as tooling, training, set-up costs charged by the vendor; reference section (XIX) of the Pontiac Coil, Inc. specifications.
12.	Terms	Again, if complex enough to warrant (i.e. - progressive or partial payments), break out terms specifically; reference section (XIX) of the Pontiac Coil, Inc. specification.
13.	Delivery/Installation	Note any specific considerations relating to delivery, installation, or start up on our floor. It should be received complete; requiring only hook-up to our utilities.

III. Design/Documentation: Specification and Review

1. All drawings supplied by vendor must be in a CAD format. Preferred format is AutoDesk Inventor * .IDW, acceptable alternative file formats are * .DWG, *.DXF and *.CATDrawing. Applicable CAD software is as follows: AutoDesk Inventor R6.0, Mechanical Desktop R6.0 - R4.0, AutoCAD R2002 - R12 & CATIA V5r10.

2. All equipment & tooling design layouts will be reviewed with a representative of Pontiac Coil, Inc. prior to releasing for manufacturing. This review and tacit approval **does not** relieve the vendor of ultimate responsibility for proper functioning of the design.

3. Vendor to provide planning schedule from design through runoff for each individual piece of equipment.

4. Three maintenance/operation manuals are to be provided with all equipment on delivery to Pontiac Coil, Inc.. These manuals will include (but not necessarily be limited to) complete sequence of operations, preventive maintenance/lubrication schedules, trouble shooting guide, purchased component information, setup/changeover procedure, operator safety instructions, and control drawings. A Bill of Materials with part numbers to be supplied. A suggested back-up parts list with part number, description, vendor name and address (if uncommon, purchased item,) and pricing will be furnished in time to allow for required back-up parts to be ordered and delivered with the equipment. A copy of this list is also to be included in the manual.
   PLC Programs-Diskette copy of ladder program and descriptions to be supplied.

5. Vendor will provide original design drawing in reproducible format of all contact/wear tooling supplied with all equipment and all control drawings (electrical, pneumatic, hydraulic, water). New designs created specifically for Pontiac Coil, Inc. applications will become the property of Pontiac Coil, Inc. and may not be reproduced for other customers without written consent of Pontiac Coil, Inc.

6. A complete set of equipment/tooling blueprints must be included with equipment at the time of the shipment.

7. A scaled plan view layout drawing will be provided showing locations of all accessory items (control panels, hydraulic reservoirs, weld power supplies, et al) and approximate connection points for electrical, air and water.

8. A foundation drawing will be provided showing anchor bolt locations and any special footings required.

9. The equipment data sheet (found in the appendix of this book) will be filled out for applicable information.

10. Metric dimensions are preferred on drawings, English and metric dimensions are acceptable; English dimensions alone are not acceptable.

11. Designs should adhere to the following format rules:

- Assembly drawings should be listed first, then detail drawings
- Control drawings should be kept independent of mechanical drawings
- Stock lists should be located on assembly drawings; all details called out on an assembly drawing should be put in stock list on that assembly drawing; conversely, all details found in a stock list should be called out on that assembly drawing
- Complete vendor information must be given for standard purchased components; including pertinent dimensions, (e.g. ID, OD, length, of a spring) to allow for ordering of replacement parts
- A subassembly drawing of interchangeable tooling is required, showing the tooling in working position with machine in phantom; and tooling details charted showing the specific part number or generic size they are used for
- Interchangeable tooling details are to be detailed on sheets independent of machine details
- Sheet one (1) of any drawing package should give the total number of sheets in the package, and should note the last detail number that was used.

IV. Safety

It is the goal of Pontiac Coil, Inc. to have every piece of equipment in our plant allow for the safest possible operation and maintenance for our employees and for outside contractors working on equipment in our plants.

Pontiac Coil, Inc. is the user of industrial equipment and machinery, not a designer or developer of such equipment and machinery. Pontiac Coil, Inc. employees and representatives are not familiar with past, current and future safety requirements, or changes of those requirements. This includes OSHA, MIOSHA, OSHA Lockout requirements, industrial standards, and all other standards that may apply to assure safety at the workplace. Therefore, Pontiac Coil, Inc. employees do not review or approve safety systems and features for adequacy and correctness. The outside vendor, selling equipment to Pontiac Coil, Inc., is expected to have full level of competency regarding all safety issues. Pontiac Coil, Inc. specifically objects to accept any responsibility for the safety of purchased equipment and machinery.

A. **Guarding**

***All required guarding to protect machine operators and other employees in the area from hazard including, but not limited to, those created by point of operation, pinch points, rotating parts, flying chips, sparks and flash - is to be provided by the machine builder.**

1. All guards are to conform to applicable OSHA standards (29 CFR 1910.212) at the time of shipment. (Photographic and/or video tape record of all guarding and enclosures by the vendor is recommended.)

2. Guards must be designed to allow ready access to the equipment for maintenance, changeover and adjustment.

3. Efforts should be made to not allow guarding to be removed from the immediate area in which it is used. If guards are not attached to the machine with hinges, they should be “cabled” to the equipment.

4. Removable barrier guards should be designed to attach to the equipment utilizing a “drop-in” design (gravity attachment), with a “pin and ring”

attachment. One pin should be longer than the other to allow for ease of placement of guard to the machine.

5. All guards are to be painted safety yellow. Expanded metal guards will have orange framing and black interior. Extruded aluminum/lexan windows can be used (no paint for extrusion guarding).

6. Guards must not increase the internal operating temperature of the equipment to the point of premature equipment malfunction.

7. Lighting is to be provided inside guards where normal lighting does not adequately illuminate working area(s).

8. Guarding must be reviewed and approved prior to build.

9. Schmersal interlocks to be used.

B. **Noise**

1. Noise level of all equipment is not to exceed 85 dba peak at a distance of 3 feet from any point around the machine and at the operator's position. Noise readings will be taken under production operation conditions.

   NO exceptions will be considered which are in noncompliance of OSHA specifications.

2. Measurements will be the responsibility of the machine builder and will be taken in accordance with acceptable standards developed by Industrial Trade Association. Results are to be reported to the Requisitioner.

3. Noise enclosures must not increase the internal operating temperature of the equipment to the point of premature equipment malfunction.

4. Lighting is to be provided inside noise enclosures (that cannot be readily removed) where normal lighting does not sufficiently illuminate machine working area(s).

C. **Ventilation and Exhaust**

1. Machines and/or fixtures which generate smoke, fumes or mist are to include provisions for their containments and collection.

2. Collection smoke, fumes or mist is to be localized at point of generation rather than using large common collection hoods.

D. **Environmental**

It is Pontiac Coil, Inc.'s firm intention to provide equipment to it's operating plants that meets or exceeds all local and federal requirements for environmental safety; in terms of the process itself, any material used in the process, and any by-product of the process. It is the supplier's responsibility to inform Pontiac Coil, Inc. immediately of any situation that will not meet this criteria. Supplier should jointly review and complete the applicable sections of the Pontiac Coil, Inc. Environmental Procedure as early in the project as possible.

V. Ergonomics

It is Pontiac Coil, Inc's goal with every new piece of equipment to address that relationship between the worker's job performance and his well-being (both physical and mental), his tools, equipment, environment, and specific tasks he performs. It is expected that the equipment supplier will share this philosophy when making design and build decisions.

1. The use of light touch devices is preferred for machine actuation. If dual action actuation is required, sensor activated devices are to be used (in lieu of dual palm buttons).

2. The vendor will provide all platforms, steps and railings as necessary to provide access to tooling and/or parts handling equipment that is being provided by the vendor.

3. All equipment is to be designed and built for ease of access to all adjustments and gages; and for ready replacement of valves, cylinders, tooling, etc..

4. Design of equipment should be such that "quick reflexing," repetitive motions requiring twisting of the wrists or awkward, non-straight positioning of the wrists are not required for normal operation.

5. Part load heights and operator orientation during normal operation should be evaluated during equipment design to allow optimum operator comfort.

VI. Electrical Specifications

1. Machines are to conform to JIC, NFPA, and NEC Electrical Standards. All enclosures for electrical equipment are to be NEMA 12 Enclosures.

2. Unless otherwise specified, electrical power is 208 VAC, 3 phase, 60 hz. For small loads (3/4 HP or less), 115 VAC, 1 phase 15 AMP is acceptable.

3. All electrical power is to be wired to a single common fused disconnect in the main equipment panel. Exceptions for major power consuming stations (such as welders and D.C. power supplies) may be considered but must be specifically noted and authorized by the Requisitioner. Any exception will require special considerations for operator safety.

4. Equipment is to include all required electrical hardware and fuses so that equipment only requires an electrical drop upon installation for start-up.

5. All major control transformers as well as any other major heat generators are to be mounted to the exterior of the control enclosure.

6. All PLC equipment is to include a constant voltage isolation transformer mounted outside of the control cabinet.

7. All inputs and outputs on PLC's are to use PLC addresses for wire numbers. Input and output designations are to be referenced by PLC addresses.

8. All inputs and outputs are to be labeled on the machine next to valves, switches, etc. with description and wire and/or input/output number. Labeling is to be done on a white background with black letters and permanently attached mechanically. (Adhesive attachment is not allowed.)

9. All switches and/or machine inputs are to have status indication at control panel. "Point of contact" terminology should be used (i.e. CLAMP CLOSED versus CYLINDER ADVANCED).

10. All PLC equipment is to have room for a minimum of 30% additional I/O capacity to one (1) rack, whichever is smaller.

11. Mounting or wiring of control panels and operator's push button stations is not to commence until location is approved by a representative of Pontiac Coil, Inc..

12. All major machine status conditions (heads home, station cycled, manual/auto, cycle stop, etc.) are to be indicated by PUSH TO TEST lights.

    The following chart is to be used to determine the correct color of indicator lights.

COLOR	DESCRIPTION EXAMPLES
Red	fault conditions over temperature, part has failed test
Green	home or "go" all heads home, station has conditions cycled
Amber	"active" functions non-static pressure switch between home, fault
Blue	"passive action" hydraulic functions

    The goal is to allow the operator, with a glance at the panel, to make an "on the spot" evaluation of the equipment status while in operation.

    On stations over twenty-four (24) displayed I/O's, (Push button inputs are not requires to be displayed), a pictorial display with LED indicators showing the motions and status is to be provided. A light test circuit is also to be provided to ensure the LED's are operating.

13. Displays and set points for all production instrumentation (PSI, TIME, DISPLACEMENT, FORCE, etc.) are to be digital; that is digital displays for outputs and digital thumbwheel type encoders or keypad for data input/output.

All encoders are to be absolute rather than relative (i.e. resolver rather than pulse generators and/or glass scale). Digital is to be used vs. analog.

14. Program tapes/cartridges and at least one set of electrical control documentation are to be sent with each machine.

    Electrical documentation is to contain the following information, in the following sequence:

    A. Stocklist (including source of uncommon purchased items
    B. Cabinet layout
    C. Panel layout
    D. Schematic of hard wired items
    E. Programmable logic to consist of the following computer generated documentation (Xycom or equivalent)

Ladder Diagram

Address Usage Report
Unreferenced Description Report
Undefined Description Report
Full Cross Reference Report
Data Table Listing
Data Handling Report

15. A minimum of one (1) 115 volt, 10 amp duplex outlet ground fault connected and seperately fused mounted on the exterior of the control cabinet is to be provided (outlet distance from CPU to be 24" maximum). If a second outlet is required due to distance from CPU, an outlet is to be located inside the panel and fused to 5 amps.

16. A light is to be provided inside of the main electrical panel with its circuit by-passing the main disconnect and separately fused and switched (door actuated). Single strip florescent lamps shall be used and mounted along top of the enclosure.

17. A hardwired MCR is required on all equipment for safety and must require prior action to re-energize.

18. All inputs and outputs on PLC equipment are to be controlled directly by the processor. There are to be no hard wired circuits independent of the processor, except for the emergency stop circuit which should directly de-energize the MCR or processor controlled CR (such as motors, or other high current devices.)

19. The emergency stop circuit shall be designed such that all outputs that could cause any machine movement will be in a "safe state" upon re-applying power to the machine.

20. All outputs are to be fused with individual blown fuse indications.

21. Controls of parts feeding/material handling systems may be hard wired independent of processor (PLC systems) where they are not interfacing with machine logic (e.g. hopper level switched, vibratory drives.) Material handling must have status feedback to PLC system.

22. Good, bad, and total parts counters are to be provided and mounted to the main panel on all equipment.

23. Push button boxes are to utilize outside piano hinges to either right or left side of box.

24. Noise suppression on all coils and contacts, line filtration or isolation, and panel cooling is recommended on all systems using electronic instrumentation but is left to the discretion of the vendor who is guaranteeing machine function. Pontiac Coil, Inc. will not be responsible for costs to add any of these items if vendor elects not to follow guidelines.

25. All machines using variable speed drives and/or having stations capable of causing over 5% variation in gross machine cycle are to have built-in rate meters with a selectable “seconds per cycle,” “cycles per minute,” and “cycles per hour” readout.

26. Non-contact switches are to be used wherever possible. Proximity switches are to be 18 mm 24 VAC with indicator light.

27. Positive logic indication is to be used for fail safe operation; i.e. part presence sensing rather that part missing sensing.

28. No mechanical cam limit switches are to be used.

29. System component inter-wiring requiring breakdown for shipment, i.e., control panel independent of main machine, are to be wired in box type wire way capable of being disassembled for shipment without wiring disconnection.

30. All DC control wiring to be routed independent of AC wiring and must be shielded.

31. Flexible or rigid conduit is to be used in place of flexible cord where possible.

32. No electrical lines are to be run on the floor.

33. Proper direction of rotation of each motor is to be indicated by a permanent metal direction arrow mounted adjacent to the motor.

34. Battery and EEPROM Program backup is to be supplied on all equipment utilizing any type of central processing unit that retains machine control commands or data.

35. Equipment is to be wired for 208 VAC, 60 hz operation; control circuits will be 110 VAC unless otherwise specified by Pontiac Coil, Inc..

36. Every effort should be made to provide closed loop feedback systems (i.e. self-monitored and self-correction of operation parameters) on all equipment.

37. Any power factor capacitors used will be of the dry type; or be filled with non PCB substance; and must be marked/certified as containing no PCB's.

38. NO Sequences to be used in program!

VII. Hydraulic Specifications

1. All hydraulic functions are to be reviewed by a Pontiac Coil, Inc. representative for the application of separate pressure regulators (with gages) as well as flow controls. Any functions not agreed upon as having a common regulator shall have a separate regulator, any function not specifically excepted is to have flow controls. Each regulator is to be tagged with the functional description of that regulated machine operation (e.g. CLAMP PRESSURE and state design pressure requirement) and be separately gaged.

2. Hydraulic systems shall be designed to operate between 110-135 degrees Fahrenheit. Pressure level and temperature indication and interlocks must be provided for safe and proper system operation.

3. Where loss of working pressure on the discharge side of the pump or pumps may result in damage to the equipment, loss of accuracy, damage or injury to personnel, proper interlocking and indication shall be provided to prevent operation under these conditions.

4. Overpressure protection on discharge side of pump(s) is to be provided and status indicated.

5. The input side of all pumps will be protected with an accessible strainer.

6. In addition to the strainer, a full flow, high pressure 10 micron nominal filter, externally mounted, shall be provided for the continuous removal of materials from the hydraulic fluid; on systems with servo valves. A 10 micron absolute or OEM specified

filter, whichever is less, is required. Return side piping shall have a 25 micron nominal filter, also externally mounted. Status of both filters is to be indicated.

7. Filters are to be tagged with recommended change frequency.

8. Specifications are for conventional hydraulic systems. Servo-Hydraulic systems will further follow manufacture's recommendations.

9. Pumps are to be mounted external to the reservoir.

10. All branch off points from the main source below tank level are to have check valves or shut off valves. Reasonable provisions are to be made to allow servicing of hydraulic systems without excessive hydraulic fluid loss.

11. All hydraulic valve functions are to be controlled by two(2) or three(3) position double solenoid valves. Other valve configurations are permissible only where specifically requested and approved.

12. All hydraulic systems are to include the required volume of fluid. Type of fluid used to be permanently affixed or stamped next to the fill point. The hydraulic fluid supplied is to be compatible with those in use at the requisitioning plant, this information to be supplied by Pontiac Coil Inc..

13. All hydraulic reservoirs to be equipped with fluid level indicator, drip pan, internal baffles and have provisions to drain oil.

14. Hydraulics systems utilizing water cooling will conform to "Water Cooling Specifications" section of this specification, (X B).

15. Where there is more than one hydraulically or manually controlled device on any industrial equipment, and where possible damage may be caused by the failure of any one device to function properly, the circuits shall be arranged with protective interlocks.

16. All threaded connections are to be SAE straight threads with Oring seals.

17. No piping is to be used to support valves or equipment.

18. Separate on/off power control to hydraulic systems is to be provided; (separate from equipment control power).

19. Hydraulic system power will be part of the emergency stop circuit.

20. Pressure control valves will have push-to-test gages.

21. All hydraulic hoses will be of double braided construction, and rated for the maximum pressure the system can generate.

22. Flexible hydraulic lines will be confined or restrained if their failure could constitute a safety hazard.

23. An automatically actuated means for shutting down the oil pump on equipment with hydraulic fluid reservoirs of 100 gal. or more will be provided; in case of fire. Automatic shut-down of hydraulic system equipment may be accomplished through the use of a localized sprinkler water flow switch, a fusible line or other fire detector located over the hydraulically operated equipment, or on an oil reservoir level switch interlocked with the oil pump; indicating when the oil level is 25 gallons or less below the normal operating oil level.

24. All piping will specify where hard piping vs. flexible hose will be used.

25. Any system requiring pressurized accumulators must provide gaging and shut-off valves at the accumulator.

26. All filters must include indication of filter cleanliness(i.e. pop-up indicator, differential pressure drop, etc.).

VIII. Pneumatic Specifications

1. All pneumatic specifications are to be reviewed by a Pontiac Coil, Inc. representative for application of separate pressure regulators (with gages) as well as flow controls. Any functions not agreed upon as having common regulator shall have a separate regulator. Each regulator shall be tagged with the functional description of that regulated machine operation (e.g. CLAMP PRESSURE).

2. The pneumatic circuits to include a pressure switch wired into the PLC and programmed to stop the machine when pressure drops below 80 P.S.I.

3. All lines are to be piped to a single point connection with a shut-off in an accessible location. All equipment is to utilize a main quick dump lockout shutoff in front of the FRL; with the ability to bleed off condensate.

4. All pneumatic equipment is to incorporate a Filter Regulator Lubricator (with Gage) off the single point connection.

5. Air accumulator (surge tank) is to be piped prior to the FRL and must have an automatic bleed off.

Tanks shall be designed and constructed such that they cannot be disassembled while containing an unsafe charge. A means shall be provided for safely releasing air pressure. The following information shall be permanently indicated on each tank.

1. Nation Board serial number
2. Name of manufacturer
3. Maximum allowable working pressure
4. Manufacturers serial number
5. Year built

6. Each individual station on multiple station machines to have a separate manual shut off.

7. Piping to tooling is to utilize hard plastic tubing and quick disconnect fittings.

8. Pneumatic valve functions are to be controlled by 2 or 3 position double solenoid valves. Single solenoid (spring returned) valve applications are permissible only where specifically requested and approved. Valves should have manual override push button capability.

9. Under-pressure and/or over-pressure indication and interlock shall be provided on pneumatic circuits where safety or quality may be affected.

10. Automatic controls shall be protected and so located as to prevent inadvertent operation.

11. Automatic controls shall be mounted as close to the actuator as practical to keep working lines as short as possible to prevent wasted air, and excessive actuator lag time.

12. No piping is to be used to support valves or equipment.

NOTE: Every attempt is to be made to minimize the use of compressed air primarily due to the generation of hazardous noise by exhausts and related loss inefficiencies.

13. Pneumatic control circuits (i.e. air logic) are not acceptable in any situation.

IX. Machine Lubrication Specifications

1. Any equipment having over ten (10) lubrication points shall have a centralized lubrication system. An automatic system with a readily accessible reservoir is to be quoted if the frequency of lubrication is more often than once every six (6) running hours. Otherwise, a manually operated central system is required. Minimum reservoir size to allow for one hundred twenty (120) operating hours.

2. Any equipment having ten (10) or less lubrication points, but requiring lubricating every four (4) hours or less is to be quoted with an automatic or semi-automatic lubrication system.

3. All other equipment may be manually lubricated. It is preferred that they be piped to a common accessible area (but not necessarily a common point).

4. When automatic or semi-automatic equipment is used, a lubrication drawing is required showing the system with all the lubrication points and piping.

5. On manual systems, lubrication points should be identified on the assembly, or separate drawing noting the type and frequency of lube to be used.

6. Lubrication points will be plainly and permanently identified on the equipment; using the same identification as used on the lubrication drawing.

7. Sealed or pre-lubricated bearings or bearing requiring no lubrication should be used whenever design and operating conditions permit.

8. When automatic lubrication systems are installed, failure of lubrication shall be indicated by warning lights and/or interlock.

9. Standard thread, Zerk fittings shall be used for individual pressure grease points; and be readily accessible without removing guards and/or covers.

10. Standard thread, button type fittings shall be used for individual pressure oil points; and be readily accessible without removing guards and/or covers.

X. Process Cooling/Lubrication Specifications

A. Flood Cooling/Lubrication

1. Machines and/or fixtures which utilize flood cooling/lubrication are to include provisions for their containment, collection, recirculation, filtration and maintenance.

2. Systems are to include automatic level control and/or monitoring and are to be interfaced with the machine control for interlocked operation.

3. Machines and/or fixtures are to be designed for above-floor-level reservoirs and sumps and are to include piping and a manual valve for emptying the system using the systems circulation provisions.

4. Systems requiring filtration and/or material separation, if not included in the machine quotation, must be specifically noted. Vendors are requested

to quote optional filtration and/or material separation systems whenever appropriate.

5. Adequate filters, strainers, reliefs, and sensors are to be employed to protect systems from expected operating conditions (contamination, pump cavitation, overpressure output, etc.) as well as to provide indication to the operator as to need for system attention.

6. Specification applies to both liquid and vapor cooling and lubrication.

7. Flood cooling should be routed through segmented, plastic lines (e.g. Loc-Lines) rather than solid tubing.

8. Individual, readily accessible (without removing any guards) shut offs are to be provided.

B. **Water Cooling**

1. Use closed loop (Mill water) systems wherever possible and where inlet temperatures are not required to be less than 85 degrees Fahrenheit. If lower cooling temperatures are required the equipment should be provided with its own closed loop cooling system. Operating range for cooling water must be noted.

2. A single point connection is to be provided with a strainer and/or filter. A solenoid shut-off is also to be provided to turn off water when machine power is off.

3. Utilize thermostatic shut off where applicable and status indicated.

4. Manual shut-off valves and a drain are to be provided on a closed loop system. (This may be quoted as an option.)

5. All branch points from main power source to have shut-off valves and visual flow indicators mounted after the strainer and/or filter.

XI. Utility Metering

1. Metering of utilities is requested to be quoted as an optional feature for all major consumers of energy. The following list designates utility usage levels at which metering is expected to be considered:

Natural Gas	1,250 CF/HR
Electricity(Connected Lead)	225 KW
Compressed Air	250 SCF/HR
Water	1,000 GAL/HR

2. For gas, steam and compressed air where metering is not used, in-line orifice plates and test taps are to be included and appropriately labeled as to type and size.

3. Meters used should be totalizing type and are to have generating or transmitting options.

4. All gas and oil burners are expected to be tested and adjusted for optimum combustion efficiently upon installation and documented at point of installation with copies forwarded to Pontiac Coil, Inc. Engineering.

   NOTE: Usage levels represent approximately 5% total daily cost or 5% capacity.

XII. Tooling Specifications

1. Tooling should not have multiple changeable details for changeover but rather should be changed out as tooling sub-assemblies.

2. Tooling must be designed for fast changeover; with a target of ten (10) minutes or less; when done by the operators assigned to the equipment. No removable fasteners should be used; the objective is to use no tools for tooling changeover whatsoever; reference guidelines found in the appendix.

   If any changeover utilizing standard fasteners is approved, the required tool must be attached to the machine vie chain or cable.

3. Part-contact/locating tooling should be designed to accept parts in only the correct orientation; the tooling should not allow an operator to inadvertently place the part improperly.

4. Number of different screw sizes used in tooling assembly to be kept to an absolute minimum. (Preferably one (1) only.)

5. All flush tooling which is doweled together must have thru jack screw holes (same size thread as tooling bolts). HeliCoil inserts to be used on all aluminum details.

6. All tooling is to be permanently identified with its drawing number and detail (on a non-working surface). **(Non-marked machine and tooling details will be rejected.)**

7. All fixtures and/or machines with interchangeable tooling details are to have provisions for on-machine, readily accessible tooling storage. In the case of high quantities of tooling or especially bulky tooling, separate off machine tooling storage cabinets should be quoted as a separate item.

8. Weld tooling operating is a weld zone must be copper, ampco, or specially treated steel to prevent weld spatter from sticking.

9. Tooling and part number cross reference sheets must be affixed to the machine in a location visible to operator. The cross reference sheets must be sealed in clear plastic for protection. This information must also be included in the maintenance/operation manual.

10. Multi-station fixtures or tooling must be individually marked with a sequential identification number.

11. Tooling, particularly dies, are to be stamped per OSHA requirements, 29 CFR 1910.217 (d). These include die tonnage and stroke and complete die weight.

12. Resistance welding contact tooling will be water cooled - reference section (X) in water cooling.

13. All casting patterns that are designed and built specifically for components of equipment purchased by Pontiac Coil, Inc. will become property of Pontiac Coil, Inc..

14. Interchangeable tooling details/subassemblies should be designed such that they are of a size and weight that they can be readily changed out without the use of auxiliary lifting

equipment. In situations where this is not feasible, the vendor will identify this fact and propose further action to facilitate ready changeover.

15. All tooling designs must be reviewed and approved by appropriate Pontiac Coil, Inc. personnel.

16. All tooling purchased by a Pontiac Coil, Inc. customer must be identified with "Property of ...". Pontiac Coil, Inc. will supply this information.

17. "All tooling to have a rust preventative treatment (plating, black oxide, anodize, etc.) Unless use of tooling dictates no treatment.

18. Tooling design to accept normal component and subassembly print tolerances.

XIII. Part Feeding

A. Hoppers

1. Special consideration must be given to bulk hopper applications to make sure no parts damage will occur. Bulk hoppers are not to be proposed where any damage is expected to be likely to occur.

2. Hoppers are to be floor loaded type except in cases of small (where two (2) hours supply of parts is less than three (3) cubic feet) or very light

parts where above bowl level hopper may be used if approved by the Requisitioner.

3. Hoppers are to be capable of being readily emptied via a quick dump door on the hopper and a diverter chute at exit end of the elevator chute for returning parts to bulk containers.

4. Hoppers that dump parts directly to the bowl are to have diverters to prevent parts from dropping full force onto the bowl bottom.

5. Hoppers must be lined or enclosed for under 85 dba peak. Enclosures are to be mounted to posts with 1/2 turn non-removable fasteners, hinged or attached with an easy access means to facilitate maintenance and changeover.

6. Hoppers and feeder bowls should have covers to reduce noise where applicable.

B. **Feeder Bowls**

1. Feeder bowls are to be lined or enclosed for under 85 dBA peak. Enclosures are to be mounted to posts with a 1/2 turn non-removable fastener, hinged or attached with an easy access means to facilitate maintenance and changeover.

2. Trash Drop Out/Cut Out with special attention to offal, slugs, cleaning media or other parts occasionally mixed in.

3. Feed Hopper required if part is expected to show high sensitivity to level of bowl loading or if parts volume warrants. Systems to have capability of 1-2 hour gross parts supply.

4. Feeder bowl changeover tooling is to be rigidly mounted adhering to the fast changeover tooling specification. Functional bowl areas not requiring changeover - drop-offs, turnovers, thin sections, orienters, areas susceptible to high wear, etc. are to be bolt in inserts for repairs/adjustments to parts conditions or to handle different but similar parts.

C. **Tracks**

1. Functional track changeover tooling is to be rigidly mounted adhering to the fast changeover tooling specification. Functional track areas not requiring a changeover - drop-offs, turnovers, thin sections, orienters, areas susceptible to high wear, etc. are to be bolt in inserts for repair/adjustments to parts conditions or to handle different but similar parts. All tracks should be hardened tool steel.

2. To be built with access "doors" in the track or containment rail to allow the removal of jammed parts - especially at track ends.

3. Have parts stop immediately prior to track output end (for gravity feed tracks) to allow servicing of parts nest and/or assembly tooling.

4. Multiple tracks to be used, rather than expecting to make adjustments to a single track, to aid in changeover and to not lose an optimized set up.

5. Tracks should be built sectionally where the track must change directions i.e., dog leg, 90 degree drop, etc., with access "door" at track junction.

6. Powered tracks are to be used wherever possible except in cases where it can be absolutely established to not be necessary or is inappropriate.

7. Each track to have individual variable rate controls except in cases where it can be absolutely established that a single drive can feed the parts evenly in each track even with variable loads.

D. **Escape Nests/Track Nests**

1. All feeder tracks must deposit parts into dead nest prior to parts transferring into machine.

2. Tooling must conform to guidelines for fast change and ease of adjustment.

3. Design to allow total access and/or removal, taking into consideration the particular parts' variations and prime modes for print variation and should be inserted or built sectionally to allow for rapid and inexpensive repair, adjustment or replacement.

E. **Controls**

1. Parts hoppers that are feeding bowls are to be controlled directly by parts volume in feeder bowl.

2. Feeder bowls (where positive parts pressure exerted by bowl is not required) are to be controlled by part presence in feed track.

3. Parts sensors/switched are to be incorporated to sense for "part available for transfer," "part has been secured" and "part has been transferred" as well as "track empty."

4. Non-contract parts sensors are to be used.

5. All bowl controls and drives are to be 120V.

6. No controls are to be mounted internal to sound enclosure or guarding.

7. All feeder controls attached to feeders are to be vibration isolation mounted.

8. Floor hopper controls should be electrically interlocked to other feeder components so as to prevent the bowl from being loaded when it is turned off.

9. Tracks shall have track full sensors to control the bowl, and track empty sensors to control the machine. All must be indicated.

10. Auto-transformer type controllers are to be used. Solid state type vibratory controllers are not acceptable.

11. Compressed air jets are not to be used anywhere within feeding systems. Any exception must be specifically approved by the Requisitioner.

12. Controls of parts feeding or material handling systems may be hard wired Independent of the central processing unit on PLC controlled systems - where they do not interface with the machine control logic; e.g. track virbatory drives and parts hopper level control. Material handling must have status feedback to PLC system.

XIV. Gaging Instrumentation Specifications

1. All gage and instrumentation displays/readouts are to be digital, and display engineering units (inches/mm, pounds/grams, etc.)

2. All gage and instrumentation values are to be **absolute** numbers rather than a differential reading. (i.e. a total length rather than the difference from a "0" set point master.)

3. Gaging and instrumentation systems are to have an RS-232-C digital output port. (BCD, binary, hex, synchronous or parallel output may be acceptable but must be specifically approved.)

4. Absolute digital gaging and instrumentation inputs are to be utilized wherever possible. Systems using relative encoding must employ battery backups providing uninterrupted value retention. Systems using other than absolute digital input must be specifically noted. (see "Electrical Specifications" for further specifications especially applicable for analog inputs.)

5. All gages are to include gage masters (Jo blocks, standard weights, master parts) in order to confirm the accuracy and repeatability of the gages in operation. (NOTE: These are not "reference" masters to allow differential readings from a "0" set point.)

6. All gages must have a **Gage Repeatability Study** performed prior to its acceptance and shipment. Use Ford/AIAG format to achieve <10% GR&R.

7. All gages/instrumentation must include complete set up and operating instructions capable of being posted for the operator.

8. Gages/instrumentation systems are to be designed for operator independence. Actual gaging and data acquisition/recording should occur automatically.

9. Equipment vendors are encouraged to quote on line 100% gaging where deemed appropriate as well as automatic feedback control systems. Costs should be presented as options so that they may be individually assessed.

10. Load cells are to have overload cage protection.

11. Gage masters (painted green) should be provided and certified (NITS and used in GR&R.). Gage masters to demonstrate maginal pass and marginal fail for each test limit.

12. All gage or test equipment must be documented and entered into the Pontiac Coil calibration lab upon delievery.

XV. General Conditions for Construction/Work Performed on Pontiac Coil, Inc. Property

1. Immediately after being awarded a contract, the Contractor shall provide to Pontiac Coil, Inc.:

A. Certificate of Insurance in conformance with requirements

B. A Performance Bond and a Material Payment Bond for the full contract.

C. A time schedule for the work

D. A list of Subcontractors and major material suppliers with the approximate dollar value of work to be provided by each. This list shall be kept up-to-date as the job progresses. Pontiac Coil, Inc. reserves the right to approve all subcontractors.

E. The name and address of the Contractor's representative to whom all of Pontiac Coil, Inc.'s instructions, questions and correspondence should be delivered.

F. A signed copy of the "Contractor-Right-To-Know Compliance Form" (found in appendix).

G. Exchange information on Lockout/Tagout Procedures.

H. A list of required deliverables and dates for Pontiac Coil to support on-time completion of project.

2. As required during the progress of the work, the Contractor shall provide: (except as agreed to by Pontiac Coil, Inc.'s representative)

A. Temporary light, power and water

B. Job trailer

C. Job telephone

D. Temporary enclosures and cold or foul weather protection

E. Guard rails, barricades, bracing, security lighting and other safety precautions to protect personnel from injury, and to prevent property damage.

F. All permits

3. The job must be supervised by a full time, on-site, qualified Superintendent approved by Pontiac Coil, Inc..

Pontiac Coil, Inc. reserves the right to decide that any employee of the Contractor be denied access to the property, if, in Pontiac Coil, Inc.'s sole judgment, there is sufficient cause.

4. During the progress of the work, the Contractor shall:

   A. Keep all areas clean and orderly. All scrap materials which have been removed shall not be allowed to accumulate on the property.

   B. Provide for such necessary devices or procedures to protect the building and the vehicles parked in adjacent lots from damage (e.g. paint overspray, falling debits, etc.).

   C. Receive, store and assume full responsibility for his own tools, equipment and materials as well as any of these furnished him by Pontiac Coil, Inc..

   D. Be permitted to use Pontiac Coil, Inc.'s toilet facilities and vending areas. Pontiac Coil, Inc. will set forth rules so that Pontiac Coil, Inc. can maintain security and can avoid overcrowding.

   E. Pay all taxes, inspection and permit fees, etc..

5. Use only materials and construction methods approved by the building code or authority having jurisdiction. All design and construction must be approved by Factory Mutual.

   All products and services shall comply with the standards promulgated under the Occupational Safety and Health Act (OSHA).

6. Pontiac Coil, Inc. shall have the right to take possession of or use any completed or partially completed part of the work. Such possession or use shall not be deemed as an acceptance of work not completed in accordance with the contract.

7. Where the term "or an approved equal," "or equal," or a similar expression is used in the detailed specifications, it is intended to give the Contractor the optional use of materials of other manufacturers than those specifically mentioned, but it shall be understood that such substitution can be made only after the written consent of Pontiac Coil, Inc. has been obtained.

8. Contractor shall not be permitted to any compensation for work not required under the contract, unless, prior to the performance of such work, he shall have received from

Pontiac Coil, Inc. written authorization to perform such work and any additional compensation shall have been agreed upon in writing.

9. The Contractor must submit affidavits with partial waivers of lien from himself as well as his Subcontractors and material suppliers. These waivers need not accompany each monthly invoice, but in no case may they be submitted later than with the following month's invoice. Waivers covering all prior billings will be a prerequisite of a current invoice.

10. Payments otherwise due may be withheld on account of:

    A. Defective work not remedied
    B. Claims or liens filed or reasonable evidence indicating probability of filing
    C. Failure of Contractor to make payments promptly to his Subcontractors or material suppliers
    D. Reasonable doubt that the Contract can be completed for the unpaid balance
    E. Damage to Pontiac Coil, Inc.

11. Should the Contractor at any time refuse or neglect to supply sufficient labor or materials so that the work will be completed in accordance with the agreed schedule, Pontiac Coil, Inc. may, after seven (7) days written notice to the Contractor, provide such labor and materials and deduct the cost from any money due the Contractor under the Contract.

12. Contractor and Subcontractors shall comply with jobsite work rules and safety rules of Pontiac Coil, Inc.. If the site of the work is an operating plant, the Contractor must give Pontiac Coil, Inc. advanced notice before performing any work that might interfere with the operation of the plant. Pontiac Coil, Inc. has the right to direct a reasonable postponement of such work.

13. Contractor shall promptly report to Pontiac Coil, Inc., in writing, details on any accident or injury in connection with performance of the work.

14. For any work installed not in accordance with the Contract, and which Pontiac Coil, Inc. deems it inexpedient to correct, there shall be an equitable deduction from the Contract price.

15. When the work is essentially complete, the Contractor shall:

A. Correct all items on Pontiac Coil, Inc.'s punch list

B. Clean up all work and remove any temporary facilities

C. Provide a written guarantee. The guarantee shall state when it commences, how long it is in effect, the work covered, and the name, address, and telephone number of the person to be contacted.

D. Furnish all final lien waivers

When all of these have been accomplished, Pontiac Coil, Inc. will accept work and pay the retainage withheld during the job progress.

16. Should any defects develop during the guarantee period, the Contractor shall, at his own expense, make any necessary repairs or take corrective action within five (5) days of being so notified by Pontiac Coil, Inc..

17. Before proceeding with any work that is to be paid for on a Unit Price basis, the representatives of both Pontiac Coil, Inc. and the Contractor shall agree upon and record the quantity of work involved.

18. The details of the existing eaves, roof joins, roof deck, etc. are the best data available, but are not guaranteed by Pontiac Coil, Inc.. Before proceeding with any purchases or work which is dependent upon these details, the Contractor shall field check to verify information.

19. The Contractor shall be totally responsibility for any clean up, damage to lawns and landscaping, or any repairs made necessary by his workers, equipment, or materials; and those of any subcontractors.

20. Any discrepancy affecting the work shall be called to Pontiac Coil, Inc.'s attention. No work shall proceed until the discrepancy is clarified or rectified.

XVI. Standard Purchased Components

Every effort should be made to utilize standard "off the shelf" components in the design of equipment; rather than designing special application; i.e., do not "reinvent the wheel."

Electrical Component Specifications

1. Switch Selectors, Operators, Indicating Push Buttons, Key Operators, Indicators - Allen Bradley
2. Limit Switches - Allen Bradley
3. Specialty Switched - Micro Switch
4. Light Operated Switches - Banner (Multibeam models) Micro Switch, ATC, Keyence
5. Motor Starters (Manual & Magnetic) - Allen Bradley
6. Programmable Controllers - Allen Bradley
7. Enclosures - Any supplier that meets NEMA requirements for specific application
8. Relays - Allen Bradley, Potter Brumfield
9. Timers - ATC, Eagle Signal
10. Counters - Durant
11. Magnetic Proximity - Go Proximity
12. Disconnect Switch & Operating Mechanisms - Square D, Allen Bradley
13. Fuses - Bussman, Shawmut, Slow-Blow Type
14. Motors - Lincoln, Reliance, U.S., Baldor Bodine
15. Clutch-Brake Units - Warner Electric
16. Isolation Transformers - Sola
17. Panel Air Conditioners - McLean Midwest, Kooltronics
18. Light Curtains - Weldotron

19. Press Controls – Wintress

20. Omron

21. Baumer

Mechanical Component Specifications

1. Indexers - Camco

2. Gear Reducers - Boston Gear

3. Torque Limiters - Browning (Torque Guard)

4. Shaft Couplings - < 1/2" - Lovejoy
   > 1/2" - Dodge (Taper Lock)

5. Clutch-Brakes - Horton

6. Linear Bearings, Shafts - Thompson

7. Screw Jacks - Duff Norton, Power Jac

Hydraulic Component Specifications

1. Cylinders - Parker, Ortman, Miller
2. Pumps - Vickers
3. Pressure Regulators - Vickers
4. Flow Controls - Vickers
5. Directional Control Valves - Vickers, sub plate mounted
6. Fittings - Aeroquip Fittings
7. Accumulators - <1 pint capacity - Parker piston type
   >1 pint capacity - Gerolator bladder type
8. Filters - spin on type
9. Heat Exchangers - Vickers
10. Disc Brakes - Tol-O Matic

Pneumatic Component Specifications

1. Filter-Regulator-Lubricator - Norgen, Wilkerson

2. Directional Valves – SMC, Festo
3. Flow Controls - Legris

4. Fittings - Parker, Legris

5. Mufflers - Norgren

6. Cylinders – Bimba, SMC

7. Hand Valves - Schrader

8. In-Line Filters – Norgren

9. SMC/Festo

Grippers

1. SMC, Robohand

Electrical Component Deviation Sheet

1. Switch Selectors, Operators, Indicating Push Buttons, Key Operators, Indicators - _____
2. Limit Switches - _____
3. Specialty Switches - _____
4. Light Operated Switches - _____
5. Motor Starters (Manual & Magnetic) - _____
6. Programmable Controllers - _____
7. Enclosures - _____
8. Relays - _____
9. Timers - _____
10. Counters - _____
11. Magnetic Proximity - _____
12. Disconnect Switch & Operating Mechanisms - _____
13. Fuses - _____
14. Motors - _____
15. Clutch-Break Units - _____
16. Isolation Transformers - _____
17. Panel Air Conditioners - _____

Hydraulic Component Deviation Sheet

1. Cylinders - _____
2. Pumps - _____
3. Pressure Regulators - _____
4. Flow Controls - _____
5. Directional Control Valves - _____
6. Fittings - _____
7. Accumulators - < 1 pint capacity - _____
   > 1 pint capacity - _____
8. Filters - _____
9. Heat Exchangers - _____
10. Disc Brakes - _____

Mechanical Component Deviation Sheet

1. Indexers - _____

2. Gear Reducers - _____

3. Torque Limiters - _____

4. Shaft Couplings - < 1/2" - _____
   > 1/2" - _____

5. Clutch-Breaks - _____

6. Linear Bearings, Shafts - _____

7. Screw Jacks - _____

Pneumatic Component Deviation Sheet

1. Filter-Regulator-Lubricator - _____
2. Directional Valves - _____
3. Flow Controls - _____
4. Fittings - _____
5. Mufflers - _____
6. Cylinders - _____
7. Hand Valves - _____
8. In-Line Filters - _____

Welding Equipment Deviation Sheet

1. Power Supplies - _____
2. Torches - _____
3. Wire Feeds - _____
4. Wire Reels - _____

XVII. Warranty Requirements

1. Pontiac Coil, Inc. expects that the quality of design and workmanship on the capital equipment that it purchases will allow it to be free of defects and/or failures for a **minimum of one year** in production. Warranty period is to commence at start up at Pontiac Coil, Inc. manufacturing facility.

2. It is expected that the vendor will warrant design and workmanship on all items supplied or specified by vendor for this period.

3. Vendors warranty is expected to include repair or replacement of defective component/system damage as well as vendors assistance at Pontiac Coil, Inc. facility for diagnosis and resolution of design related problems at no cost to Pontiac Coil.

4. Any vendor exceptions to this or definitions of "normal wear and tear" should be clearly stated in writing with the vendor's proposal.

5. No exceptions whatsoever are acceptable which relate to the health and safety of the worker.

6. Equipment must maintain a minimum of 85% uptime during the warranty period.

7. Warranty does not expire when Pontiac Coil works on machine.

XVIII. Acceptance Criteria

A. GENERAL ACCEPTANCE CRITERIA

1. Machine is to dry cycle for a continuous 24 hour period. It must run continuously for the duration. Any stop will require the dry cycle to be started over.

2. The production runoff will be under load conditions for four (4) hours continuous operation at rated cycle time. Machine must perform at 100%, less any nonrecurring downtime, operator inefficiencies, and stated and scheduled tooling changes/adjustments. Total Accumulated passed (shipable) parts from process during 4 hour run is required to meet or excede quoted cycle time. Runoff will be performed in the presence of a representative(s) of Pontiac Coil, Inc..

3. Production parts used for runoff will be returned as usable production parts.

4. Labor for machine run-off to be supplied by machine builder, and must not excede the number of operators used in machine quote. It is the machine builders responsibility to demonstrate that manual operations can be accomplished in the allowed cycle time, allowing for P.F. & D.

B. CHANGEOVER REQUIREMENTS

1. Machines must be capable of being changed over complete, worst case, in a time not to exceed ten (10) minutes by the operator(s) manning the machine.

C. CAPABILITY STUDY

1. Prior to the design of equipment, the dimensions and specifications of all parts as they relate to the process are to be reviewed by the vendor to assure that equipment being quoted is capable of making parts 100% to print. It is expected that all new equipment will be totally capable.

2. All critical characteristics must meet ± 5 Sigma process capability. Analysis will be performed per the attached "Equipment Capability Requirements."

3. All equipment must meet capability requirements prior to shipment.

D. SAFETY

1. Equipment is to be complete with all necessary enclosures, guards, and safety interlocking devices required to provide for safe operation and must meet or exceed Federal OSHA Standards and related requirements per this specification prior to acceptance. Photographic documentation of guards and enclosures is recommended. (Reference section IV of these guidelines.)

XIX. Equipment Capability Requirements

Purpose
To assure that all new or rebuilt manufacturing equipment will meet ± 5 Sigma capability prior to Pontiac Coil, Inc's acceptance.

Preparation
Obtain optimum machine setup. Confirm acceptability of component parts/raw materials to be used for the run off. Activate the equipment and run a minimum of 300 parts; these parts must be run consecutively and made without machine downtime or manual adjustments.

Attribute Data
Inspect 300 pieces from this run; all 300 must meet "go/no go" criteria for acceptance on any individual characteristics.

Variable Data
Chose a minimum of 30 consecutive pieces from the run. Measure and record data for each sample part and calculate x and Sigma. Calculate x and ± 5 Sigma; these values must fall within the specification tolerance to be acceptable. Use a computer software package to calculate Cpk; the minimum acceptable Cpk is 1.67 - unless a different value has been previously mutually agreed upon. If computer software is not available, the attached capability analysis sheets may be used.

Non Critical Characteristics
Equipment must be able to meet all blueprint requirements; although capability studies will be done only on critical characteristics, a complete layout of all requirements must be passed prior to acceptance.

Equipment Acceptance or Rejection
Where equipment passes the above criteria, capability requirements per Pontiac Coil, Inc. Engineering and Quality Assurance Standards will be satisfied; total equipment acceptance,

however, requires that all other specifications, terms and conditions of the purchase order must be met. At such time as the criteria are not met; and all appearances are that they cannot be improved, a written status outlining and qualifying individual areas of unacceptability is to be presented to Pontiac Coil, Inc.. Copies of equipment capability studies on all accepted equipment are to be sent to Pontiac Coil, Inc..

XX. Capability Analysis Form

Instructions/Examples for Completion

1. Fill in heading (A) and enter measurement values under "sample data" (B) on "Data Collection for Capability Analysis" sheet. (NOTE: In the examples the values are coded for ease of manipulation; ref. remark (C).)

2. The sample size must be at least 30 pieces to have statistical significance.

3. Fill in the tally sheet (D) showing frequencies for each value.

4. Put the values and frequencies from the tally sheet into the corresponding rows (E) and (F) at the bottom of the graph sheet.

5. Calculate and enter the "estimated accumulated frequencies" (EAF) in the EAF row (G). The EAF value for the first reading is equal to that reading's frequency. Subsequent EAF values are calculated by adding the EAF value of the previous reading, the frequency of the previous reading and the frequency of the current reading.

6. Calculate and enter the "plot point" in the plot point row (H). The plot point value is calculated with the formula (EAF/2N) x 100; where N is the sample size.

7. Plot the "plot point" values on the vertical lines above each value on the graph; using the left vertical axis (I); % of the population for the vertical location of each point.

8. After plotting all of the points, connect them all with a straight edge (K), and draw a "best fit" line through the points (L).

9. Draw a vertical line through the graph for the upper and lower specification limits at the

appropriate values (M). (For a unilateral tolerance there will be only one specification line.)

10. Establish the mean, x. This is the value at the intersection of the 50% horizontal grid line and the "best fit" line (N).

11. Establish the standard deviation. Find the value at the intersection of the "3" horizontal line (at the top, right of the graph) and the "best fit" line (O). Subtract this value from the mean (x) and divide by 3 to get the standard deviation.

12. Calculate x + 3 or $\pm$ 5, depending on the requirements. If these values fall within the specification limits (M), the process is considered capable for this characteristic (P).

13. Calculate the other decision criteria:

    a. Cpk Index (Q) - the distance from x to the closest specification limit, divided by 3 times the standard deviation.

    b. Cp Index (R) - tolerance range, divided by 6 times the standard deviation; does not apply to the unilateral tolerances.

    c. % estimated to be out-of-specification (S) - find the value at the intersection of the "best fit" line and the vertical specification limit lines; read the corresponding value for "% out of Spec" on the left vertical axis of the graph.

XXI. Payments and Terms

1. Partial invoicing is to conform to "Partial Invoicing Procedure."

2. No invoice will be paid for any item for which a valid Pontiac Coil, Inc. Purchasing Department purchase order does not exist. No item should be invoiced until the proper purchase order has been received by the vendor.

3. Any changes to design or equipment during design, build and tryout that the vendor contends will result in additional cost to Pontiac Coil, Inc. over and above the purchase order amount must be quoted in writing and approved by the Requisioner prior to their actually taking place.

   It will be the vendor's responsibility to initiate these quotations and any additional charges that are not handled in this matter will not be processed.

   Quotations must be submitted in a timely manner so as to not affect equipment delivery.

4. All terms are considered "NET 60" unless specifically stated otherwise in the purchase order.

5. Partial payment and/or progressive payment schedules will be considered in cases of large capital expenditures or lengthy projects

6. Payments will be made only for value received; down payments or advanced payments which require payment prior to any service being rendered are not

allowed and any exception must be specifically approved and authorized on an individual basis.

7. Payments can be made upon receipt of invoice after a vendor has received a purchase order from Pontiac Coil, Inc. but payments are not issued with a purchase order. Terms stating (and mutually agreed upon) "Payment with Purchase Order" are interpreted as "Payment upon receipt of invoice after issuance of purchase order."

8. All prices from vendors outside the U.S., quoting for delivery into the U.S. are to be in U.S. funds.

9. All purchase orders are to be placed with a cancellation contingency; such that in the event of cancellation, Pontiac Coil, Inc. will reimburse the vendor only for incurred costs converted to selling price.

XXII. Partial Invoicing Procedure

Following is the required form and procedure for invoicing for equipment where partial payments have been authorized on the purchase order and are to be made during machine design, build, test, and final start-up.

(Equipment General Description and Purchase Order Number)

Payment schedules:

25% of total on completion of design

50% of total upon completion of equipment qualification and shipment

25% upon final qualification on Pontiac Coil, Inc.'s floor.

Invoices not adhering to this procedure will be returned to the vendor for correction prior to payment.

XXIII. Appendix

- Buyer's Checklist
- Equipment Data Sheet
- Fast Changeover Guidelines
- Environmental Management Procedure (ENV-115)
- Contractor Right-To Know Compliance Letter

BUYER'S CHECKLIST

Specify all standards for the equipment to the vendor; based on Pontiac Coil, Inc.'s needs, vs. letting the vendor tell you what he intends to provide.

Purchase equipment that is "envelope capable" for Pontiac Coil, Inc.'s range of parts; even if the specific application at hand does not require the entire range; it might in the future.

The "footprint" for all equipment should be minimized to ensure optimum use of floor space.

Loading/unloading automation should be considered for all equipment - from both operating efficiency and ergonomic perspectives.

Obtain multiple quotations to a common proposal request.

Involve all affected functional groups (production, quality, finance, et al) early on in specification and design.

Be sure to consider any ancillary items that will be required; in operation; conveyors, tooling storage cabinets, gage tables, CRT's for PLC equipment, material handling, et al.

"Stack up" all individual parts tolerances to ensure assemblies are manufacturable as designed.

Envision potential burrs, edge conditions, "washouts," and other "non-dimensioned" conditions that may exist on individual parts.

When deciding on the basic control algorithm, remember that the machine should pace the operator, not the other way around.

At equipment runoff, check and document parts prior to runoff; both gaging method and actual results.

Have production gages on hand at runoff.

Have latest revision part prints on hand at runoff.

For equipment tooled for multiple parts, have some quantity of try out parts available for every set of tooling. If all parts are not available, minimum requirement would be to put every tooling set in the machine to ensure the fit and ease of set up.

Ensure all conditions for receiving and installing the equipment at the plant are considered; crane for unloading, ample door size, special foundations, et al.

Ensure new equipment utility requirements (compressed air, electrical power, water, et al) are within existing plant capacity.

Has an equipment data sheet been filled out and returned.

Have all P.M.'s been entered into the computer system.

Has the environmental checklist been completed.

Do regular, interim progress inspections on all long lead items.

These specifications should be used as a guideline for purchasing used equipment as well as for rebuilds of existing equipment.

Have the vendor supply critical replacement parts on a consignment basis during the warranty period.

Has photographic or video tape record of guards/enclosures been made.

Do a Dunn and Bradstreet credit check on vendors being considered for purchase over $50,000.

FAST CHANGEOVER GUIDELINES

GOVERNING PRINCIPAL: To improve changeover time by minutes and even hours...just save seconds. The key is intolerance of any avoidable task, motion or inconvenience that prevents an operation from immediately changing from one job to another.

Guidelines to reduce changeover time follow. They start at the most basic level and continue through progressive levels of accomplishment. The guidelines are summarized first and then expanded individually for greater explanation.

1. Track your actual changeover time and "keep it visible" by posting current status charts. Develop specific changeover plans and responsibilities.

2. Allow no loose nut and bolt attachments.

3. Allow no removable fasteners (screw, bolt, nut, etc.).

4. Eliminate the need to use any hand tool.

5. Assure that all tooling and adjustments are readily accessible.

6. Preserve setups by changing out assemblies vs. individual pieces.

7. Document changeover procedures, machine and tooling layouts and post or attach to each operation for reference.

8. Provide on-machine or near-machine tooling storage wherever change tooling is used. Provide dedicated change tooling material handling (hoists, die charts, etc.) wherever possible.

9. Where a finite number of set-ups or "family type positions are required, use fixed position stops or set up blocks which reference from a defined point.

10. Control tooling movement and use position indicators for infinite position adjustments and motorize longer adjustments.

1. Track your actual changeover time and "keep it visible" by posting current status charts. Develop specific changeover plans and responsibilities.

The only way to understand if you're moving is to know where you started. As with all problem solving, you must define the problem, set an improvement goal and then track your progress. While the "top three" might be easy enough to see and understand, it will take detail to understand the less obvious opportunities. "Without the facts all you've got is an opinion."

Have an organized, written plan for each line/piece of equipment. Assign the responsibility to organize the changeover (have all tooling, gloves, shop towels, etc. available) to one individual. Assign specific duties for each person involved.

Develop and provide each person involved in the changeover an expected time in which their portion of the changeover will be accomplished. Use a large, portable digital "stopwatch" that will be visible to everyone to time changeovers and help instill a sense of urgency. It is a given that the operators themselves should be involved in the development of the actual methods used!

2. Allow no loose nut and bolt attachments.

Trying to fish a nut onto a bolt while holding tooling or guarding in place is one of the worst situations that is encountered. One end or the other must be fixed in place. Possible solutions include a nut welded in place, a tapper plate in place of a nut or a stud in place of a bolt.

The number of different size fasteners should be minimized, keeping to one size only if possible, to require only one (1) tool.

3. Allow no removable fasteners (screw, bolt, nut, etc.)

Once you have one end of the fasteners fixed in place, don't take the fasteners apart. Fasteners that are removed get lost, damaged or dirty. Modify tooling or guarding by slotting out bolt holes or making a "keyhole" that fits over the head of the bolt. Then, merely loosen the fastener and slide the tooling in or out.

Use swing away bolts, toggle clamps, wedge clamps, spring loaded latches, sliding l latches, snaps or anything that will quickly secure the tooling in place.

4. Eliminate the need to use any hand tools.

Separate tools are not only inconvenient, they require extra time to locate, provide another interface to get worn, and rob seconds on every use. Solutions include welding a simple "T" handle to an allen head screw, the use of ratchet handle bolts or any of the latches or clamps referenced above.

If a tool is necessary, locate it in very close proximity to where it is used and attach it very securely to the machine with a chain or a cable. If the adjustment entails more than a partial turn or motion, it should be motorized with an air or electric tool.

5. Assure that all tooling and adjustments are readily accessible.

This is a simple statement but is often the worst source of lost time. A primary concern is machine guarding. It must be very fast access to complement fast change tooling! Guards should be hinged and latched so that they can be swung open or should slide up or slide over to allow tooling to be reached.

Adjustments should be centralized and tooling should be designed to allow change from just one side of a machine, and should only require a single individual to perform the task. If tooling is in a difficult position to reach, steps or platforms should be built into the machine for the operator to use. Just as with "no loose fasteners," there should be no loose stools or ladders, etc..

Many adjustments can easily have remote adjusters built into them. A simple set of sprockets and a chain can place a rotary adjustment in reach; flexible cables can transmit both rotary and push pull motions. Remember that very low adjustment locations can be as difficult as very high ones. (It's best not to design either from the start.)

6. Preserve setups by changing out assemblies vs. individual pieces.

Often, as much time is expended making adjustments after tooling is changed as is spent changing it to start with. The greatest cause of this problem is generally breaking down a tooling assembly to replace one detail vs. changing out the whole assembly. Preserving the setup from run to run not only saves time, it generally saves a great deal of scrap cost. Always work to minimize the total number of pieces that have to be changed. A set of tooling is a one time cost; changeover time continues to add up for the life of the project.

A corollary to this guideline is that setup adjustments should be preset outside the machine and not made during the actual changeover itself.

7. Document changeover procedures, machine and tooling layouts and post or attach to each operation for reference.

Besides the obvious benefit of retaining information for the next shift or the next new operator, the act of documenting procedures tests how well it can be explained and often helps promote further simplification. If others can see how something is presently being done, they can often contribute additional good ideas. It further allows a very quick check to determine what the current status is. Maximize the use of actual pictures or drawings in the instructions. Video taping is an excellent aid, both in before and after documentation.

Documentation is effective only if operators are trained in the developed method. Who will train for a specific operation must be identified and changeover training must be a part of each new operator's orientation. An operator sign off sheet should be posted with each procedure that is signed by the operator, signifying they have read the information and have been trained. Supervisors should be required to regularly audit these sheets to assure that they are current.

8. Provide on-machine or near-machine tooling storage wherever change tooling is used. Provide dedicated change tooling material handling (hoists, die carts, etc.) wherever possible.

While a great deal of the effort of improving changeover is concentrated on the machine and tooling, there is an equal amount of improvement to be found in the planning and preparation for a changeover. One of the keys to this process is to have a specific place to put removed tooling, as well as knowing exactly where the next set of tooling is to be found. Tooling should be located as close as possible to the machine and should have clearly marked storage locations.

Tooling should be easily identifiable as to just what part or family of parts it runs. Tooling numbers should always be marked on individual pieces of tooling; tooling changed out as a set should be color coded as a family.

Time spent looking for material handling equipment during a changeover is still changeover time. General purpose equipment often lacks the ease and simplicity that can be gained with specific design. A built-in jib arm, a fold down roller conveyor, or a small pneumatic hoist can assure the right material handling equipment at the right place.

9. Where a finite number of setups or "family type" positions are required, use fixes position stops or set up blocks which reference from a defined point.

A large number of setup variables fall into a "family" category where many different parts utilize the same setup or where the total number of different parts are very small. In these cases specific setups should be "fixed." Pull pin locating holes can be drilled through the tool and the machine; detents can be designed for the specific locations, or multiple keyways can be used. Specific part setup blocks can be made to set a depth or an offset and attached to the tooling with a chain or a cable. Rotating or sliding blocks with multiple steps can accomplish a similar effect and can be built right into the machine. While a correction may sometimes have to be made in a "fixed" adjustment, at least you art starting with a known position. To maintain consistency, the machine locator is always "zero." Any adjustments which need to be made should be made on the replaceable tooling so that other tooling sets are not affected!

10. Control tooling movement and use position indicators for infinite position adjustments and motorize longer adjustments.

Slotted adjustments for infinite position adjustment are perhaps the most misused of any method in the factory today. Rather than allowing easy changeover, they almost always guarantee a repetitive process of set and adjust (generally with a hammer or weighty tool.) Unless the adjustment is specifically gaged to an actual part or a gage block, or being repositioned to a fixed position stop (per point nine), it should be controlled with a captive jack screw. Jack screws provide not only a controlled motion, but a predictable movement proportional to the thread pitch. While the slotted adjustment offers only the ability to loosen the screw and tap the tooling forward or backward (often loosing the starting point in the process,) the jack screw allows a calibrated repositioning that narrows in on the correct point vs. jumping around it.

Any time the overall motion is relatively long, the adjustment should be motorized or at a minimum geared up to provide speed. Gear jack sets, which have a relatively coarse threaded shaft driven through a high ratio gear drive, are especially appropriate. These adjusters can also be easily synchronized to allow multiple points to be adjusted simultaneously. In cases of more precise adjustments, there should be both coarse and fine adjusters staged together. Micrometer adjusters are readily available for incorporation into tooling. A simple mechanical scale should be attached to the machine, or an electronic readout of the position can be used to enable specific, measurable increments of adjustment. The appropriate setup position would, of course, be noted in the setup procedure!

For both points nine and ten, the goal is to have the tooling capable of being set in one try with a 100% confidence level of being correct and causing no scrap.

Internal Use ONLY!!!!!!

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03-000	KEN GEORGE-2/7/03	2/7/03	C

REFERENCE SHEET-FOR QUOTING PURPOSES ONLY!!

REF. DOC #	RECEIVED/DT	RV.DATE	REV. LEVEL
96-001	J. PETER	2/15/96	IR
96-002	TA SYSTEMS	2/15/96	IR
96-003	ASSEMBLY SYSTEM	2/15/97	IR

96-004			IR
96-005	KEN GEORGE	2/15/97	IR
97-001	Adaptive Tech.-N/A	4/15/97	A
97-002	Tri-Star-N/A	4/15/97	A
97-003	Olivier(Europe)-3/27/98	4/15/97	A
97-004	Automation Tech. Corp.-	4/15/97	A
97-005	Micafil - Axis	4/15/97	A
97-001	Meikle Auto.-8/19/99	7/8/99	B
97-002	Assembly System Inc.	7/8/99	B
99-003	Mark 1 Special Mach.	7/8/99	B
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99-005	Nov. Precision	7/8/99	B
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99-010	Puritan Industries	7/8/99	B
99-011	Flexible Auto	7/8/99	B

03-001	2/7/03	C
03-002	2/7/03	C
03-003	2/7/03	C
03-004	2/7/03	C
03-001	2/7/03	C
03-002	2/7/03	C
03-003	2/7/03	C
03-004	2/7/03	C