

**Solid Concrete Masonry
Brick/Unit
Quality Control/Quality Assurance
Program**

June 13, 1997
(Revised October 2, 2001)

A joint effort of the
North Carolina Department of Transportation
and the
Carolinas Concrete Masonry Association

This page left intentionally blank.

Table of Contents

Revisions

I	General Description	Page 1
II	Program Requirements	Page 2
	A. Basic Requirements	Page 2
	B. Quality Control Plan	Page 2
	C. Approved Laboratory	Page 2
	D. Quality Control Individual	Page 3
	E. Plant Approval Process	Page 3
	F. Certification for Participation in the QC/QA Program	Page 3
	G. Notification of Production of Material for NCDOT Use	Page 3
	H. Identification of QC/QA Product	Page 4
III	Sampling and Testing Procedures	Page 5
	A. Producer's Quality Control	Page 5
	B. NCDOT's Quality Assurance	Page 6
	C. Independent Assurance	Page 8
V	Exhibits	
	A. Sampling Procedures	Page 9
	B. Quality Control Test Form	Page 10
	C. Contact Information for Notification Prior to Production of NCDOT Products	Page 11
	D. Brand Registration and Guarantee Form	Page 12
	E. Plant Ownership Update Form	Page 13
	F. Testing Procedures	Page 14

Revisions

October 2, 2001

Added Exhibit D, Brand Registration and Guarantee Form sample.

Added Exhibit E, Plant Ownership Update Form.

Added Exhibit F, Testing Procedures

Page 2, Added note on Plant Ownership Update and Brand Registration and Guarantee.

Page 3, Updated mailing address for Materials and Tests Unit

Pages 4 and 5, Added notes on identification and marking of QC Brick/Block.

Exhibit C, Added Section Material Specialist contact information.

I GENERAL DESCRIPTION

The Brick and Block Quality Control/Quality Assurance Program is designed to give producers more responsibility for controlling the quality of material they produce and to utilize the quality control information they provide in the acceptance process by the North Carolina Department of Transportation (NCDOT). It requires producers to perform quality control sampling, testing and record keeping on materials they ship for use by the NCDOT. Also, it requires the NCDOT to perform quality assurance sampling, testing and record keeping to confirm the performance of the producers' control plan as set forth herein.

The types of samples and the lot sizes required will be described in detail later in this document.

It is the intent of this program that acceptance or rejection of material be based on the total program. Therefore, comparison of the Quality Control, Quality Assurance, and other sample data may be used by the NCDOT for acceptance or rejection of a lot of material.

Participation in this program does not relieve the producer of the responsibility of complying with all requirements of the *NCDOT Standard Specifications for Roads and Structures*.

II PROGRAM REQUIREMENTS

A. **Basic Requirements** - There are three basic requirements for approval:

- The plant must have an approved in-house quality control plan.
- The plant must have an approved laboratory or have written approval to utilize an approved laboratory at another location.
- The plant must have a qualified quality control individual approved by the Department.

B. **Quality Control Plan** - The Producer must prepare a written quality control plan. The plan may be generic, but must be site specific. The plan must indicate in detail how the Producer proposes to control the equipment, materials, and production methods to insure that the specified products are obtained. The plan must list the personnel responsible for production and quality control at the site and include information on how to contact each person. The following specific information must also be included in the plan:

- Identification of the physical location of the plant, to include a description of the property site and reference to the nearest identifiable points such as highways and towns.
- The method of identification of each lot of material during manufacture, testing, storage, and shipment, including identifying it as intended for NCDOT usage.
- The method of sampling and testing raw materials and the finished product, including lot sizes and tests performed.
- A plan for dealing with quality control sample failures. This plan must include how the Producer plans to initiate an immediate investigation and how the Producer will implement corrective action to remedy the cause of the problem. A description of the method used to insure that products not meeting NCDOT specification are not shipped to NCDOT projects shall also be included.
- A loading and shipping control plan which includes a description of the methods by which the products are to be loaded and shipped for use by NCDOT, including safeguards against loading non-specification material. The plan must also include methods of insuring that all products are accurately identified.

Two copies of the Producer's written quality control plan signed by the Plant Manager and an executed Brand Registration and Guarantee must be submitted with the original request for plant approval. Two copies of an updated Plant QC Plan must be submitted when changes are made to the plant's operations or ownership. A copy of the Plant's Ownership Update Form and Brand Registration and Guarantee must be submitted by June 30th of each year.

C. **Approved Laboratory** - The Program requires all tests to be conducted at laboratories approved by the NCDOT. Each source may establish and maintain its own laboratory for the performance of quality control testing, or the NCDOT will consider a producer's request to utilize

an approved laboratory at another location. The Producer must make this request in writing and have written NCDOT approval before testing material off site. The equipment required for an approved laboratory shall be sufficient to perform the required test procedures referenced by the ASTM specifications listed in Sections 1040-1, 1040-2, and 1040-3 of the *NCDOT Standard Specifications for Roads and Structures*. Records on instrument calibration and maintenance and sample collection and analysis must be maintained at the laboratory. NCDOT may require a demonstration of the equipment and procedures.

D. Quality Control Individual - All samples must be taken and tested by quality control individuals approved by the NCDOT. The Producer must designate and identify the quality control individuals responsible at each plant. The designated QC individuals will be responsible for overall Quality Control at the plant. The NCDOT may require a demonstration of the equipment and procedures used by the individual.

E. Plant Approval Process - The approval process requires the Producer to write the State Materials Engineer at NCDOT, Materials and Tests Unit, 1801 Blue Ridge Road, Raleigh, NC27607, requesting that the plant be considered for acceptance into the program. It must identify the specific products that are to be produced. Two copies of the Producer's written quality control plan signed by the Plant Manager must be submitted with the request for approval.

The NCDOT will review the Producer's written quality control plan and if it is approved, an on-site inspection will be scheduled. This on-site inspection will verify that the Producer's quality control plan has been implemented and is being followed and that at least one qualified quality control individual is on site and will be present when material is being produced or shipped under this program. The laboratory will be inspected and approved if it meets the requirements and has not already been approved. If either the Producer's quality control plan or laboratory do not meet NCDOT requirements, the Producer will be informed of the deficiencies in writing. Once the deficiencies have been addressed, the Producer may again request approval in writing to the State Materials Engineer.

F. Certification for Participation in the QC/QA Program - If the NCDOT has approved the Producer's written quality control plan and the on-site inspection confirms that the initial program requirements have been met, NCDOT will issue a certificate, valid for one year, certifying the plant for participation in the program. At the end of the year, upon receipt of a Plant Ownership Update Form and an executed Brand Registration and Guarantee, NCDOT will conduct another on-site inspection and if all requirements are continuing to be met, the plant will be recertified for participation in the program for another year. Random inspections may be conducted at any time by NCDOT to verify compliance with the program requirements.

G. Notification of Production of Materials for NCDOT use - The Producer shall notify the Department when production of material for use by the NCDOT is scheduled. This notification shall be by telephone, facsimile, or by electronic mail. The notification shall be made to the Section Materials Specialist assigned to the plant. Manufacture of products for the NCDOT may

commence as soon as the notification is made. The telephone numbers and electronic mail address for the Section Materials Specialists are given in Exhibit C.

H. Identification of QC/QA Product – The Producer will identify each cube of brick or masonry unit with a label. The label shall have, as a minimum, the following information: company name, plant name and NCDOT number, date of manufacture, and QC lot number. A sample label shall be submitted with the Plant Ownership Update Form. The brick or masonry units are to be tinted red.

III SAMPLING AND TESTING PROCEDURES

A. Producer's Quality Control - The Producer's Quality Control (QC) samples are used by the Producer to monitor the quality of material being produced.

1. Standard Specifications - The Producer is to perform all sampling and testing in accordance with current specifications and procedures referenced in the *NCDOT Standard Specifications for Roads and Structures*.
2. Lot Size - Quality Control lot sizes for solid concrete masonry units will be a plant run, or 100,000 units, whichever occurs first. Quality Control lot sizes for solid concrete masonry bricks shall be a plant run, or 300,000 units, whichever occurs first.
3. Sampling - The approved plant quality control individual is to obtain a sample from each lot. QC samples will consist of one sample per lot. The sample will consist of minimum of ten units with the units randomly taken at a rate of two units per hour of production. Each unit will be marked with the time or day that it was sampled. One unit from each hour of production will be used by the Producer; the other unit from that hour will be retained for use by the Department.
4. Check Samples - If the test results for a sample indicate the material does not meet the specification requirements, a check sample is to be immediately obtained by the Producer. Check samples are to be twice the number and taken in the same manner as the original sample. The samples are to be clearly identified and shared with one half tested by the Producer and the other half provided to the NCDOT.

If the check sample indicates the material meets the specification requirements, the Producer is to record on the test report form what is felt to be the reason for the original failure and then may resume normal testing procedures.

If the check sample indicates the material does not meet the specification requirements, the Producer is to initiate an investigation to determine the cause of the failure. The investigation is to include a review of the sampling procedures, the equipment used in the production and the testing of the material, and the testing procedures of the individual. If the cause can be attributed to one of the above categories, the Producer is to take corrective action to bring the material, equipment, or procedure into compliance. The Producer is to then record the corrective action on the test report form and take another check sample after the corrections have been made.

If the investigation into the cause of the failure of the first check sample cannot be attributed to one of the above reasons, the Producer is to notify the NCDOT, obtain a second check sample, and continue the investigation into these failures and work with the NCDOT to determine the cause of the failure.

If the second check sample indicates the material meets the specification requirements, the Producer may resume normal testing procedures.

If the second check sample indicates the material does not meet the specification requirements, the Producer is to notify the NCDOT and stop the shipment of material. The Producer is to continue the investigation into these failures and work with the NCDOT to determine the cause.

5. Test Procedures - Required test procedures shall be those required to meet the ASTM specifications referenced in Sections 1040-1, 1040-2, and 1040-3 of the *NCDOT Standard Specifications for Roads and Structures* except that concrete brick and masonry units shall be tinted red.
6. Sample Identification and Record Keeping - It is critical that care be taken to properly label samples and record test data accurately.

Producer's Quality Control samples are to be identified with consecutive numbers: QC-1, QC-2, etc. The samples are to be numbered consecutively for the entire calendar year.

All Quality Control test results are to be entered on an approved Quality Control Test Summary Form. The form shall indicate the Quality Control sample number, type, and quantity of material represented by the sample.

Quality Control and Quality Assurance data is to be retained by the Producer for at least one year and made available to the NCDOT upon request.

After a QC Test Summary Form is completely filled with data, a copy is to be given to the NCDOT Materials Inspector and the Producer is to retain the original. At such a time when it becomes possible for the Producer to transmit data directly into the Department's computerized database, or when the volume of QC tests does not result in at least one completely filled form per month, copies of these summaries are to be provided to the NCDOT at a minimum frequency of once per month.

B. NCDOT's Quality Assurance - The NCDOT's Quality Assurance (QA) samples are used by the NCDOT to verify the performance of the Producer's quality control plan.

1. Standard Specifications - The NCDOT shall perform all sampling and testing in accordance with current specifications and procedures referenced in the *NCDOT Standard Specifications for Roads and Structures*.
2. Lot Size - Quality Assurance lot sizes for solid concrete masonry units will be a maximum of 500,000 units, or fraction thereof. Quality Assurance lot sizes for solid concrete masonry bricks shall be a maximum of 1,500,000 units, or fraction thereof.

3. Sampling - The NCDOT's Quality Assurance samples are to be taken randomly from each lot and tested by the NCDOT. QA samples will consist of one sample per lot. The sample will consist of ten units.
4. QC/QA Comparison - If the results of the Quality Assurance sample are not in agreement with the results of the corresponding Quality Control sample, i.e. greater than five percent difference, an investigation will be made to determine the source of the difference. The investigation will include a review of the sampling and testing procedures and the testing equipment. The results of the investigation will be recorded on the Plant Quality Assurance Form.
5. Resolution System - In the event the above referenced investigation does not resolve the difference and the results of the next Quality Assurance sample are not in agreement with the corresponding Quality Control sample, a resolution system will be employed. The resolution system will require that two additional samples be taken from the same location in the stockpile, and in the same manner that the original Quality Control samples were taken by the approved plant individual. The samples are to be twice the number of the original samples. The samples are to be taken by NCDOT Materials and Tests Unit personnel and are to be shared, with one half to be tested by the Producer and the other half taken by the NCDOT to be tested at its facility. The average test results of the two Quality Control samples and the average test results of the two Quality Assurance samples are to be within the appropriate specification limits and the comparison of the two averages is to be within five percent of each other. If these results are not within the appropriate specification limits and the comparison of the average test results is not within five percent, the material will be rejected. If rejected, the material is to be disposed of in a manner approved by the NCDOT.

If the test results indicate that the material is within the specification requirements but the comparison of the Quality Control samples and the Quality Assurance samples are not within five percent, the material will be accepted for use. However, the Producer, with the assistance of the NCDOT, must determine the cause of the differences in test results. If the cause is determined to be improper sampling or testing procedures by the Producer or the NCDOT, the appropriate approved individual will be notified. If the problem continues, the individual's approval may be revoked. If the cause is determined to be in the Producer's testing equipment or handling of the material, the Producer is to take corrective action. If this problem continues, the Producer's approval to provide material to NCDOT may be revoked. If the cause is determined to be in the NCDOT's testing equipment, the NCDOT will take corrective action.

6. Sample Identification and Record Keeping - It is critical that care be taken to properly label samples and record test data accurately.

The Quality Assurance samples are to be numbered with a number corresponding to the appropriate Quality Control sample. The number following "QA" is the number of the corresponding Quality Control split sample, QA-1, QA-6, etc.

C. **Independent Assurance** - Independent Assurance (IA) samples are to be taken at least annually from each production site by a representative of the Materials and Tests Unit.

Exhibit A

Sampling Procedures

I. Introduction

In order to reduce the number of variables that affect the correlation between, it is important that all samples be obtained following procedures outlined in the *Standard Specifications*, or as outlined in this program.

II. Sampling Procedures

The Designated Quality Control Individual will obtain Quality Control Samples by randomly selecting Brick/Block from the finished product line prior to placement of these Brick/Block in the designated storage area. The Designated Quality Control Individual shall obtain twenty Brick/Block for testing purposes. These samples shall be taken randomly in pairs at the rate of no less than two units per hour of production. Each unit will be marked with the time or day that it was sampled. Ten units will be tested for compliance, the remaining ten will be held for check sampling by the plant if necessary or for NCDOT testing. The units selected for compliance testing shall consist of one brick from any pair.

The samples will be labeled appropriately and transported to an NCDOT approved testing laboratory.

III. Sample Retention

Samples taken by the Designated Quality Control Individual that are not used for testing will be retained for at least three months before being discarded.

Exhibit B

Quality Control Test Form

State of North Carolina
Department of Transportation - Materials and Tests Unit
Raleigh, North Carolina

Producer's Brick and Block Quality Control Test Summary

Laboratory Number:			Date Sampled:		
Report on sample of:			Date Received:		
Identification marks:			Date Reported:		
Sampled by:			Furnished by:		
Sample taken from:			Location of supply:		
Quantity represented:					
Testing Laboratory:					
Address:					
Number	Length (in.)	Width (in.)	Thickness (in.)	P.S.I.	
Average					
Number	Length (in.)	Width (in.)	Thickness (in.)	Density	Abs. (#/ft ³)
Average					
Remarks:					

QC Individual

Exhibit C

Contact Information for Notification Prior to Production of NCDOT Products

Prior to manufacturing Brick/Block for NCDOT use, the Producer shall contact the local Section Materials Specialist assigned to the plant. Manufacture of products for the NCDOT may commence as soon as the notification is made.

Section Materials Specialists

Name	DOT Divisions/Office Location	Phone number/email
Gerald McCauley	Divisions 1 & 4 Williamston	(252)799-4001 gmccauley@dot.state.nc.us
Ken Chase	Divisions 6 & 8 Fayetteville	910)486-1732 kchase@dot.state.nc.us
Bill Watson	Divisions 2 & 3 Wilmington	(910)371-6964 bwwatson@dot.state.nc.us
Clarence Clark	Division 5 Raleigh	(919)556-7606 cclark@dot.state.nc.us
Walton Jones	Divisions 7 & 9 Greensboro	(336)334-3611 wijones@dot.state.nc.us
Pam Carriker	Division 10 Matthews	(704)847-1314 pcarriker@dot.state.nc.us
Benny Parsons	Divisions 11 & 12 North Wilkesboro	(336)903-9107 bparsons@dot.state.nc.us
Bill Graham	Divisions 13 & 14 Asheville	(828)298-1516 bgraham@dot.state.nc.us

T. W. Whittington, PE, Field Operations Engineer
919-733-7091
twhittington@dot.state.nc.us

Exhibit D

Sample Brand Registration and Guarantee

Each plant will submit copies of an annual brand registration and guarantee prior to June 30, of each calendar year to the State Materials Engineer.

[COMPANY NAME]
[COMPANY ADDRESS]
[COMPANY TELEPHONE NUMBER]

BRAND REGISTRATION AND GUARANTEE FOR SOLID CONCRETE MASONRY BRICK AND BLOCK MATERIALS

This guarantee verifies that solid concrete masonry brick and block furnished by [COMPANY NAME] conforms to the requirements of the Solid Concrete Masonry Brick/Unit Quality Control/Quality Assurance Program, and the NCDOT Standard Specifications, for the material specified in the contract or purchase order.

Any material found not in conformance will be replaced at no cost to the North Carolina Department of Transportation.

DATE : _____ BY: _____

NOTARY:

Exhibit E

Plant Ownership Update Form

Name of Company: _____

Corporate Address and Contact Information:

Street: _____
Street: _____
City: _____ State: _____ ZIP _____
Telephone: _____ FAX: _____
Email: _____
Name and Title of Contact: _____

Name of Facility: _____

NCDOT Facility Number: BB _____

Facility Mailing Address and Contact Information:

Street: _____
Street: _____
City: _____ State: _____ ZIP _____
Telephone: _____ FAX _____
Telephone: _____
Email: _____
Name and Title of Contact: _____

Facility Physical Address:

Street: _____
Street: _____
City: _____ State: _____ ZIP _____
Driving Directions from Major Landmark: _____

Plant Personnel Responsible for Quality:

	Name	Title	Cert. Number ¹
1)	_____	_____	_____
2)	_____	_____	_____
3)	_____	_____	_____
4)	_____	_____	_____
5)	_____	_____	_____

The Quality Control Plan for this facility HAS been revised since it was NCDOT Approved? **YES / NO**

If YES, attach copy of current Quality Control Plan to this document and submit for review.

I certify that the foregoing entries are correct.

Signature _____
Title: _____
Date: _____

¹ List NCDOT assigned Technician Certification Number if applicable.

Exhibit F

Testing Procedures

Test solid block in accordance with ASTM C140-01.

The option to cut the block that is given in the specification will be taken. The block will be cut in half. One half is to be tested for absorption and the other half is to be tested for compressive strength.

For absorption, test in accordance with ASTM C140-01.

For compressive strength, test in accordance with ASTM C140-01.

The block will be air dried for 48 hours before capping.

Test brick in accordance with ASTM C55-01

The brick will be air dried for 48 hours before capping