

**OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
QUALITY CONTROL AND ACCEPTANCE FOR
CONCRETE BRIDGE DECKS**

These Special Provisions revise, amend and where in conflict, supersede applicable sections of the 1999 Standard Specifications for Highway Construction, English and Metric, as applicable.

504.01. Description. *(Add the following:)*

Contractor's quality control and acceptance procedures will apply to all concrete and related reinforcing steel used in bridge as herein specified.

504.04. Construction methods. *(Amend to include the following:)*

(j) Contractor's Quality Control Testing and Inspection.

The contractor shall provide quality control personnel and testing equipment as necessary to assure the production of quality products as specified. Personnel shall include one or more quality control technicians who either individually or collectively are fully qualified in the production, placement and testing of concrete and reinforcing steel placed in the bridge decks. The contractor or his concrete supplier shall provide a fully equipped laboratory at a location no more than 50 road miles from the production site. In addition, the contractor shall provide a limited purpose laboratory at the bridge site. This laboratory shall be equipped for temperature and moisture controlled storage cylinders, and tests for slump, air content and unit weight. To assure accuracy, the laboratory equipment shall be checked periodically and calibrated to the required standards by qualified individuals at the contractor's expense. Personnel shall be reviewed to assure their proficiency in conduction of the required tests.

The contractor shall be responsible for the formulation of all mix designs. This shall be accomplished by contractor personnel or subcontractors, such as approved independent laboratories. Mix designs shall be subject to review and approval of the engineer. The contractor shall perform or have performed all field sampling and testing necessary to ensure that materials and products are within the specified acceptable range. Control charts covering as a minimum the characteristics of unit weight, air content, slump, and strength shall be maintained by the Contractor and displayed at the plant or bridge site. Copies of the contractor's quality control tests shall be provided to the engineer at time intervals acceptable to the engineer. Certifications by the manufacturers may be used in lieu of field tests when such tests in the field are impracticable.

1. Contractor's Process Control.

The contractor shall be responsible for the process control of all materials during handling, blending, mixing and placing operations to produce acceptable concrete bridge decks.

At no time will the engineer issue instructions to the contractor or producer as to setting of dials, gauges, scales and meters. However, he may advise the contractor against the continuance of any operations or sequence of operations which will result in non-compliance with specifications requirements.

2. Contractor's Testing.

For unit weight and the four characteristics subject to pay adjustments in this special provision, the contractor sampling and testing as a minimum shall comply with the schedule in the paragraph (k) 5 "*Contractor's Testing and Engineer's Acceptance Procedures.*"

Additional sampling and testing to ensure compliance with standard specifications and other special provision requirements shall be in accordance with the contractor's quality control plan.

3. Contractor's Quality Control Plan.

Prior to initiation of work, the contractor shall prepare a project specific plan to ensure that acceptable quality can and will be obtained. The plan which is to be submitted to the engineer at the prework conference shall address all requirements in sections 504, 509 and 701 of the standard specifications. Once accepted by the engineer the plan becomes a part of the contract and shall be enforced accordingly. Subsequent changes to the plan may be required by the engineer in order to adjust to changes in the process or to correct problems in meeting specification requirements.

(k) Acceptance.

While the contractor shall be fully and exclusively responsible for producing an acceptable product, acceptance responsibility rests with the engineer. The entire lot of structural concrete as defined in the paragraph (k) 4 "Lot and Sublot Selection" will be accepted or rejected and paid for on the basis of acceptance test results.

1. Basis of Acceptance and Payment.

The following characteristics will be considered when determining the acceptability and pay factors for structural concrete. However, all of the requirements of the standard specifications on materials and workmanship shall remain in effect.

- (A) air content
 - (B) strength
 - (C) cracking
 - (D) cover on reinforcing steel
 - (E) smoothness (as provided in special provision 430-1QA(a-i)99 and 431-3QA(a-b)99)
- (Data on slump and unit weight shall be displayed on control charts but will not be used for pay adjustment purposes.)

Several tests may be made to measure each characteristic. The greater the number of tests conducted for each characteristic, the less average deviations will be allowed for full payment. The basis for individual acceptance and pay factors will be the average of the Deviations from standards as indicated in the table I.

The standard for each characteristic is identified as a target, a minimum or a maximum. The standard may be a specific number or a range. Deviations above as well as below either specific number or range targets are considered detrimental and will be penalized. The standard for air content and cover on reinforcing steel is the target.

Deviations below either specific number or range minimums are considered detrimental and will be penalized. Those above minimum are considered beneficial and will help offset the effects of those below when averaged. The standards for strength are minimums. Deviations above either specific number or range maximums are considered detrimental and will be penalized. Those below maximum are considered beneficial and will help offset the effects of those above when averaged. The standard for cracking is maximum. The total pay adjustment for all characteristics except smoothness will be based on a combined pay factor. This factor will be determined from the following formula:

$$CFP = \frac{3S + 2CR + A + C}{7}$$

Where: CPF = combined pay factor
S = strength pay factor
CR = cover on reinforcing steel pay factor
A = air content pay factor
C = cracking pay factor

Pay adjustment for smoothness will be in accordance with special provision 430-1QA(a-i)99.

2. Conflicts Between Engineer's and Contractor's Test Results.

At the beginning and throughout the contract, the engineer and the contractor shall compare each other's test procedures and results. Tests used for correlation of the contractor's and engineer's results will be used for acceptance purposes only if the tested specimens were collected in a random manner and tested using normal acceptance procedures. Tests taken for the sole purpose of correlation of test results will not be used for pay purposes.

If the engineer further determines that the remaining correct results adequately represent the material being evaluated he will use them for pay adjustment purposes. In doing so, he will take into account the increased allowable average deviations resulting from decrease in number of tests. If he determines that the remaining tests' results are too few to represent the material being evaluated, he may test additional samples or supplement them with appropriate contractor test results.

If the engineer and the contractor are unable to resolve their differences, the contractor may request referee testing by the department's materials division or a mutually accepted independent testing laboratory accredited by AASHTO.

The contractor shall request referee testing in writing within 15 calendar days after the completion of the lot. Such testing will be independent from any previous testing by either the engineer or the contractor and the results shall be considered final. Should the referee testing result in higher pay factors on the questioned lots the additional testing costs will be absorbed by the department. Otherwise, the entire cost shall be borne by the contractor.

3. Extreme Values (Outliers).

Test results apparently inconsistent with the results of the majority of tests will also be closely examined by the engineer in order to determine their validity. The examination will cover the procedures used in sampling and testing and, if necessary, a mathematical analysis performed in accordance with ASTM e 178-80 (upper 2.5% significance level). Test results thus determined by the engineer to be non-representative of the material being evaluated will be discarded. The remaining test results will then be supplemented, if necessary, and treated in the manner indicated in the paragraph (k) 2 above "*Conflicts Between Engineer's and Contractor's Test Results.*"

4. Lot and Sublot Selection.

The concrete will be randomly sampled and tested for all control test characteristics on a lot to lot basis in accordance with the following requirements. However, any load of mixture which is visually unacceptable because of being excessively segregated, high in water content or other obvious reasons will be rejected for use in the work.

Furthermore, portions of completed structure which from visual observation or known

deficiencies appear to be seriously inadequate will be tested. The results of such tests will not be used for pay adjustment purposes but will be used to determine whether the questionable portion is totally unacceptable and must be removed. In the event that it is determined to be unacceptable its removal and replacement shall be at no additional cost to the department.

Lots will be measured in the same units as those used as the basis of payment for the particular components. Each lot will consist of four equal sublots. The sizes of the lots and sublots will be as follows:

	Lots	Sublots
Bridge decks	200 CU. YDS.	50 CU. YDS.

Quantities of mixture less than those specified for sublots may be accepted by the engineer upon visual inspection by which he has reason to believe that the materials are of acceptable quality. Any partial lot (one that is less than 200 cubic yards) resulting from completion or suspension of operations for more than seven calendar days may be treated as a separate lot, combined with the previous lot or combined with the following lot at the option of the contractor. On a multiple project contract, the lots of the concrete will carry over from project to project.

5. Contractor's Testing and Engineer's Acceptance Procedures.

Once a lot has been defined, its identity will be maintained throughout the mixing and placement process. Pay factors, determined by the engineer from random sampling and testing the lot at appropriate locations, will be used in computing its payment adjustment. The contractor is required as a minimum to comply with the following schedule for sampling and testing. Depending upon the available time and his confidence in the contractor's process control, the engineer may elect to perform more or less sampling and testing. Also, the engineer may choose to use the contractor's tests for acceptance after their results have been demonstrated to be consistent with those by the department and that they adequately represent the material being evaluated.

Air content - 1 specimen and 1 test per subplot.

Strength - 3 cylinders per subplot averaged and considered as 1 test in the table I.

Cover on reinforcing steel and cracking - one 12 feet by 12 feet area per subplot (same area for both characteristics.)

- (A) Cover on reinforcing steel - 10 depth measurements at equally spaced intervals on any randomly selected bar within the 12 feet by 12 feet area averaged and considered as 1 test in the table I. Any bar located within 2 feet either side of a rooftop or valley break in cross slope or superelevation will be exempt from consideration. When such a bar is randomly selected for measurement, it will be replaced by the closest bar outside the 4 feet wide exempted area. Depth measurements will be taken after correction for smoothness.

- (B) Cracking - the total length in feet of all cracking regardless of size or cause in the 12 feet by 12 feet area will be considered as 1 test in the table I.

Unit weight - 1 specimen and 1 test in accordance with AASHTO T-121 per lot. All unit weights determined in accordance with AASHTO T-121 shall be compared to the theoretical weight from the current job mix formula. This information shall be used by the contractor to aid in his process control and furnished upon request to the engineer.

It will not be used for pay adjustment purposes.

(1) Plant Startup Requirements.

Prior to beginning production of structural concrete, the contractor shall provide a quality control system. The system shall include the fully equipped laboratory and the full complement of quality control personnel that are to perform the quality control functions for the remainder of the project. Plant startup production shall be limited to that necessary to calibrate the plant, testing equipment and procedures using the approved mix design. The structural concrete thus produced shall be sampled and tested by both the contractor and the engineer for air content and strength(three-day). The contractor's test results shall then be reconciled with those from the engineer.

No concrete from the startup operation that is outside the 1.00 pay factor range of the table I shall be placed in the bridge floor. Instead adjustments shall continue to be made until all of the requirements are met. Concrete not meeting the requirements shall become the property of the contractor. Costs associated with startup operations will not be measured separately for payment but will be included in the payment for contractor's quality control.

Table I
Acceptance Schedule

Average of deviations from the target (without regard to signs)					
Characteristics	Pay factor	1 test	2 tests	3 tests	4 tests(1)
Air Content	1.00	0-3.00	0-2.12	0-1.73	0-1.50
	.98	3.01-3.68	2.13-2.60	1.74-2.12	1.51-1.84
	.95	3.69-4.36	2.61-3.08	2.13-2.52	1.85-2.18
	.90	4.37-5.04	3.09-3.56	2.53-2.91	2.19-2.52
Target 6.5%	.80	5.05-5.73	3.57-4.05	2.92-3.31	2.53-2.87
	Unacceptable(2)	over 5.73	over 4.05	over 3.31	over 2.87
Average of deviations from minimum (considering signs)					
Strengths(3)	1.00	0-1000	0-710	0-580	0-500
	.98	1001-1150	711-810	581-660	501-580
Minimums:	.95	1151-1300	811-920	661-750	581-650
Class AA 4500 psi	.90	1301-1450	921-1030	751-830	651-730
Class A 4000 psi	.80	1451-1600	1031-1130	831-920	731-800
	Unacceptable(2)	over 1600	over 1130	over 920	over 800
Average of deviations from the target (without regard to signs)					
Cover on reinforcing Steel	1.00	0-.50	0-.35	0-.29	0-.25
	.98	.51-.60	.36-.42	.30-.35	.26-.30
	.95	.61-.70	.43-.50	.36-.40	.31-.35
	.91	.71-.80	.51-.57	.41-.46	.35-.40
	.86	.81-.90	.58-.64	.47-.52	.41-.45
Target	.80	.91-1.00	.65-.71	.53-.58	.46-.50
Plan Cover	Unacceptable(2)	over 1.00	over .71	over .58	over .50

	Average of deviations from maximum (considering signs)				
Cracking(4)	1.00	0-10	0-7	0-6	0-5
Maximum	.99	11-30	8-21	7-17	6-15
40 L.F.	.97	31-50	22-35	18-29	16-25
(In 12'x12' area)	.93	51-70	36-50	30-40	26-35
	.87	71-90	51-63	41-52	36-45
	.80	91-110	64-80	53-64	46-55
	Unacceptable(2)	over 110	over 80	over 64	over 55

Footnotes

- (1) If more than four tests are conducted the allowable deviations will be determined by dividing the allowable deviations for one test by the square root of the number of tests actually conducted. Normally four random tests will be taken for a 200 cubic yard lot. Use of more than four tests to determine allowable deviations for a lot will be utilized only when additional tests are requested by the contractor and there is no reason to eliminate any previous test results. Tests taken for the sole purpose of correlation of test results will not be used for pay purposes.
- (2) Unless otherwise directed by the engineer, products testing in this range are unacceptable and shall be removed and replaced at no additional cost to the department.
 In addition to requirements for quality as defined by the individual characteristics, overall quality must be obtained. The basis for determining overall quality will be the combined pay factor.
 When the combined pay factor is equal to or less than 0.90, the contractor may, at his own option, remove and replace the products at no additional cost to the department or leave them in place and receive no payment for them.
- (3) It is the intent of the specification that uniform strength of concrete be attained. In addition to average strength requirements, the allowable range (difference between the highest and lowest strengths from an acceptability test of the affected lot) is limited to 2500 psi. The strength pay factors for lots exceeding this limit will be 0.98 or the strength pay factors shown on the table I, whichever is less.
- (4) From 28 to 60 days after concrete placement, the total length of cracks regardless of size or cause within randomly selected 12 feet by 12 feet areas of a bridge floor will be measured by use of a roll-a-tape. The cracks to be measured will include all of those visible after thorough wetting and a partial drying of the areas. Before each series of measurements is to be made, the roll-a-tape will be calibrated by measurement of an accurately taped 100 foot length.