

QUALITY ASSURANCE MANUAL

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Ceramco, Inc.
1467 East Main Street
P.O. Box 300
Center Conway, NH 03813
Telephone # (603) 447-2090
Fax # (603) 447-3906



APPROVED BY: _____

DATE: _____

**Thomas Henriksen
President/CEO**

APPROVED BY: _____

DATE: _____

**Susan LeBlanc
Quality Assurance Manager**

REVISION DATE:

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TABLE OF CONTENTS – SECTIONS

SECTIONS	PAGE
1.0 Synopsis	4
2.0 Ceramco, Inc. Organizational Chart	5
3.0 Control of Drawings and PO's	6
4.0 Control of Procurement	8
5.0 Manufacturing Control	9
6.0 Inspection and Test Equipment	11
7.0 Customer Property Control	12
8.0 Nonconforming Material Control	12
9.0 Packaging and Shipping	13
Appendix I	14
Appendix II	15



1.0

SYNOPSIS

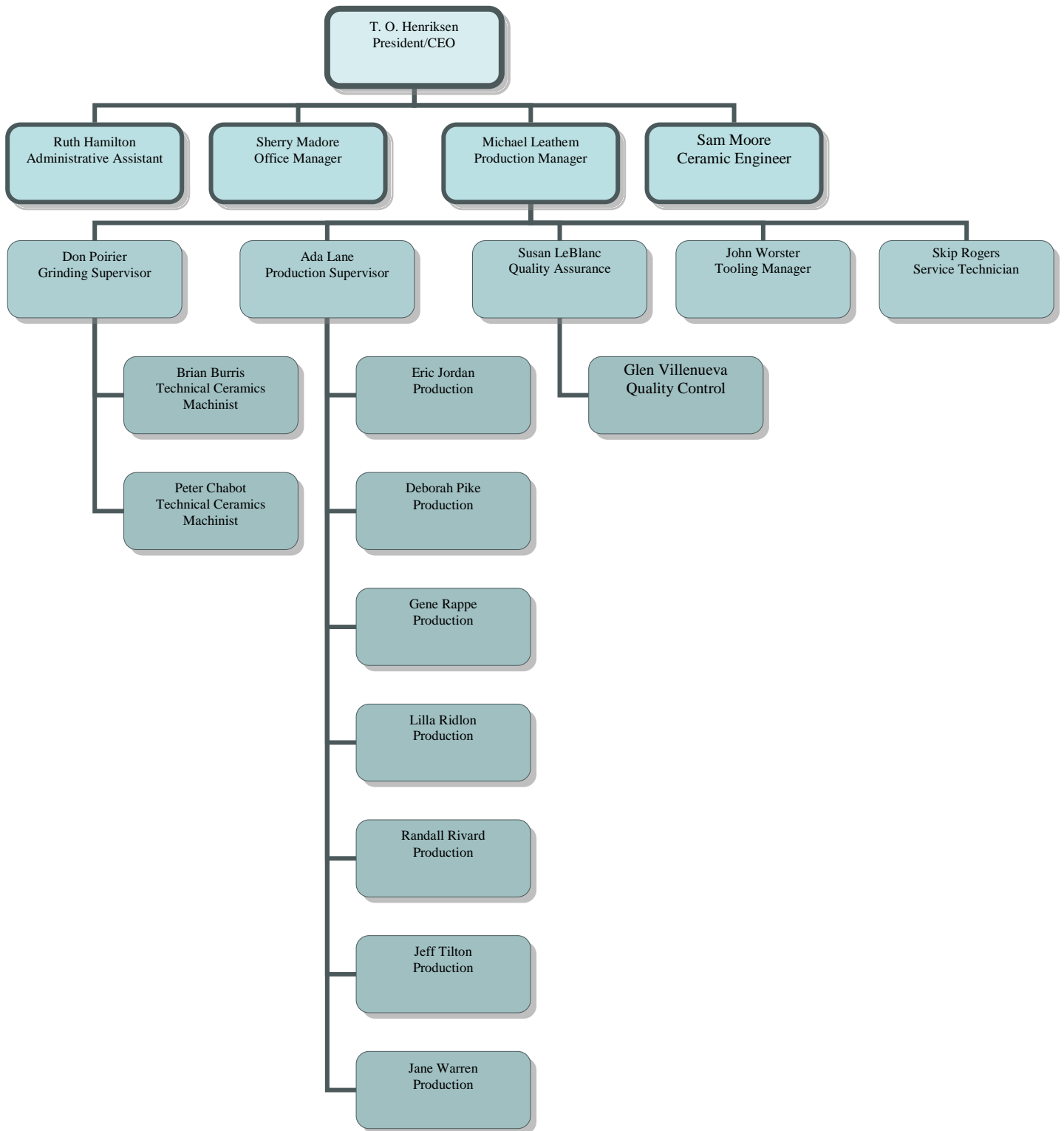
This manual sets forth the Quality Assurance Procedures employed by Ceramco, Inc. to ensure compliance with drawings and specifications as issued by our customers.

The manual is comprised of two elements: One covers the procedures utilized to control the manufacturing process. The other applies to the inspection procedures utilized to examine dimensional conformance to print specifications.

This manual is reviewed and amended periodically.



2.0 CERAMCO, INC. ORGANIZATIONAL CHART





CONTROL OF INCOMING PURCHASE ORDERS, CUSTOMER DRAWINGS/BLEUPRINTS, AND ORDER SPECIFICATIONS

3.0 Scope

This procedure relates to how purchase orders are handled at Ceramco, Inc. There are three modes of receiving a new order for which a procedure is in place.

1. When a new part is ordered (requires new tooling)
2. An existing part has a revision change (may or may not require new tooling)
3. A re-order of a part number and revision for which tooling already exists.

3.1 Procedure

- 3.1.1 A new purchase order is received accompanied by the appropriate drawing(s).
- 3.1.2 The Administrative Assistant in the Main Office is responsible for the distribution of any and all incoming drawings to the appropriate departments for order verification purposes. Before all incoming purchase orders are confirmed, the order quantity, part number, and revision number (if applicable) is cross-referenced with the customer quote.
 - 3.1.2.1 New part numbers or new revisions to existing part numbers are filed with the new blueprint.
 - 3.1.2.2 Re-orders are checked against any pre-existing Revision Number for that product in the customer's file.
- 3.1.3 After a purchase order is confirmed, it is entered in the Order Master computerized database, and an Internal Order form is generated. It is the responsibility of Administration to distribute any and all required documents to the appropriate Departments.
 - 3.1.3.1 The Internal Order, Purchase Order, new or revised drawing(s), and the customer quote are distributed to the Tooling Department in the event the tool has not yet been fabricated or an existing one needs modification.
 - 3.1.3.2 One copy of the Internal Order is always distributed to the Production Manager. A re-order is only accompanied with a copy of the Purchase Order. A new part order is accompanied with copies of the Purchase Order, the quote, and the drawing.
 - 3.1.3.3 When a new part or a new revision on a previously ordered part is ordered and requires grinding operations, a copy of the Internal Order and the customer quote is delivered to the Grinding Department.



- 3.1.4 Upon completion of the tooling, the tool is labeled with the part number, revision, date, and material, then released into production.
- 3.1.5 The Tooling Manager forwards the drawing to Quality Assurance, where the drawing becomes a permanent part of the QA customer files.
 - 3.1.5.1 Customer files are organized alphabetically by company name and then by part number.
 - 3.1.5.2 When a customer confirmed change in a drawing takes place, Quality Assurance will place the new drawing in the appropriate file and stamp the pre-existing drawing "Obsolete".
 - 3.1.5.3 Changes to company names are updated as necessary.



CONTROL OF PROCUREMENT

4.0 Scope

This procedure covers the control of purchase orders for process materials and the control of other materials used in the manufacture of customer product.

4.1 Purchase Orders (Process Materials) Procedure

All purchase orders shall include the following:

- 4.1.1 Purchase order number
- 4.1.2 Vendor name and address
- 4.1.3 Quantity ordered
- 4.1.4 Vendor product ID
- 4.1.5 Material description
- 4.1.6 Any applicable quality or material specification requirements

4.2 Purchase Order Centralization

- 4.2.1 All purchase orders are processed in the main office by the Office Manager.

4.3 Material Control

- 4.3.1 All incoming materials used in the manufacture of contracted product will be inspected to assure compliance with purchase order specifications.

4.4 Tooling Control Procedure

- 4.4.1 Tooling for manufacture of contracted product will be inspected by the Production Manager and Quality Control. Tooling is engraved with the customer name, part number, date of issue, material designation, revision number, and shrink factor.
- 4.4.2 Modifications to tooling will be designated by engraving on the tool, the date of modification and new revision number.
- 4.4.3 Tooling will be shelved alphabetically in clearly marked containers in the tooling storage area.
- 4.4.4 Tooling unused and aged for more than three years may be removed from the tooling storage area.



4.4.5 Obsolete tooling is to be removed from the tooling storage area.

MANUFACTURING CONTROL

5.0 Scope

The Operations Manager in coordination with the Production Supervisor assign work orders to the production workforce. See Appendix I for applicable forms used.

5.1 Process Mix Control Procedure

All raw materials required for customer parts are taken from their designated storage areas and are combined to form the relevant proprietary mix utilizing a "Master Formula" sheet developed and controlled by Mr. Henriksen. Each mix is to be assigned a code identifying the raw material and date of preparation. Any replenishment of a mix will cause the ID code to change. All mix formula components are weighed and documentation of component material weights is attached to each Mix Data sheet.

5.2 Forming Process Control Procedure (Form CI 001)

- 5.2.1 Tooling for manufacture of contracted product will be inspected by Operations and Quality Control. Tooling is engraved with the customer name, part number, date of issue, material designation, revision number, and shrink factor.
- 5.2.2 A searchable database of Injection Reference Numbers is maintained, as well as sequential filing for hard copies after completion of an order.
- 5.2.3 A new injection sheet is issued for each new purchase order or whenever a mix identification changes.
- 5.2.4 The consistency of injected parts is monitored by weighing an assigned percentage of injected parts against a weight standard (where applicable) established by the operator at the outset of the injection run. Parts falling below the established standard are reprocessed. Weight variations are reviewed with the Operations Mgr to determine



appropriate adjustments in the injection settings and or tool configuration.

5.3 Debinding Process Control (Form CI 002)

The debinding process is monitored according to form CI 002. If parts do not meet the weight standard established for them, they are exposed to additional processing.

5.4 Firing Process Control (Form CI 003)

Firings are controlled and monitored using appropriate micro-process controllers using bare noble metal thermocouples. A continuous temperature/time history is recorded for each firing cycle. These recordings are marked with the date and furnace identification. Product flow and identity of product within each furnace is recorded on Form CI 003.

5.5 Intermediate Product Identification

Intermediate product (product that has been partially fired, is being hand worked in a partially fired or fired state, or that has been delivered to the grinding division) is to be identified by an appropriate move ticket.

INSPECTION AND TEST EQUIPMENT CONTROL

6.0 Scope

The inspection of final product from Ceramco, Inc. consists of one or more of the following:

- Inspecting the parts for cracks, voids and other deleterious defects (visual).
- Inspecting the parts for conformance to density requirements.
- Inspecting the parts for dimensional conformance to specifications.

The equipment necessary to achieve this is listed in this control procedure and controlled as stated.

6.1 Methods of Calibration



The methods of calibration as to temperature and weight measurements are listed below. Calibration of dimensional devices follows accepted procedures, a written copy of which is kept on file in the Certification File.

6.1.1 Temperature Measurement/Control Devices

Controllers are calibrated using a certified mV source once a year. Standard mV source is checked against internal standard each time used. If internal standard deviates more than 0.01 mV from calibration setting, it is to be calibrated by certification traceable to National Bureau of Standards. Recorders are compared to certified mV source once a year.

6.1.2 Weights and Scales

Electronic balances are calibrated every 6 months. A class S weight (100g) is certified every 2 years.

6.1.3 Dimensional measuring devices.

- Dial calipers are calibrated every 6 months.
- OD micrometers are calibrated every 6 months.
- Depth gauges are calibrated every 6 months.
- Dial indicators are calibrated every 6 months.
- Plug gauges are calibrated as used.

6.2 Calibration Control

It is the responsibility of the QC Department to do the required calibrations and to maintain the calibration records in a secure file.



CUSTOMER PROPERTY CONTROL

7.0 Scope

This procedure outlines the treatment of customer property assigned to Ceramco, Inc. under contract for which the QA Department has responsibility.

7.1 Procedure

7.1.1 Examination and inspection of customer property upon receipt in accordance with receiving and inspection procedures. These functions shall be consistent with practicability to detect damage in transit and for completeness and proper type.

7.1.2 Perform inspection at periodic intervals to assure adequate storage conditions to preclude damage from deterioration and handling.

7.1.3 Functional testing in accordance with operating instructions as required by applicable contract and/or specifications.

7.1.4 Assure that customer property is properly identified and stored in a segregated area.

NONCONFORMING MATERIAL (MRB AND DMR)

8.0 Scope

It is the function of the Materials Review Board (MRB) to assess the degree of discrepancy in non-conforming product. From this assessment, the MRB is responsible for the disposition of the product. The MRB have different criteria depending on whether the product is resulting from in-house processes or whether it is from outside vendors. This procedure describes the responsibilities of the MRB.

8.1 Composition of the MRB

The MRB shall consist of the Company President, Operations Manager and the Quality Assurance Manager.

8.2 MRB Procedure, Manufacture Process



Faulty injected parts are recycled. Faulty or broken parts from the firing process are discarded. Faulty or broken parts from the grinding process are discarded.

Final fired product will pass thru Q.A. (Form CI005). Those parts which are rejected in Q.A. are discarded or appropriately marked and used for training purposes. Those parts which are approved by Q.A. travel either to the Grinding department accompanied by form CI005 for further process requirements, cleaning station, or to the stocking area. Stocking personnel will not receive parts that do not have an "ok" stamp of approval on the move ticket.

Depending on the results given in the QA report (Form CI 005), the MRB can choose to rework the parts or discard them.

8.3 MRB Procedure, Returned Product

Returned product shall be reviewed by the MRB. A Defective Materials Report (DMR) (FORM CI 006) shall be filed upon receipt. (*See Appendix*) The MRB is to decide the corrective action and is responsible for the final disposition.

PACKAGING AND SHIPPING

9.0 Scope

This procedure covers the preservation, packing and shipping of all products manufactured by Ceramco, Inc.

9.1 Procedure

Quality Assurance shall determine that adequate identification marking have been applied to items including final acceptance inspection verification before items are wrapped, crated or packaged. It shall be the responsibility of the Operations Manager to assure that certification documents in accordance with contractual requirements. Packing and marking will be in accordance with acceptable commercial practice unless otherwise specified in the customer's purchase order.



Appendix I

PROCESS AND QUALITY CONTROL FORMS

The following pages display the forms used in Ceramco's process and quality control system:

Form CI 001	Mix Data Sheet
Form CI 002	Injection Reference Sheet
Form CI 003	Dewax Log
Form CI 004	Firing Log
Form CI 005	Immersion Density Report Form
Form CI 006	Inspection Report
Form CI 007	Discrepant Materials Report
Form CI 008	Acid Bath Log
Form CI 009	New Tooling Traveler Form
Form CI 010	QC to Grind Process Form
Blue Move Ticket	For injected parts
Green Move Ticket	For dewaxed parts
Yellow Move Ticket	For fired parts
White Move Ticket	For parts moving from grinding
Pink Move Ticket	For test bars



Appendix II

METHODS OF CALIBRATION

Purpose

To define the general method of control of quality equipment calibration and maintenance, and to assure accuracy of measurement.

Scope

Applies to all measuring equipment used by Ceramco, Inc., including QC, Tooling and Grinding.

Procedure

1. All quality measuring equipment shall be calibrated using certified standards. All standards will be traceable to the National Bureau of Standards (N.B.S.).
2. The quality calibration and maintenance system will be administered by the Quality Control Manager.
3. This calibration procedure is in compliance with MIL-STD-45662.
4. Quality measuring equipment shall be placed under calibration control at time of purchase. At that time, a 'Calibration Record Sheet' will be generated, which will include the following information:
 - 4.1 Type of equipment
 - 4.2 D.P.I. Number (placed on tool as well)
 - 4.3 Calibration frequency
 - 4.4 Date of last calibration
5. Quality measuring equipment shall have calibration stickers attached to them, which include the following:
 - 5.1 Calibrated by
 - 5.2 Calibration date
 - 5.3 Next calibration due date



Calibration of Dial Calipers

Purpose

To provide for controlled calibration of Ceramco, Inc. dial calipers.

Scope

Applies to all dial calipers used by Ceramco, Inc. including QC, Tooling, and Grinding.

Procedure

4.0 Visual inspection and cleaning

- 1.1 Clean the caliper with mild solvent and a soft brush and allow to air dry.
- 1.2 Visually inspect the caliper for burrs, damage, loose gear rack, bent or damaged jaws, binding or other damage. Adjust or repair as required.
- 1.3 Bring slide and anvil together. Indicator should read zero. The jaws should fit together snugly showing no gaps. Adjust if necessary.

2.0 Calibration

- 2.1 Inspect for jaw parallelism using a .1250" pin at the tip, center and back of the jaws. Deviation must not exceed .001".
- 2.2 Check setting accuracy by taking measurements over gauge block stack combinations of .100", .500", 2.000", 4.000" and 5.900". For calipers with capacities in excess of 6 inches, check at every even inch greater than six. All measurements must be within .001".
- 2.3 Using gauge blocks, check the depth indication at 1.000". The measurement must be within .002".
- 2.4 With the inside jaw feature, measure the inside diameter of two (2) certified ring gauges. Accuracy must be within .002".

3.0 Records

- 3.1 Fill out all records of calibration using Calibration Record Sheet.



Calibration of Dial Indicators

Purpose

To define a procedure for the controlled calibration of Ceramco, Inc. dial indicators.

Scope

Applies to all dial indicators used by Ceramco, Inc. including QC, Tooling and Grinding.

Procedure

1.0 Visual inspection and cleaning

1.1 Clean the indicator thoroughly with a mild solvent and a soft cloth. Use solvent sparingly so that migration into the working mechanism of the indicator is avoided.

1.2 Check the indicator for obvious damage and to ensure free movement of the mechanism.

1.3 Apply light oil, Starrett M1 type tool oil, or an equivalent.

2.0 Mechanical inspection

2.1 Inspect for repeatability

2.2 Mount the indicator on a test base and place on a surface plate.

2.3 Bring a .100" gauge block on the surface plate under the indicator. Zero the indicator and lock in place.

2.4 Slide the gauge block in and out under the indicator five (5) times. Each reading must repeat to within one-half dial division.

3.0 Inspect for accuracy

3.1 Zero the indicator on the .100" gauge block and secure in place.



- 3.2 Increase the size of the gauge block in increments equivalent to one-quarter of the dial revolution for a full revolution. Each reading must be within one dial division.
- 3.3 Check one point per revolution for the balance of the full range of the indicator.

4.0 Records

- 4.1 Fill out all records of calibration using Calibration Record Sheet.



Calibration of Outside Micrometers

Purpose

To define the procedure for controlled calibration of outside micrometers. (Includes Anvil Micrometers and Blade Micrometers).

Scope

Applies to all outside micrometers used by Ceramco, Inc. including QC, Tooling and Grinding.

Procedure

1.0 Visual examination and cleaning

- 1.1 Disassemble the micrometer and clean components with a mild solvent and soft brush and air dry. Examine the interior for chips, rust or other debris.
- 1.2 Reassemble, using a few drops of Starret M1 tool oil or equivalent light oil.
- 1.3 Examine the micrometer for bent spindle, damaged faces, illegible graduations, damaged threads, burrs or other apparent problems.
- 1.4 Check spindle for end play. If end play exist, tighten the adjusting nut until it has been removed and micrometer action is free moving over the entire length of travel.
- 1.5 Check that the use of the spindle locking nut does not alter the distance between measuring surfaces by more than .001".

2.0 Calibration

- 2.1 Check the micrometer accuracy by measuring over gauge blocks or precision balls at .100", .108", .120", .500", and .900". Check at every half inch thereafter for the full range of the micrometer. Accuracy must be within .0001" from 0-1", .00015" from 1-3", .0002" from 3-6" and .0005 from 6-12".

3.0 Records

- 3.1 Fill out all records of calibration using Calibration Record Sheet.



Calibration of Depth Micrometers

Purpose

To define a procedure for the controlled calibration of depth micrometer.

Scope

Applies to all depth micrometers used by Ceramco, Inc. including QC, Tooling and Grinding.

Procedure

1.0 Visual inspection and cleaning.

- 1.1 Wipe all outside surfaces clean with a soft cloth dampened with a mild solvent.
- 1.2 Examine the micrometer for damage, bending, illegible graduations, burrs or obvious wear.
- 1.3 Observe the rod(s) straightness by rolling over a surface plate with back lighting and look for gaps.
- 1.4 Disassemble the micrometer and clean with a mild solvent and a soft brush.
- 1.5 Reassemble, using a few drops of Starret M1 tool oil (or equivalent light oil).
- 1.6 Check for excessive play of the thimble in lead screw axis. Tighten adjusting nut until play is eliminated and the spindle runs free.

2.0 Calibration

- 2.1 Check micrometer by measuring gauge blocks on a surface plate at .100", .108", .120" and .500". Check at every half inch interval thereafter for the full range of the micrometer spindle and at least one depth with each rod. Accuracy must be with .0005".
- 2.2 Using a .015 gauge block, check that the locking nut does not alter the reading in excess of .002".

3.0 Records



3.1 Fill out all records of calibration using Calibration Record Sheet.



Calibration of Inside Micrometers

Purpose

To provide for controlled calibration of Ceramco, Inc. inside micrometer (Intrimik).

Scope

Applies to all inside micrometers used by Ceramco, Inc.

Procedure

1.0 Visual inspection and cleaning

- 1.1 Clean the Intrimik using a soft cloth dampened with a mild solvent.
- 1.2 Visually inspect the Intrimik for damage, burrs, illegible graduations or other apparent problems.
- 1.3 Disassemble the Intrimik completely, soaking all parts in a mild solvent, and using a soft brush to clean. Allow to air dry.
- 1.4 Reassemble the Intrimik, spraying all parts with Starret M1 tool oil (or equivalent light oil).
- 1.5 Check to see if the three contact pads move in and out freely as the dial is turned. If the pads stick out, apply light oil and free up movement.

2.0 Calibration

- 2.1 Each Intrimik has two (2) ring gauges for calibration. Each ring gauge is certified by the National Bureau of Standards (N.B.S.). Put Intrimik in ring gauge and snug it up, reading shall be within .0001".
- 2.2 Adjustment is easily made by loosening Allen screw and adjusting graduation ring. This will bring Intrimik in to .0001".

3.0 Records

- 3.1 Fill out all records of calibration using Calibration Record Sheet.



Calibration of Pitch Micrometers

Purpose

To define the procedure for controlled calibration of pitch micrometers.

Scope

Applies to all pitch micrometers used by Ceramco, Inc.

Procedure

1.0 Visual examination and cleaning

- 1.1 Wipe all outside surfaces clean with a soft cloth dampened with a mild solvent.
- 1.2 Examine the micrometer for damage, illegible graduations or obvious wear.
- 1.3 Disassemble micrometer and clean with a mild solvent and a soft brush, allow to air dry.
- 1.4 Reassemble, using a few drops of Starret M1 tool oil (or equivalent light oil).
- 1.5 Check for excessive play of the thimble in lead screw axis. Tighten adjusting nut until play is eliminated.

2.0 Calibration

- 2.1 Check that the micrometer zero's out properly.
- 2.2 Starret screw thread comparitor; make sure both conical points touch at the zero mark. Adjust with spanner wrench.
- 2.3 Mitutoyo screw thread micrometer; make sure the conical spindle seats into V anvil at the zero mark. Adjust using knurled knob located on the anvil side of the frame.
- 2.4 Check the micrometer by measuring certified thread gauges, at .1697", .1736", .2175", and .2224". Accuracy must be with .0005".

3. Records



3.1 Fill out all records of calibration using Record Sheet.



Calibration of Height Master

Purpose

To provide for controlled calibration of Ceramco, Inc. height masters.

Scope

Applies to all height masters used in Ceramco, Inc.

Procedure

1.0 Visual inspection and cleaning

- 1.1 Clean height master used mild solvent and a soft brush.
- 1.2 Visually inspect all reference blocks for damage, burrs, rust or foreign material.
- 1.3 Disassemble height master by removing speed dial and unscrewing reference block spindle.
- 1.4 Clean components by using a mild solvent and a soft brush. Use a stiffer brush on the cast iron frame. Allow to air dry.
- 1.5 Apply light oil (Starret M1) generously to both the cast iron frame and reference block spindle. Reassemble the height master with the speed dial Allen screw barely snug.

2.0 Calibration

- 2.1 Using a vernier height gauge with a .0001" dial indicator and certified gauge blocks, calibrate height master. Check the height master for accuracy by zeroing out dial indicator on gauge blocks and then zeroing out indicator by using the micrometer adjustment on the height master. Height master adjustment is made by loosening Allen screw on speed dial and reset accordingly. Gauge blocks to be used are 1.000", 1.103", 2.000", 3.000", 4.000", 5.000", 5.108" and 6.000". Accuracy must be within .0002".

3.0 Records

- 3.1 Fill out all records of calibration using Calibration Record Sheet.



Calibration of Vernier Height Gauge

Purpose

To provide for controlled calibration of Ceramco, Inc. vernier height gauges.

Scope

Applies to all vernier height gauges used in Ceramco, Inc.

Procedure

1.0 Visual inspection and cleaning

- 1.1 Clean height gauge with a soft cloth dampened with solvent.
- 1.2 Visually inspect height gauge for damage, bent main scale, illegible graduations and binding. Check base and make sure it is perpendicular with surface plate.
- 1.3 Disassemble height gauge putting slider with scribe into solvent. Clean beam with brush and mild solvent, including base.
- 1.4 Apply light oil (Starret M1) generously to both components and reassemble.

2.0 Calibration

- 2.1 With hardened offset scriber firmly in marker clamp, calibration can begin.
- 2.2 Take certified gauge blocks and rest the scriber on to the tops of the blocks. Use the 1.000", 2.000", 3.000" and 4.000" blocks (as 99% of the time this height gauge will be used with a dial indicator).

3.0 Records

- 3.1 Fill out all recordings on Calibration Record Sheet.



Calibration of Weight Measurement Scales

Purpose

To provide for controlled calibration of Ceramco, Inc. weight measurement scales.

Scope

Applies to all scales used by Ceramco, Inc.

Procedure

1.0 Visual inspection and cleaning

1.1 Clean scale with a soft cloth and a mild detergent.

1.2 Visually inspect scale for any damage. Check electric cord. Make sure wire is not exposed.

2.0 Calibration

A&D Company Model FX-300 scales (Bench model).

2.1 Level the scale using the bubble gauge.

2.2 Allow scale to warm up for 30 minutes.

2.3 Slide the rear calibration switch up. (Display must be on)

2.4 "CAL O" will be displayed, press RE-ZERO

2.5 After a pause, "CALF" will be displayed, place a certified 200 gram weight on the pan.

2.6 Press RE-ZERO and after a pause, "CALEND" will be displayed.

2.7 Slide the rear calibration switch down, calibration is over.

2.8 Affix calibration sticker.



SETRA Platform Scale

- 2.2.1 Press "-" key.
- 2.2.2 Press "CLEAR" key
- 2.2.3 Remove all objects from the pan.
- 2.2.4 Press the "0" key.
- 2.2.5 Press the "CONV" key until the scale reads in units of grams.
- 2.2.6 Place the 200 gram weight on the pan.
- 2.2.7 Enter "200".
- 2.2.8 Press the "SETUP/CAL" key.
- 2.2.9 Calibration is complete. Affix calibration sticker.

Allied Model 7303DA Bench Top Scale

- 2.3.1 Place certified 100 gram weight on scale.
- 2.3.2 Press "AUTOCAL".
- 2.3.3 Calibration is complete.
- 2.3.4 Affix calibration sticker.

OHAUS Model Galaxy 120 Bench Top Scale

- 2.4.1 Allow scale to warm up for 30 minutes.
- 2.4.2 Press and hold the ON/Re-Zero Switch. Release the switch as soon as CAL is displayed.
- 2.4.3 After CAL is displayed, release the ON/Re-Zero switch.
- 2.4.4 The display will show CO (indicating that no weight should be on the platform).
- 2.4.5 Momentarily press the ON/Re-Zero switch.



2.4.6 The balance will then display 100g.

2.4.7 Place the certified 100g calibration weight on the center of the pan and press the ON/Re-Zero switch.

2.4.8 Wait until the balance displays the indicated calibration weight (100g).

2.4.9 The scale is now calibrated. Affix calibration sticker.

3. Records

3.1 Fill out a Calibration Record Sheet for every scale calibration.



Calibration of LFE Controllers (For Furnaces)

Purpose

To provide for controlled calibration of Ceramco, Inc. furnace controllers.

Scope

Applies to all furnaces using LFE controllers at Ceramco, Inc.

Procedure

- 1.0 Obtain necessary instruments for calibration.
 - 1.1 OMEGA millivolt source.
 - 1.2 Ice/water bath.
 - 1.3 50 mV/ice bath switcher.
 - 1.4 Regular screwdriver.
- 2.0 Equipment set-up
 - 2.1 Place millivolt source on mobile cart and plug unit into 120V source.
 - 2.2 Plug in 50 mV/ice bath switcher into "Output" of millivolt source.
 - 2.2.1 Red wire is "-", Black is "+"
 - 2.3 Set millivolt source to mV output.
 - 2.4 Stabilize output at 50,000 mV.
 - 2.5 Place ice/water bath next to switcher.
 - 2.6 Put "I" type T/C from switcher into center of ice bath.
- 3.0 Calibration
 - 3.1 Wheel mobile cart to first furnace.
 - 3.2 On the back of LFE controller disconnect the "+" leg of T/C.



- 3.3 From 50 mV/ice bath switcher hook clips to the LFE T/C inputs.
- 3.4 Red to "-" (screw marked "F")
- 3.5 Black to "+" (screw marked "H")
- 3.6 Switch mV/ice switcher to 50 mV source.
- 3.7 Turn furnace on.
- 3.8 Part number must be changed (ref. OEM calibration manual).
- 3.9 On face of LFE controller press the PARAM-TUNE-LAST buttons simultaneously.
- 3.10 This display will appear:
PN XX XX
T/C XX XX XX
- 3.11 To change part number press AUTO-LAST simultaneously.
- 3.12 Press the PARAM button until the T/C type units blink.
- 3.13 The T/C type (typically 02 for R or 03 for S) must be changed to 00 for I.
- 3.14 After 00 is shown press the PARAM button until HI SPAN is displayed.
- 3.8 Calibration loop can now be entered.
 - 3.8.1 With the above displayed press AUTO/START simultaneously.
 - 3.8.2 This display will be shown: INPUT 50.000 MV
 - 3.8.3 Allow millivolt source to stabilize for 30 seconds than press PARAM.
 - 3.8.4 This display will be shown: J T/C IN ICE BATH.
 - 3.8.5 Switch mV/Ice switcher to Ice/Water Bath.
 - 3.8.6 Allow 20-30 seconds for stabilization and press PARAM.
 - 3.8.7 After a brief "Please Wait" the display will show CAL COMPLETE
 - 3.8.8 Press the RETURN key (this saves the calibration).



3.8.9 Make sure the display reads 0° C.

4.0 Getting back to operation.

4.1 The part number must be changed back to what it was before calibration.

4.2 Follow steps outlined in 3.9 - 3.13.

4.3 After part number is changed (back to 02 or 03) press PARAM button until HI SPAN is displayed. This value must be increased from 766°C to 1550°C.

4.4 Once HI SPAN reads 1550°C press PARAM button.

4.5 The CAL-Complete will read again press RETURN to save data.

4.6 Turn furnace off.

4.7 Disconnect leads from switcher and re-connect "+" leg of T/C.

4.8 Turn furnace ON.

4.9 Make sure temperature stabilizes check w/water temp.

4.10 Apply calibration sticker.

4.11 Calibration is complete.

5.0 Records

5.1 The calibration sticker is the record.

5.2 Calibration is done annually.