T C I ORIGINAL IF GREEN	**QUALITY ISSUE FORM** QI # 022	Document # TCF.14.01 / Revision Date 09/05/03 / Page 1 of 2

SECTION I – INITIATION OF QI

DATE 11.30.04 INITIATED BY NSF - FINDING #JH2

DESCRIPTION OF (CHECK ONE) ✓ **ACTUAL NONCONFORMANCE** ____ **POTENTIAL NONCONFORMANCE** ____ **IMPROVEMENT OPPORTUNITY** ____ **MGT REV ACTION ITEM**

NO OBJECTIVE EVIDENCE THAT THE VALIDITY OF PREVIOUS MEASURING RESULTS WERE ASSESSED WHEN EQUIPMENT WAS OUT OF CALIBRATION - SEE ATTACHED CERT MR-1.

IS CONTAINMENT AND/OR INTERIM ACTION REQUIRED? (APPLIES TO NONCONFORMING PRODUCT ONLY)

✓ NO EXPLAIN: NO DANGER OF N/C PRODUCT - TEAR DOWN MIC'S

____ YES DESCRIBE: ____

**********INITIATOR – FILL OUT THIS SECTION ONLY – DO NOT WRITE BELOW THIS LINE**********

SECTION II – ASSIGN NUMBER AND LOG REQUEST

Cari J Spears — MANAGEMENT REPRESENTATIVE SIGNATURE — 12.1.04 DATE

SECTION III – QI ASSIGNED TO

Cari Spears / Joe Bunker — MANAGEMENT / AUDITEE ACKNOWLEDGEMENT

SECTION IV – RESOLUTION OF QI

DEFINE AND VERIFY ROOT CAUSE(S)

NOT ADDRESSED IN PROCEDURE, NOT INCLUDED IN TRAINING.

CHOOSE AND VERIFY PERMANENT ACTION(S)

1.) CHANGE PROCEDURE TO INCLUDE REQUIREMENT TO NOTIFY QA MGR - ALSO ON CERT FORMS. 2.) CHANGE PROCEDURE TO SPECIFY RECORD OF ASSESSMENT RESULTS. 3.) CONDUCT TRAINING W/ CAL. TECH.

IMPLEMENT PERMANENT ACTION(S)

IMPLEMENTED ACTIONS	RESPONSIBLE	(30 DAYS MAX) TIMETABLE
REVISE TCP.11.01 & CERT FORMS	C. SPEARS	ASAP
CONDUCT TRNG.	C. SPEARS	ASAP

SECTION V – FOLLOW-UP ACTIVITIES

DOCUMENT CHANGE CHECKLIST COMPLETED? ✓ YES – SEE ATTACHED ____ N/A

PLANT MGR / MGT REP APPROVAL: [signature] DATE: 12.13.04

FOLLOW-UP REQ'D ✓ YES ____ NO RESULTS: INCREASE IA FREQ TO 2X/YR - REQ QA MGR APPROVAL OF CERTS U.F.N. Keep

DATE CLOSED: 5.23.05 MGT REP APPROVAL: Cari Spears

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SECTION VI – DOCUMENT CHANGE CHECKLIST

DOCUMENT TITLE / NUMBER / REV. DATE: TCP.11.01 – CONTROL & CALIBRATION OF INSPECTION & MEASURING EQUIPMENT REV 6/30/02.

REVISE DOCUMENT	**CHECK ONE:**	**DONE**	**N/A**
CHANGE REVISION DATE		✓	
REVISION RECORD (SECTION 6.0) REV. 12/13/04		✓	

CHECK REFERENCE DOCUMENTS AND REVISE	✓	
POLICIES:		✓
PROCEDURES:		✓
WORK INSTRUCTIONS: 3rd Cal Certs –	✓	
FORMS: TCP.11.01 THRU .06	✓	

PRINT NECESSARY COPIES	✓	
PROCURE PREPARER AND APPROVAL SIGNATURES	✓	

UPDATE MASTER DOC LIST	✓	
UPDATE INTERNAL AUDIT SCHEDULE	✓	
UPDATE QUALITY RECORDS MATRIX		✓

REMOVE PREVIOUS REVISION OF ALL DOCUMENTS	✓	
INSERT REVISED DOCUMENTS	✓	
RETAIN ONE COPY IDENTIFIED "OBSOLETE – HISTORICAL REFERENCE"		✓
DESTROY ALL OTHER COPIES OF OBSOLET DOCUMENTS	✓	

CONDUCT TRAINING IN REVISED DOCUMENTS	✓	
RETAIN EVIDENCE OF TRAINING WITH ORIGINAL CAR FORM	✓	

Lou Spears
DOCUMENT ADMINISTRATOR / MGT REP SIGNATURE

12.13.04
DATE COMPLETED

TRAINING RECORD NSF#JH2 12.13.04

T C I ORIGINAL IF GREEN	STANDARD OPERATING PROCEDURE CONTROL AND CALIBRATION OF INSPECTION AND MEASURING EQUIPMENT	Document # TCP.11.01 Revision Date 12/13/04 Page 1 of 5
Prepared by:	- Joe Burnham – Calibration Technician	
	- Cari Spears – QA Manager	
Approved by:	- Mike Sharon – Plant Manager	

1.0 PURPOSE AND SCOPE

1.1 To make certain that inspection, measuring and test equipment is capable of consistently providing specified measurement requirements, so that proper decisions can be made for control and acceptance of product.

1.2 To ensure that measurement uncertainty is known and consistent with required capability.

1.3 In-house calibration activities are limited to dimensional inspection and measurement devices.

2.0 DEFINITIONS

2.1 NIST: National Institute of Standards and Technology.

2.2 Calibration: A set of operations which compare values taken from a gage or piece of inspection, measuring or test equipment to a known standard under specified conditions.

2.3 Measurement Uncertainty: Identified uncertainties in the measurement process attributable to measuring equipment and contributed to by personnel, procedures and environment.

2.4 Ten to One Rule: The discrimination of the measuring instrument or standard should divide the tolerance into ten parts.

3.0 PROCEDURE

3.1 CALIBRATION SCOPE

3.1.1 List of measuring equipment calibrated in-house:

A. Height Gages
B. Test Indicators
C. Dial Indicators
D. Calipers
E. Outside Micrometers
F. Depth Micrometers

3.1.2 Employee owned measuring instruments identified as "NOT IN CALIBRATION SYSTEM" must be used for rough-in dimensions only. No product shall be verified or approved using measuring equipment that is not included in TCI's calibration program.

3.1.3 Commercial laboratory / calibration facilities contracted for calibration and repair of TCI measuring equipment must be accredited.

3.2 CALIBRATION PERSONNEL

3.2.1 The QA Manager is responsible for verifying the qualifications of personnel performing calibration activities, and for providing training as required. Calibration personnel are trained in TCI practices for the care and maintenance of calibration equipment and general calibration practices outlined in this procedure; as well as specific instructions for calibrating the measuring instruments listed in 3.1.1 above.

3.3 CALIBRATION FREQUENCY / SCHEDULE

3.3.1 Calibration frequencies are established by the QA Manager and the calibration technician; determined by usage, calibration history, customer requirements, consulting with the user, and evaluating the environment in which the instrument is used. The calibration schedule is maintained in the Inspection Room computer as well as a hardcopy binder.

3.7 GENERAL CALIBRATION INSTRUCTIONS

3.7.1 ENVIRONMENT

A. Calibration activities are performed in the inspection room. It is recommended that a clean, lint-free cloth, tissue or chamois be placed on the bench or workspace.
B. Calibration activities should be performed at a time when the technician is unlikely to be interrupted.
C. If an instrument has recently been brought from a different area, it must be given ample time to normalize.

3.7.2 WRINGING GAGE BLOCKS

A. The first step is to clean the blocks as described in 3.6 above.
B. Be sure that one block is not slightly tilted. If so, its edge may shave, wear or roughen the precisely flat, polished end surface of the mating block.
C. Do not use unnecessary pressure to wring them together. Too much pressure makes it harder to separate the blocks and also sets up unnecessary wear.
D. One pass is not always sufficient to start the wring. In that case, move back from "C" to "B", but not all the way off, and begin again. The wringing action has begun when resistance is felt. Continue until further movement does not increase adhesion.
E. DO NOT swipe the mating surface over the palm, wrist or nose to aid in wringing. Sweat and other acid-based emanations from the skin are always present and begin a chemical reaction that starts the process of contamination and corrosion. As blocks wear they become more difficult to wring unless an oil film is furnished. It is permissible to apply a SMALL amount of oil, providing that it is noncorrosive and does not carry dirt or dust particles onto the blocks as "palm oil" will.

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3.4 UNIQUE IDENTIFICATION

3.4.1 Inspection and measuring equipment is identified with a gage number traceable to calibration records. The gage number is noted on the calibration sticker, and may also be scribed or painted on the instrument itself.

3.4.2 When measuring equipment is lost, ordered out of commission, or replaced by a facsimile, that number shall not be reassigned to any other gage. The latter will be given another number. Records of obsolete gages are retained for traceability and surveillance.

3.5 TRACEABILITY

3.5.1 Each calibration rests upon the calibration of a higher instrument or standard, until the international standard is reached. The "Ten to One" rule applies in the event that one instrument is used to calibrate another instrument or gage. It must be an instrument designated for the inspection room only and show a past history of reliability.

3.5.2 Hand held measuring instruments and height gages are generally calibrated against the master gage block sets designated for inspection room use only. The master blocks are in turn calibrated by an outside laboratory that certifies calibration against measurement standards traceable to national or international measurement standards.

3.6 CARE AND MAINTENANCE OF CALIBRATION EQUIPMENT

3.6.1 GAGE BLOCKS

A. Before use, clean blocks with a high-grade solvent or commercial gage block cleaner. Quickly wipe dry with a lint-free tissue. Do not soak gage blocks in solvent, keep aerosol sprays to a minimum, and do not use compressed air to remove excess solvent.
B. Lay a clean, lint-free tissue or chamois between the gage block case and the work to ensure a clean location on which to set the gage blocks after they have been selected.
C. Handle blocks separately and by their sides. Never pick them up by their polished ends or combine them in one hand.
D. Examine the polished ends for scratches, worn spots, corrosion and nicks on the edges. Do not attempt to wring blocks with scratches or nicks; a scratch displaces material, causing scratching on the surface of a mating block and will affect the measurement.
E. Consult with the QA Manager on the use of conditioning stones.
F. Do not allow blocks to remain wrung together for long periods. Two finely finished metal surfaces left in close contact will speed up the chemistry of corrosion and add a special pitting effect of its own; the more nearly perfect the surface, the greater the chance for damage from extended contact.
G. When separating blocks, do not snap them apart. Instead, move them in opposite directions in a circular motion.
H. Clean and place blocks in their case after use. Thoroughly clean the case periodically.

3.6.2 SURFACE PLATES

A. Use an appropriate surface plate cleaner, following the directions on the product.
B. Do not allow surface plates to become littered with tools, workpieces, rags, etc. Use slow, careful motions in setting apparatus on the surface plate.
C. Surface plates should be checked at least every few months for wear or hollows formed in areas regularly used.

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3.7.3 COMBINING GAGE BLOCKS

A. To save time and reduce the chance of error, use the least number of blocks to make up a given dimension.
B. The best method of selecting blocks is to successively eliminate the right-hand figure of the desired dimension.

3.7.4 THE GAGE

A. Visually inspect the gage and note its condition in the calibration entry.
   - Clean the gage to eliminate the variable of dirt. Remove any rust or corrosion. NEVER use compressed air to clean any precision instrument. The high velocity forces abrasive particles into the mechanism as well as away from it.
   - Examine the contact surfaces carefully for nicks, pits, scratches, burrs, etc. Hunt for cracks and weak spots in gage frames and bases.
   - Try the gage: its anvils, accessories, clamping devices and such for tightness and proper freedom of movement. Any part that will move or deflect when it shouldn't is a source of variation or error.
B. Test for flatness and parallelism of the measuring surfaces. Although there are several methods that can be applied, a ball provides a convenient means of checking flatness and parallelism of the contact surfaces. The ball explores the surfaces as the gage is opened and closed on it. Take great care to apply uniform gaging force each time.

3.7.5 THE READINGS

A. Zero-setting error is common to both the linearity and topical check and thus should be checked first. Next, take a reading at nearly the extreme range of the instrument.
B. Instrument specific calibration instructions detailed on the gage certification forms clearly establish the reading increments and the acceptance criteria.
C. Record any out of specification readings as received for calibration. Record any necessary adjustments, then begin again and record the readings after adjustments.

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D. Out of specification readings as received for calibration must be reported to the QA Manager for review. The QA Manager investigates the validity of previous measuring results and records actions taken on the calibration certificate.

3.7.6 COMMON ERRORS

A. Parallax is the apparent shifting of an object caused by the change of position of the observer. Reading a scale or dial at an angle will make the reading seem to be higher or lower than it actually is. In order to avoid the observational error, align the head so that the line of sight is perpendicular to the scale being read.
B. Many manipulative errors can be avoided.
   - A gage checker must use his geometry instinctively. He must be careful not to tip or cant a gage or the gage blocks. The conceptions of parallel, perpendicular and flat must be clear to him.
   - Gaging force must not distort the measurement. The lighter the "feel", the more reliable the measurement. A gage checker must make certain of never springing or deflecting the equipment he is testing by the use of excess gaging force.
C. We unconsciously influence every measurement we make. In order to avoid bias errors, calibrations should not be performed by the owner or user of the gage.

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3.7.7 CALIBRATION STATUS

A. If calibration results are acceptable, note "PASS" results on the calibration records. Affix to the gage a calibration sticker denoting the gage number, the date calibrated, the next calibration due date, and the gage checkers initials.

B. If calibration results are unacceptable, note "FAIL" results on the calibration records. Affix to the gage a red reject tag denoting "Out of Calibration" with an explanation of the out of tolerance condition.

- The gage checker may be able to do some repairs, however, if extensive or sensitive repairs are required, it should be sent to an accredited laboratory or the manufacturer for repair. The gage is recalibrated upon return.
- If the gage is irreparable it is to be noted in the gage records and removed from the building or quarantined to avoid use, accidental or intended.

3.8 CALIBRATION RECORDS

3.8.1 Calibration results are maintained in binders by the calibration technician in the inspection room. These binders denote "employee owned" and "company owned".

4.0 REFERENCE DOCUMENTS

4.1 TCF.11.01 – Height Gage Certification Form
4.2 TCF.11.02 – Test Indicator Certification Form
4.3 TCF.11.03 – Dial Indicator Certification Form
4.4 TCF.11.04 – Caliper Certification Form
4.5 TCF.11.05 – Outside Micrometer Certification Form
4.6 TCF.11.06 – Depth Micrometer Certification Form

5.0 SAFETY AND ENVIRONMENTAL ISSUES

5.1 Calibrations should be performed in an area free from dirt, chips, grease and oil, as well as any airborne contaminants.

5.2 Calibrations should be done in a location where there is, as nearly as possible, complete freedom from vibration, noise and loud talk.

5.3 68 F has been selected by NIST as the temperature at which any linear measurement will be considered correct. To be practical, the room temperature can deviate from 68 F (within reason) as long as the calibration activity is carried out in an area free from drafts where the temperature can stay in equilibrium for long periods of time.

6.0 REVISION RECORD

Description of Change	*Date*
Original Issue	04-12-98
Added sect. 4.4 – employee owned gage identification.	08-18-00
Completely rewritten. See Document Administrator for historical reference.	06-30-02
Added 3.7.5.D (also added statement to all Calibration Certificates) – see NSF finding #JH2	12-13-04

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TC ORIGINAL IF GREEN	CALIBRATION CERTIFICATION HEIGHT GAGE ID # _____	Doc #: TCF.11.01 / Rev Date: 12/13/04 / Page 1 of 1

RANGE: _____ **RESOLUTION:** _____ **LOCATION:** _____

CAL. FREQ. : _____ **DATE LAST CAL. :** _____ **OWNER:** _____

PRELIMINARY OPERATIONS:

- Clean the surface plate and inspect for flatness and damage.
- Clean the height gage.
- Inspect for damage paying particular attention to the bottom surface of the base.
- Inspect the column for looseness and for perpendicularity to the base.
- Move the arm completely through its range of travel to verify freedom of movement and excessive arm free play. Ensure that the fine adjustment mechanism operates smoothly.
- Verify parallelism of measuring plane of the arm to the reference plane (surface plate).
- Allow height gage, surface plate and gage blocks to normalize.
- Zero the height gage.

CALIBRATION TECHNICIAN OBSERVATIONS AS RECEIVED:

_____

_____

MASTER GAGE BLOCK SET #_____ **INDICATOR USED #**_____

ALLOWABLE DEVIATION FROM NOMINAL +/- _____

READINGS (% OF RANGE)	GAGE BLOCK (S) USED	READING AS RECEIVED	ADJUSTMENT NEEDED? *Y OR N	READING AFTER ADJUSTMENT	PASS / FAIL
ZERO					
20%					
40%					
60%					
80%					
EXTREME					

FINDINGS:

LIMIT USE? _____ EXPLAIN:

***NOTIFY QA MANAGER OF OUT OF SPECIFICATION READINGS AS RECEIVED**

CALIBRATED BY: _____ **DATE:** _____ 12.13.04

APPROVED BY: _____ **DATE:** _____

NEXT CALIBRATION DUE: _____

all forms have this statement

TCF.11.01 THRU .06

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TC ORIGINAL IF GREEN	CALIBRATION CERTIFICATION MICROMETER ID # MR-1	Doc #: TCF.11.05 / Rev Date: 6-30-02 / Page 1 of 1

RANGE: 0-1" RESOLUTION: .0001 LOCATION: 84

CAL. FREQ.: 1YR DATE LAST CAL.: 7-7-03 OWNER: MARK RABOLD

PRELIMINARY OPERATIONS:

- Clean the micrometer.
- Inspect for damage. Check the contact surfaces for wear, nicks, scratches and corrosion.
- Inspect the graduations for good contrast.
- Slowly rotate the micrometer thimble to verify that it operates smoothly through its entire range and to ensure that there is not excessive freeplay.
- Verify parallelism and flatness of the measuring planes with a ball bearing.
- Allow the micrometer and gage blocks to normalize.
- Zero the micrometer.

CALIBRATION TECHNICIAN OBSERVATIONS AS RECEIVED:

OK

MASTER GAGE BLOCK SET # P94-99

ALLOWABLE DEVIATION FROM NOMINAL +/- .0001

READINGS (% OF RANGE)	GAGE BLOCK (S) USED	READING AS RECEIVED	ADJUSTMENT NEEDED? Y OR N	READING AFTER ADJUSTMENT	PASS / FAIL
ZERO	0	.0004	Y	0	PASS
25%	.2500	.2500	N		—
50%	.5000	.5000	"		—
75%	.7500	.7500	"		—
EXTREME	1.0000	1.0000	"		—

FINDINGS:

LIMIT USE? NO
EXPLAIN:

"Y" OR "N" only on + checks 12.13.04

CALIBRATED BY: J. BURNHAM DATE: 6-11-04

APPROVED BY: C ROBINSON QA MGR ONLY DATE: 6-11-04

NEXT CALIBRATION DUE: 6-11-05

Need further notice

12-13-04 * ADJUST IA SCHEDULE - CALIBRATION EVERY 6 MOS

12-13-04 (ck 12-14-04)