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1000 CONTROL OF MATERIAL

Logging of Tests

Project personnel will keep and maintain materials testing logs or reports for all testing results. Either "paper" or "computer" logs may be kept as desired by the project. Copies of materials testing logs are sent to the Regional Lab and/or the Central Lab only upon request.

The service life of a project is dependent not only upon the care used in construction, but also on the quality control and kind of materials incorporated. It is necessary that only materials which comply with the specifications be used. The *Materials Policy & Procedures Directives, Materials Testing Manual*, *AASHTO and ASTM Standard Methods of Sampling and Testing, Construction Manual*, and Construction Bulletins provide the procedures necessary for the sampling and testing of material. The project personnel must continually watch to see that no inferior materials are used. They must see that samples are taken in accordance with the Sampling Guide Schedule, by the required procedures, and that these samples are tested and reported promptly.

Prompt testing and prompt reporting to all concerned (including the Contractor) are a vital part of our system of quality control. The following guidelines are established in order to provide an acceptable system of reporting project material test results.

Each construction ORG will implement one of the two systems as below outlined, with no substitutions or exceptions. The systems will be either Manual Materials Logs or Computer Material Logs.

Manual Materials Logs

1. Materials test cards or work cards listed below will be used:

   44-1000 One Point Proctor Density
   44-1001 Field Density/Moisture of Soils by the Nuclear Method
   44-1002 Method A or Alternate Method D Proctor Density
   44-1003 Method C or Method D Proctor Density
   44-9337 Concrete Test Report
   44-9338 Asphalt Test Data
   44-9347 Sand Cone Density
   44-9348 Volumeter Density
   44-9352 Asphaltic Concrete Tabulation
   44-9353 Soil and Aggregate Tabulation
   44-9370 Asphaltic Concrete Tabulation - Nuclear (English)
   44-9371 Asphaltic Concrete Tabulation - Nuclear (Metric)
   44-9372 Asphaltic Concrete Tabulation - Furnace (English)
   44-9373 Asphaltic Concrete Tabulation - Furnace (Metric)
   44-9374 PG Binder Test Data

2. The required information will be transferred from the work cards to the appropriate log form listed below:

   44-3904 Materials Log
   44-3917 Proctor and Density Log
   44-4404 Concrete Log

Additions and/or updates can be made intermittently to any of the above listed forms.

3. Materials will be sampled as outlined in the *Sampling Guide Schedule of the Materials Testing Manual* or the project Special Provisions. Project test results will be typed or printed in black. Lines will be left blank immediately below the results of each split sample for the purpose of recording corresponding Regional and Central lab results as soon as they are received at the project.

   For those who wish to record statistical information such as running averages, averages in data, standard deviation, coefficient of variation, and etc. of individual screens, or other information, may do so on these forms. Averages and etc. may be accumulated down the sheet and recorded by leaving blank the number of lines needed. This type of information may also be recorded in the concrete log in spaces not utilized.

Computer Materials Reports (Logs)

1. The same test or work cards as listed for manual material logs will be used.

2. Information from the test or work cards will be entered into the computer when completed, which will make all testing information performed by the project lab available by computer to the project.

3. An up-to-date computer report may be maintained at the project lab or office. When computer reports, commonly called material logs, are used, the necessary information may be obtained two ways, by either looking at the computer screen directly or by printing out a materials report.

4. Materials will be sampled as outlined in the *Sampling Guide of the Materials Testing Manua*l or the project Special Provisions.

Whichever of the two systems is utilized, it is essential that all calculations of test results be correct. When manual materials logs are used, it is essential that the individual performing each test, sign and date each test or work card. Each card should, in turn, be checked and initialed by a supervisor before the results are recorded in the materials log. If a computer report is used, the name of the person performing the test should be recorded in the computer next to the test results.

Logs or computer reports should show all acceptance and test results performed by the project, regional, and central lab. Tests such as informational, etc., will be left to the individual project or District discretion as to whether the information will be included in the log or report. The approximate total quantity of material required should also be shown in the log heading.

Logging of Concrete Test Results

It has been customary to log all tests on concrete after the laboratory reports covering strength have been received. It is suggested all tests on concrete, except strength, be logged as soon as possible after making the tests, then log the strength tests after receipt of the laboratory report showing the strength results. It is believed that earlier logging of all tests, except strength, will serve to alert the Engineer and others concerned with the project to the need of any corrective action with respect to the slump, air content, yield, and etc.

Logging of Density Test Results

The location and results of density tests shall be logged in the proctor and density log.

1001 MATERIAL SOURCES

The Standard Specifications provide definitions for two types of materials sources specified in the contracts. Sources may be Department-Furnished, or Contractor-Furnished. Contractor-furnished sources include commercial operations.

An environmental analysis is required for every and all types of material sources. ADOT Materials Group has a list of sources known by the Department to have approved environmental analysis. Department-furnished sources should be on the list. The contractor must provide an acceptable environmental analysis for contractor-furnished sources. The contractor can either choose a source from ADOT's approved list, or provide an environmental analysis in accordance with the requirements of Subsection 104.12 of the Standard Specifications.

1001-2 General

Section 1001 covers the requirements and restrictions when working a materials source. The Engineer and the Inspectors are expected to be familiar with the section and to properly document that the source is worked in accordance with the requirements and restrictions.

The provisions of the OSHA, State Mining Laws, the Arizona Native Plant Law, and Pollution Control Laws relating to exhaust emissions, burning, stream pollution, and dust control are to be complied with. If the Contractor does not appear to be complying with these laws he should be notified and the situation should be documented in the project record. ADOT does not enforce these laws but there is an obligation to promote an awareness on the part of the Contractor that he must comply with the law.

If the nature of the material or the method of processing changes, so that an unacceptable product may result, the Engineer is to notify the Contractor. Changing conditions are to be documented along with any action or inaction on the part of the Contractor towards correcting the condition.

Whenever the material source shows evidence of material varying in the vertical plane, the approval of the source should include a requirement to work a full face in order to get the maximum blending of the different materials. Almost all sources, including quarries, have enough variability that justify a full-face method of working. Sources having variability in the horizontal dimension may require blending of material from various areas before final processing.

Even though a source is the Contractor's responsibility, the Engineer will need to monitor the operation so he can alert the Contractor to any processing problems that could result in a lowering of the quality of the final product. There have been occasions when Contractors have refused access to materials sources to ADOT personnel under the pretext that ADOT had no right to be concerned until the final product was tested. The Engineer should not accept such a position on the part of the Contractor. If necessary, the assistance of the District and Central offices should be enlisted in getting access to the Contractor's operations.

In crushing and screening operations, wet and dry materials usually require different handling methods to produce the same results. The mixing or selection of wet and dry material has to be watched closely to prevent broad and erratic variations in the final product.

1001-3 Department-Furnished Sources

An information packet may be available with Department furnished sources. The Engineer should be familiar with the information packet which contains information on the type of material, ownership, and other pertinent matters.

One print of each material pit established for the project showing its serial number and location with reference to township and section, shall be received by the Materials Source Section and the Resident Engineer at the beginning of the project. The Resident Engineer is required to keep all pit information up-to-date as construction proceeds.

It is important to monitor the Contractor's operations in the source to be sure he is using the material as intended and not operating wastefully. When a Department furnished source is exhausted early, the Department may have to pay moving and development costs. A complete record should be kept of the pit operation so that it can be readily determined and verified that a source has been exhausted after being worked in a reasonable manner.

An accurate and indisputable record shall be kept of the amount and type of material removed from each individual ownership. This will save the Department many legal difficulties relating to overpayment, underpayment, no payment, or exceeding the limits of the area covered by the license.

It is very important that all pits from which any type of material is taken (including borrow pits) be accurately described as to location and serial number, and that the type and quantity of material from each pit be detailed separately with the final estimate. The name of the owner of each parcel of land from which materials are taken shall be shown.

Material from a Department furnished source is to be used only for the purposes stated in the contract. A supplemental agreement is necessary for any change in usage. The owner's approval for a change of use is to be obtained by the Contractor. The Department has the right to deny a change in use of material when the pit is to be preserved for future use or other valid reasons.

Special care shall be taken when there is more than one owner in one pit area. Before removing any material, the Resident Engineer shall make certain that the property lines between owners are mutually satisfactory. Agreement as to property lines should be attested to by the owners, in writing, after inspection at the pit site where feasible. It is not the Resident Engineer's responsibility to reestablish corners or lines for property owners.

Pits on State Land

Some projects require the procurement of material pits on State Land Department properties. This agency has issued specific requirements which must be strictly adhered to for removal of materials from State Land Mineral Material Leases.

The following procedures will apply to materials removed from all State Land Department Pits:

Preliminary Report

Within twenty days of the notice of award of a contract which requires the use of State Land Pits, Field Reports shall report to the State Land Department, through the Materials Source Section, the following information:

- Project number and general location.

- Name of Contractor.
- State Pit serial number and State Mineral Materials Pit Lease number.
- As nearly as possible, the date the Contractor proposes to enter upon the leased
- Land (verified at time of preconstruction conference).
- The time allotted to the project or anticipated completion date.
- The approximate release date (this date will normally fall after completion of project).
- The approximate amount and types of materials anticipated to be removed from each State Land Pit.

As soon as possible after the preconstruction conference, the Resident Engineer shall relay to Field Reports, by telephone, the information necessary to report items 4 and 7 above.

Pit Re-cap Documentation

The Resident Engineer will, within 24 hours after the Contractor has completed removal of materials from a State Land Department Pit, estimate quantities of each type of material removed from the State Land source. A reasonably accurate estimate will also be made of all stockpiles (aggregate base, mineral aggregate, cover material, etc.) remaining in the pit. The Resident Engineer shall also estimate the quantities in reject piles for which there will be no royalty accounting. A memo confirming information shall be sent to Field Reports. A final verification of quantities and recapitulation of all material pits is required with all final estimates. Field Reports will submit the following recapitulation through the Materials Source Section to the State Land Department within 60 days after notice of project completion:

- Project number and general location.
- Contractor.
- State Pit serial number.
- State Land Mineral Materials Pit Lease number.
- Type of material removed.
- Quantity of materials removed.
- Royalty rates on materials removed.
- Total royalties due, including a 3% administrative charge. (Total royalties due is equal to the material royalties multiplied by 1.03.)

State Land Department Inspection

Inspection of State Land Pit sites and quantity documentation records may be made at any time by an authorized agent of the State Land Department. The Resident Engineer shall cooperate and assist in any such inspection.

Pits on Indian Lands

Occasionally, projects will require the procurement of material pits on Indian lands. This procurement is accomplished by the Materials Source Section through contact with the United States Department of the Interior, Bureau of Indian Affairs and the particular Indian Agency involved.

Upon receipt of the Notice of Procurement of Material Pits on Indian lands, it is recommended that the same basic steps as outlined above be followed by the Resident Engineer, with special emphasis on the fact that care shall be taken when there is more than one owner in one pit area. Because these pits will often have designated allotments covering different entities, it is recommended that the Resident Engineer contact the Superintendent of the Indian Agency and work with him to determine suitable methods of proportioning quantities to the various allotments. This will also serve to inform the Resident Engineer of any other conditions which may be peculiar to the particular Indian Agency.

The office of Environmental Planning will receive and maintain a list of sacred sites designated by the Navajo Nation and may have additional sites from other Native American Nations. These sites will be incorporated into the highway construction contract documents and referenced to their location. Although the FHWA has informed us that we cannot prevent the use of any particular material source, we will stipulate in the contract that the Contractor must be aware that the site is sacred. The Contractor must be in compliance with all historic al and environmental laws and regulations, which may serve to limit or prevent the use of materials from a designated site.

1001-3.04 Royalty Charges

It is the Engineer's responsibility to see that the Contractor has paid all royalty charges before final payment is made on the contract.

Material pits furnished by the Department on some projects will require payment of a royalty charge, while on other projects, the pit or pits will be furnished free of royalty charges. The Resident Engineer shall review the Standard Specifications and Special Provisions to ascertain whether the pits for the project involve royalty charges, and shall be guided accordingly. In any event, a Pit Recap Sheet shall be made and submitted with the final estimate (Exhibit 1001-3.04-1).

No payment by the Contractor to the State Land Department shall be made until final billing is forwarded by Field Reports to the Contractor. The Contractor shall make checks payable to the State Land Department and mail as follows:

Attn.: Field Reports
Arizona Department of Transportation
Intermodal Transportation Division
206 South 17th Avenue, Mail Drop 133A
Phoenix, Arizona 85007

Other Situations Involving Royalties

This is a general outline on how other pit situations are handled:

State-leased pits may or may not be set up in the Special Provisions. If they are, the royalty rate is specified.

If they are not:

1. The Contractor asks to use a pit.

2. The Resident Engineer checks with the Materials Source Section and Environmental Planning to get approval and royalty rate.

3. A copy of the pit license is picked up by the Contractor at the Materials Source Section. The Contractor then checks over and clears the license and any other pertinent information with the Materials Source Section. When this is done, the Contractor will give the letter to the Resident Engineer.

4. The Resident Engineer then distributes a letter to the Materials Source Section informing them of the Contractor's use of the pit.

In either case, a Pit Recapitulation is sent to Field Reports even if the pit is not used. Field Reports verifies any quantities and sends one copy to the Contractor. Field Reports also sends one copy to the FHWA with the

project final. The FHWA sends the Pit Recap royalty final to Contractor and requests verification of payment. Upon receipt of the Contractor's verification of payment, the FHWA releases funds.

1001-3.05 Performance Bonds

The Contractor is required to furnish a performance bond when using sources under the jurisdiction of the State Land Department or the Bureau of Land Management. Note that a fully executed copy of the bond is to be furnished to the Engineer together with evidence that a fully executed copy has been sent to the agency having jurisdiction before any work is started in the source.

ARIZONA DEPARTMENT OF TRANSPORTATION
OFFICE MEMO

July 1, 2001

TO: DEE BOOKS
Field Reports, 133A

FROM: KEN DORIGHT
Project Supervisor, X999

RE: MS 1111; REVISED

As part of ADOT Project TEA-87-C(1)P, H9999-01C; Red Ridge-FS Boundary, the following aggregate quantities have been removed from above-referenced material source.

SECTION 416

Asphaltic concrete produced; to date (Item No. 4160003)	33,213 tons
Less:	
Mineral Admixture (Item No. 4160031)	312 tons
Asphaltic Binder (Item No. 4040282)	1,661 tons
Blend Sand (from pit MS1026)	10,964 tons
Subtotal Deductions	-12,937 tons
Aggregate used for Section 416	20,276 tons

SECTION 414

Asphaltic concrete produced; to date (Item No. 4140040)	4,326 tons
Less:	
Mineral Admixture (Item 4140044))	39 tons
Asphaltic Rubber Material (4140042)	389 tons
Subtotal Deductions	-428 tons
Aggregate used for Section 414	3,898 tons

Total aggregate used to date: 24,174 tons

Exhibit 1001-3.04-1. Pit Recap Sheet

1001-4 Contractor-Furnished Sources

A letter approving the source is required for contractor-furnished sources. The Bridge Group must be contacted prior to approval of a material source located within the specified upstream or downstream distances from any drainage structure.

When materials sources are contractor-furnished, the Contractor is responsible for sampling and testing to determine whether there is enough material available to complete the work within the specifications, for preparing an environmental analysis, for complying with the Arizona Native Plant Law, and for securing rights and access to the material. Evidence must be furnished to the Engineer that the Contractor has fulfilled these requirements.

The same requirements for changes in usage, royalty payments, and meeting environmental stipulations apply to contractor-furnished sources as applied to Department furnished sources. The Contractor is required to furnish evidence to the Engineer that he has fulfilled his commitment to the owner. Acceptable evidence is a letter from the owner stating that all agreements have been fulfilled, including payment, and that the Contractor is released from any further obligation.

The Contractor's complete environmental analysis should be in accordance with Standard and Specifications 104.12 for all material sources. The Resident Engineer should assure that the Contractor has complied with state historical preservation rules.

Contractor Leased Pit

The following procedures are followed if the Contractor wishes to lease a materials pit from a private party:

1. The Resident Engineer verifies the landowner's permission and any conditions (such as royalties and clean-up). The Contractor should provide a copy of the agreement.

2. The Engineer writes a Pit Approval letter to the Contractor (copy to Field Reports).

3. The Engineer completes the Pit Recap and then sends a copy to Materials Source Section and informs the Contractor of final quantities.

4. Before finalizing the project, the Engineer requests a copy of the pit-owner's release of the Contractor. Upon receipt of the pit-owner's release, the Engineer can finalize the project.

Commercial Operations

A letter approving the source is required for commercial materials sources. The Bridge Group must be contacted prior to approval of a material source located within the specified upstream or downstream distances from any drainage structure.

Commercial operations are to meet the requirements in Subsection 1001-2.01, Definitions, of the Standard Specifications. Specifically proof of the following shall be submitted to the Resident Engineer:

- Owner or Producer has been located on site for at least preceding 12 months.
- Owner or Producer has been routinely engaged during regular business hours in processing and selling of materials.
- The Owner or Producer shall have a retail sales tax license.

Specifications require the contractor to furnish documentation verifying the above requirements are being met.

Materials Group has maintained a list of former commercial sources. Information obtained from these files does not assure the material source is currently a “commercial operation” which complies with the requirements of the Standard Specifications.

1001-9 Cleaning Up

Cleanup of a source should not be taken lightly as it will have a lasting impact on the owner which can drastically affect ADOT's future relations.

The Engineer should always require a final inspection and letter of acceptance by an agent of the public agency involved and have the Contractor furnish a clearance letter from private owners.

1002 PAINT

The Inspector should be able to recognize the various paint categories since mixing and storage requirements vary. The Standard Specifications group paint into the following categories; Three-Paint Coating Systems, Aluminum Paint, Zinc Paint, Acrylic Emulsion Paints. Three-paint coating systems are consider as one unit and include a primer (paint number 1), intermediate coat (paint number 2) and topcoat (paint number 3). Zinc paint is a two-part (zinc oxide-vehicle & zinc dust) coating system used as a primer to repair galvanized metal surfaces. Aluminum paint is a two-part (water vehicle & aluminum paste) coating system normally used as a finish coat. Acrylic emulsion paint is a waterborne (latex) universal coating system similar to exterior house paint.

Certificates of Compliance are required for each lot or batch of paint. The Certificate of Compliance should be received before paint is applied. Random samples of any lot or batch may be taken at any time. The Engineer should confirm that the Contractor and paint supplier have made arrangements for paint testing. Samples of paint may be tested at the Phoenix Central laboratory before any paint is delivered to the project, or may be obtained in the field or from the fabricator and submitted to Materials Group for testing.

Three-paint coating systems must be on the Department's Approved Products List. Acrylic emulsion paint must either be on the Department's Approved Products List, or have a Certificate of Analysis.

After testing, the containers of approved paint will have appropriate tags or labels attached identifying them as tested and approved. Additional samples will be taken at the project site as the paint is used.

The Standard Specifications require each label to clearly show the exact title of the paint, the Federal specification number (when applicable), the name and address of the manufacturer, the date of paint manufacture, and the lot or batch number.

Established suppliers of paint within the State are familiar with testing and approval routines; therefore, very few problems arise in dealing with these suppliers. Suppliers from out-of-state or those who have not dealt with ADOT may experience problems initially. The Engineer and the Contractor need to cooperate in order to minimize possible problems with paint testing and approval.

Aluminum paint must be mixed fresh each day. Do not store mixed aluminum paint, or place mixed aluminum paint in sealed containers.

1003 REINFORCING STEEL

Certificates of Compliance are required for reinforcing steel. The Certificate of Compliance for reinforcing steel should be received before payment is made. If the project requires epoxy coated bars then the epoxy resin must be on the Department's Approved Products List. The Inspector must ensure that any damaged to the epoxy coating is repaired in accordance with the Standard Specifications.

Refer to the *Materials Group Policy & Procedures Directives Manual* for information on the sampling, testing, certification, and marking of reinforcing bars. Additional information on reinforcing bars and their dimensions can be found in Chapter 5, Section 605-2.

The same general procedures are followed for wire mesh and smooth bars used as reinforcement except that there are no markings on the metal.

The "W" size designation of wire mesh refers to the area of the individual wire in hundredths of a square inch. W5 wire has an area of 0.050 square inches (32.3 square millimeters) as shown in the following table (Exhibit 1003-1).

The Standard Specification allows substitution of Grade 60 reinforcing bars for Grade 40 in certain cases. When the substitution is permitted, the authorization is to be in writing.

NOMINAL SIZE NUMBER	NOMINAL DIAMETER (mm)	NOMINAL DIAMETER (in.)	AREA (square mm)	AREA (square in.)
W 31	15.95	0.628	200.00	0.310
W 30	15.70	0.618	193.55	0.300
W 28	15.16	0.597	180.64	0.280
W 26	14.61	0.575	167.74	0.260
W 24	14.05	0.553	154.84	0.240
W 22	13.44	0.529	141.94	0.220
W 20	12.83	0.505	129.03	0.200
W 18	12.17	0.479	116.13	0.180
W 16	11.46	0.451	103.23	0.160
W 14	10.72	0.422	90.32	0.140
W 12	9.93	0.391	77.42	0.120
W 10	9.07	0.357	64.52	0.100
W 8	8.10	0.319	51.61	0.080
W 7	7.59	0.299	45.16	0.070
W 6	7.01	0.276	38.71	0.060
W 5.5	6.73	0.265	35.48	0.055
W 5	6.40	0.252	32.26	0.050
W 4.5	6.07	0.239	29.03	0.045
W 4	5.74	0.226	25.81	0.040
W 3.5	5.36	0.211	22.58	0.035
W 3	4.95	0.195	19.35	0.030
W 2.5	4.52	0.178	16.13	0.025
W 2	4.06	0.160	12.90	0.020
W 1.5	3.51	0.138	9.68	0.015
W 1.2	3.15	0.124	7.74	0.012
W 1	2.87	0.113	6.45	0.010
W 0.5	2.03	0.080	3.23	0.005

Exhibit 1003-1. Welded Wire Fabric Dimensions

1004 STRUCTURAL METALS

Most structural metals are accepted on the basis of certificates of compliance and certificates of analysis.

The metal fabricator is generally the party responsible for forwarding to the Contractor (or supplier) the required mill certifications covering the base metal and any treatment prior to fabrication.

The number of certifications needed depends on how many processes/companies the metal passed through before being delivered as the final product.

Each item is to be considered separately to determine what certifications are needed.

As a minimum, all structural metals are certified in accordance with the following:

1. The manufacture of the base metal will include a chemical analysis of the metal, a statement that it was manufactured according to a given specification (ASTM, AASHTO, etc.), and a description of the pieces represented by the certificate.

    A. The chemical analysis applies to a heat, not to individual finished pieces. A heat is a quantity of metal that is processed at one time from which individual pieces are made. When the metal is shipped, the manufacturer marks or tags the pieces with the heat number. If everyone keeps their records in order, a piece of metal can be traced reasonably well back to the heat from which it was made.
    B. The manufacturer's certification also assures the individual pieces were made to comply with the specification in regard to allowable variations in dimensions and finish.

2. Any coating or special treatment such as galvanizing or heat treatment must be certified. The coating or treatment may be done by the manufacturer, an intermediate processor, or the final fabricator. Whoever does the work is the one who must certify it.

3. The fabricator who produces the final product certifies that the materials he used are the same as the materials represented by the certifications in #1 and #2 above and that his fabrication process complied with the Standard Specifications. The Standard Specifications cited in the contract are to be referred to individually. A generalized statement such as "meets ADOT requirements" is not acceptable.

    A. The certification covers all the fabrication process including bending, machining, welding, heating, painting, etc.
    B. The fabricator is responsible for securing all the certifications from the manufacturers and processors and relating them to the material he has fabricated.

Structural elements are sometimes inspected at the fabrication plant by the Bridge Group, other agencies, or consultants. A copy of the inspection report must be in the project file before structural elements are accepted. Additional discussion of steel structures is found in Section 604.

1005 BITUMINOUS MATERIALS FOR SURFACING

1005-2 Sampling of Bituminous Material

Sampling and testing of bituminous materials are covered in the Standard Specifications, the *Materials Testing Manual*, and the *Policy and Procedures Directives Manual*. Everyone involved in sampling, testing and inspection of bituminous materials is required to be familiar with the written procedures and guidelines.

It is important that everyone understands that the Contractor is the one who takes the sample while being witnessed by the Engineer. The Engineer will choose the location, the time and the number of samples to be taken by the Contractor. The Engineer also will determine whether the facilities for sampling are satisfactory for getting accurate samples and are safe.

1006 PORTLAND CEMENT CONCRETE

1006-1 General Requirements

This specification deals with Portland cement concrete. Included are component materials, design, mixing, transporting, and curing, as covered in the Standard Specifications. Placing and finishing concrete are covered by Specifications 401 and 601. Utility concrete is covered by Specification 922.

Refer to the Standard Specifications and *Materials Group Policy & Procedures Directives Manual* for additional information on Portland cement concrete inspection guidelines.

Good consistency control of concrete is of primary importance. It should be noted that other factors being equal, an increase in the water cement ratio of 0.4 gallon (1.5 liters) per sack of cement will result in an increase in slump of approximately 1 inch (2.5 millimeters) thereby causing a potential loss in compressive strength of about 100 pounds per square inch (700 kilopascals). Over-watered concrete also increases segregation and shrinkage. This is not to say that concrete having a very low slump should always be used. Good judgment must be exercised.

The concrete Inspector should be aware of the factors which affect the slump of a concrete mix. The following are some of those factors:

1. Variations in water content have a very pronounced effect on the slump. A change of 1% in the amount of free moisture in the fine, or 3% in the coarse aggregate can change the slump about 1/2 inch (12 millimeters).

2. A change of 1% in the amount of entrained air may alter the slump by approximately 1/2 inch (12 millimeters). An increase in air causes an increase in slump.

3. A fineness modulus of the sand is important because of its effect on the water demand of the mix. The finer the sand, the lower the F.M., the more water required for a given slump. The fineness modulus of sand is obtained by adding the cumulative percentages retained on the following standard sieves: 4, 8, 16, 30, 50, and 100 (metric sieves 4.75 mm, 2.36 mm, 1.18 mm, 600 m, 300 m, 150 m). The total is then divided by 100.

Under these specifications, duties such as checking the stockpiles for moisture and adjustment of the mix are the Contractor's responsibility.

For simplicity, the inspection duties to be performed by ADOT personnel are separated into two categories: plant and site inspection. Documentation of inspection is necessary and will be made as follows:

1. The number of random checks to be made is at the discretion of the individual Resident Engineer or Project Supervisor. The number of random checks needed to document the acceptability of the aggregates will vary. In areas where testing has indicated a uniform product that meets specifications and which has been properly stockpiled to minimize segregation, the sampling guide minimum will probably be sufficient. In cases where testing has shown the material to be borderline or the stockpiles show segregation or excess moisture, extensive sampling may be required.

2. Frequent visits should be made to observe plant operations during the time material is being batched for the project. Although ADOT does not control the batching and mixing, it is important that project personnel assure all plant procedures are meeting standards. If problems are found they must be

discussed and resolved with all parties involved. The Contractor should be advised in writing the first time a discrepancy occurs.

When inspecting the plant some of the things to look for are:

1. Inspect/check the aggregates to see that there is no intermingling of aggregates from one stockpile or bin to another of a different gradation. Inspect for foreign material and contamination. If any of these conditions occur, you should stop production until the condition is corrected.

2. Inspect the aggregates for moisture content and inform the Contractor of your findings. Although we do not control the mix, every expedient shall be used to obtain and preserve uniform moisture content in the aggregates.

3. Inspect the cement storage. Inspect for caked cement that may be due to long storage time.

4. Inspect additive dispensing equipment. Agitation of these materials is not required by the Standard Specifications; however, it is believed to be necessary in all cases to assure that the original quality of the material is maintained. Agitation should be accomplished by the use of an air jet extending to the bottom of the container.

5. If concrete is being mixed in truck mixers, determine that mixers are in good condition and display on an approved inspection sticker in accordance with *Materials Group Policy & Procedures Directives Manual*.

6. Verify that the mix designs submitted by the Contractor and approved by the Department is the correct design for the concrete strength (f'c) being used.

7. Check the batch ticket for correct information. The copy of the Contractor's or supplier's invoice (delivery ticket) provided for each load of concrete will be acceptable. Documentation of inspections will be made on the applicable invoice. It will not be necessary for ADOT Inspectors to fill out the concrete test report form for each load of concrete supplied. The minimum information to be shown on each invoice shall be the date, time batched, truck identification number, name or identification of the batch plant, name of the Contractor, name and location of the project, volume of the concrete, the number of revolutions the concrete has been mixed, the batch weights or mix design code number, the percent free moisture in the coarse and fine aggregates, the water withheld during batching, and any water added to the mix at the site. When samples for strength tests are taken, the concrete test report form will be completed by the ADOT Inspector and will accompany the cylinders to be tested.

8. Check the time cement is added to the batch to assure that the proper time has been recorded on the ticket. (90 minutes is the maximum time allowed for discharge.)

9. Make sure the revolution counter has been zeroed before mixing. Check mixing time and revolutions (at the plant). Document these on the delivery ticket, initial it, and return it to the driver.

10. All plant inspections and verifications must be well documented. All information, referring to a particular batch should be recorded (and initialed) on that batch ticket.

11. Any water added to a batch after the batching procedure will be measured and documented. (See placement site inspection requirements.) Measurement using a clean, calibrated sight glass is acceptable.

It is important that the complete plant operation be observed for addition of water other than in the batching operation. This is important to assure the maximum water/cement ratio is not exceeded.

The previously cited guidelines do not require full time inspection at the batch plant but it is advisable to have an Inspector watch the operation during the first day's production and on all-important major placements.

No concrete should be placed except in the presence of the concrete Inspector. Some of the duties of this Inspector are as follows:

1. Check the batch ticket to see if the correct concrete has been delivered. (See the Standard Specifications)

2. Observe the discharge of all concrete for acceptability (slump, air, segregation, etc.). If concrete slump is too low, it may have additional water incorporated, followed by additional mixing. Care should be exercised to be sure the problem of low slump is caused by low water. There may be other reasons for a low slump that water will only make worse. For example; sand too fine, or inadequate mixing.

3. Document any additional water added, mixing revolutions, temperature of concrete, and discharge times on the delivery ticket. The Contractor should not be permitted to move concrete down the chute with a vibrator since this segregates the concrete as it flows.

4. Document time each load is completed discharging.

5. Document where each load of concrete is placed, and how much of the load is placed there.

6. Take slump, air, and cylinder tests as specifications require, or as required to assure compliance of the concrete.

1006-2 Materials

1006-2.01 Hydraulic Cement

The Contractor is required to state the type and sources of cement when he submits his mix design.

Refer to the *Materials Policy and Procedures Directive Manual* for certification and acceptance of hydraulic cements and fly ash.

1006-2.02 Water

The Contractor should identify the source when he or she submits his or her mix design. If the water is from a potable supply obtained from a public utility, no testing is required, however a memo stating this should be submitted to Materials Group. Water obtained from any other source shall be sampled and tested.

1006-2.03 Aggregate

(A) General Requirements

The production of aggregates meeting the specification requirements is the Contractor's responsibility but this does not mean that the Engineer may divorce himself from all involvement in this phase of the work.

During aggregate production, the Engineer will periodically observe the production methods, the sampling and testing, and stockpiling and handling to determine whether the methods used will result in acceptable products. If the Engineer finds any shortcomings or problems he should discuss these with the Contractor and document the details. The Engineer will not do production control testing; quality control is entirely the Contractor's responsibility.

Aggregates must be inspected during production to make certain that they do not become segregated through improper handling or stockpiling practices, and that they do not become contaminated. Allowing equipment with steel tracks to operate on stockpiles will tend to break edges of coarse aggregate. This material filters down through the voids and may cause the lower portions of the coarse aggregate stockpile to be out of grading specifications due to the self-contamination.

Uniformity of moisture contents is essential in the production of a concrete mix of uniform consistency. It is necessary to have uniform consistency, particularly in bridge decks, to avoid shrinkage and finishing problems. In slip form concrete pavement, it avoids edge slumping, shrinkage of the concrete, and finishing problems. Aggregate which comes directly from washing plants should remain in the stockpile long enough so that no free drainage is visible when the aggregate is transported to the mixer. Aggregate proposed for use in concrete pavement should not vary in moisture content more than 3% in any one work shift if good slump control is to be maintained.

An excess of moisture may collect in the bottom of a sand stockpile. The bottom 1 foot (0.3 meter) of a stockpile cannot be used, unless the aggregates are stockpiled on a paved surface. If the Contractor elects to reclaim the bottom of a stockpile, he will be required to do sufficient testing to be sure that the material conforms to the Standard Specifications; this may require much more testing than is needed when producing the aggregate originally.

The Contractor's sampling for moisture tests should be at intervals governed by existing conditions. If the moisture is known to be variable or if some event or production change affects the moisture, more frequent sampling may be called for. A reasonable frequency is one or two per day, if visual observation indicates little or no change.

1006-2.04 Admixtures

(A) General Requirements

The Contractor has the option of using admixtures for adjusting time of set, adding air, or for reducing water in the mix. If the admixtures have not been used with the aggregates or in the quantities proposed, the Contractor will have to test the admixtures using the proposed aggregates to determine the proper amounts to be used. Combining admixtures can result in undesirable effects that cannot be known without testing.

The mechanical dispensing devices used for admixtures must be accurate to within narrow limits so they need to be carefully checked to see that they operate properly. Some admixtures are used at rates as low as 2 or 3 fluid ounces per 100 pounds (59 or 89 milliliters per 46 kilograms) of cement, therefore, it can be seen that the dispensing equipment needs to be accurate. Accuracy checks are made by actual measurement of the material as it is dispensed.

Admixtures may be used prior to testing provided an acceptable Certificate of Compliance has been received. Refer to the sampling guide and current *Policy and Procedure Directive Manual*.

(B) Air Entraining Admixtures

The Contractor must add air entrainment when it is called for, but the air content shall not exceed 7% and temperature must be documented.

1006-3 Design of Mixtures

1006-3.01 Design Criteria

Even though the following discussion is based on ADOT design procedures, the principles apply equally to designs by a Contractor or a private laboratory. ADOT design procedures are covered in greater detail in the *Material Testing Manual*. This Manual should be in every Construction Office.

1006-3.02 Design Procedures

Approval of Portland cement concrete mix designs is described in the *Materials Policy and Procedure Directives Manua*l.

Checking the mix design is essentially the responsibility of the Regional Laboratory; however, it is important that the project personnel are able to check mix designs and evaluate mix adjustments based on the design procedures. The concrete field Inspector should be able to perform the design calculations and to understand the relationships between the various design criteria.

After the Regional Laboratory has checked the mix design, a trial mix may be produced to check the mix design against actual field conditions.

If it is found that the "trial mix" does not give the correct slump and checking has shown that the water in the aggregates has been accurately accounted for and corrected in the field mix, then it may be necessary to change the amount of water being used to obtain the specified slump.

Changes must remain within the specifications and mix design limits. If greater changes are needed, a new mix design will be required.

If it becomes necessary to increase water by more than 3 gallons per cubic yard (15 liters per cubic meter) over the design amount, the Regional and Central labs should be notified. Decreases in water are generally beneficial but if the decrease is substantial, the mix design should be checked.

1006-4 Concrete Production

Refer to the *Materials Policy and Procedures Directives Manual* and the specifications for concrete production.

1006-4.01 General Requirements

Portland cement concrete is strength specified and there are penalties against the Contractor if his product does not meet the strength requirements. Proper sampling, molding and curing of test cylinders is of the utmost importance. The specified procedures are to be followed without variation.

The anticipated strength is used by the designer to determine the strength characteristics of the structure. If the 28-day strength is below that specified or if the Contractor's 7-day strength indicates that the 28-day strength may be lower than the anticipated strength, then an immediate study should be made to see if there is any

deficiency in the materials, proportioning, or procedure. Low strength is usually an indication that something is not being done as it should be done and is an immediate signal for investigation. The District Office should be notified whenever low strength is detected. No adjustments for low strength should be made without District Office and Regional Lab approval.

The yield, as determined by form measurement, will normally be short from 3% to 5%. The reasons for this normal loss may be attributed to such things as spillage, loss of moisture and the fact that mixer truck cannot be completely discharged. Also, when concrete is placed in the forms, expansion of the forms accounts for part of the loss. The mix will not be adjusted to correct for actual yield variations based on form volumes.

Remember that the discussion in this section is only a guide for the Resident Engineer to enable him to judge whether the Contractor is controlling the mix using acceptable practices. The Resident Engineer is not to order any of the adjustments discussed in this section; control of the mix is wholly the Contractor's responsibility. If acceptable procedures are not followed, the Contractor should be so notified and the conditions documented.

1006-4.02 Proportioning

There will probably be minor adjustments needed due to one or more of the following causes:

1. Moisture content of aggregate being used.

2. Variation in air content.

3. Variation in slump.

All the variations can be corrected by field adjustments. However, judgment is needed to determine when to consult with the Region before allowing the Contractor to make adjustments. Major adjustments may require the Contractor to submit a new mix design.

The mix design is designed on the basis of an absolute volume of 27 cubic feet (0.765 cubic meters) and aggregates in the saturated surface dry (SSD) condition.

All equipment should be inspected to assure that all scales, dials, metering devices, etc. are graduated within allowable tolerances and accurate as outlined in the specifications.

(B) Water

It is extremely important that the amount of water being used in the mix be known at all times; therefore, the water tank or water meter should be the first piece of equipment to be calibrated. This can be done by drawing off water and measuring or weighing the amount for different settings of the gauge or meter. Water valves should be inspected to make certain there are no leaks into the mix.

(C) Aggregates

The amount of mixing water will probably have to be adjusted to allow for the moisture content variations as the stockpiles are used. It is preferable that stockpiles are kept in a SSD condition to minimize adjusting mixing water. The Contractor should make moisture determinations at least daily or as often as conditions require.

Scales for weighing cement and aggregate should be inspected for condition of working parts and knife edges. Hoppers should be inspected to make certain that there is no possibility of leakage and that each hopper

empties completely. Make certain that the cement hopper is equipped with one or more suitable vibrators as required by the Standard Specifications.

Batching scales must be checked and certified by the Department of Weights and Measures before any production begins. Certified 50 pound (22.680 kilogram) weights furnished by the Contractor or supplier should be available at all times for checking these scales. To check scales using these weights, use the DWM approved procedure. If the scales are not accurate within the limits of the specifications, they should not be used until repaired or adjusted. The scales should be balanced several times each shift and should be retested when deemed necessary by the Engineer

(D) Admixtures

It should be noted that the Standard Specifications require that any admixture added shall be added by means of mechanical dispensing equipment. The Inspector should examine and test the dispensing equipment to see that it functions properly and that the amount of admixture can be accurately measured and also that the amount of admixture used can be readily adjusted.

The mix design will show the amount of air entraining agent estimated to be required to give the specified air content. It must be realized, however, that the effectiveness of air entraining agents may be changed by the effectiveness of the mixing of the concrete. The mixing action of the particular mixer employed may have an effect on the amount of air entrained. The amount of air entrained by a large batch mixer or a transit mixer might be much greater or less than the amount obtained by a somewhat smaller mixer.

The amount of air entrained is also variable with the temperature of the mix. The effectiveness of the air-entraining agent is ordinarily decreased with higher temperatures or increased with lower temperatures. It can be seen that the amount of air entraining agent required in the field might be entirely different from the originally recommended amount.

After one or two tests have been made to determine the amount of air entrained, it will often be found necessary to increase or decrease the amount of air entraining agent used on future batches. After the correct amount is once determined, the same amount will usually continue to be satisfactory unless there is considerable temperature change or some other variation which might affect the results.

If it is noted during construction that a high or a low air content has been obtained, one or two check tests should be made immediately. If these check tests confirm the original result then adjustments should be made in the amount of air entraining agent used. (Air meters sometimes get out of adjustment. To assure that results are correct, the air meter should be calibrated prior to each day's use.)

There is one other factor which sometimes affects the quantity of air entraining agents required. Some of these agents have a tendency to settle or separate in the drum. Agitation of these materials is not required by the Standard Specifications, however, it is believed to be necessary in all cases to assure that the original quality of the material is maintained. The Engineer should therefore require such agitation at lease once daily when the material is being used.

1006-4.03 Mixing

(A) General Requirements

Because the Contractor is responsible for the concrete does not mean that the Resident Engineer is unable to reject material that is obviously improperly batched. Likewise, if batching equipment is malfunctioning, the

Engineer has the authority to refuse the product. All information regarding improper batching or malfunctions of equipment must be carefully documented by the Engineer.

In order to assure that the Contractor will be able to control concrete production, the Resident Engineer will have to inspect the batching and mixing equipment for proper operation including checking the weighing devices in actual operation.

Checking will begin with the stockpiled aggregates to see that the stockpiles do not become segregated and that intermingling of stockpiles does not occur. Adequate bulkheads or pile separation will prevent mixing as the piles are built and when material is removed. Spillover in batching bins is fairly common when the bins are loaded with an end loader. It is not unusual to find good stockpile control but poor control in the bins. While the Engineer cannot direct changes in the Contractor's operation, they do have the authority to refuse to accept material that is produced when the equipment is not functioning properly. Whenever material is rejected because of faulty processing, it is important to be sure of what the mechanical problem is, what the effect on the final product is, and to carefully document all the details. It goes without saying that every effort should be made to induce the Contractor to operate efficiently without getting into the position of having to reject the material being produced.

(B) Mixing in a Stationary Mixer

After the field mix has been determined by the Contractor, the weights of each size of aggregate, cement, water, air entraining agent, and admixtures, if any, are usually given to the operator for posting on the scales. Any subsequent change in the weights due to a change in the proportions or a change in the free moisture content, should be posted, by the Contractor, on the scale and copies provided to the operator. Each change should be noted in the Inspector's records, with each one being dated including the time.

It is often useful to prepare a chart showing batch weight adjustments for changes in aggregate moisture content. The Inspector can make a quick check of the changes needed to be made by the Contractor to allow for variations in the moisture content.

Batching plants can be classified into three categories: manual, semi-automatic, and automatic. All three types are permitted under the Standard Specifications. The operator controls all the functions necessary to complete the weighing and dumping on the manual plant. This type of plant is subject to human error in every operation so it should be inspected carefully by the Inspector. A semiautomatic plant is governed by controls that are actuated in a certain sequence to complete the batching cycle. An automatic plant has the complete batching cycle set in motion by a control button, which may be located remotely from the plant. Automatic plants are seldom encountered except at commercial concrete plants and large paving plants.

Dial scales or a load cell providing a digital printed readout is required for weighing all hydraulic cement.

(C) Mixing in Truck Mixers

A large percentage of the concrete placed in structures is mixed by truck mixers. This equipment is not usually permitted for mixing concrete for pavement principally because it cannot quickly discharge the low slump concrete which is required for pavement. (Tilt-up type mixers are an exception.) Truck mixers usually are satisfactory for structural concrete but require constant inspection of the operation. Instead of having one mixer and one operator to control, as in central mixed concrete, there may be a dozen or more truck mixers and operators, on a large job, where concrete is being mixed by truck mixers. Each truck mixer should be inspected occasionally for hardened concrete, worn blades, and water leaks. The Inspector must see that no mixer is loaded beyond its mixing capacity as indicated on the manufacturer's plate attached to the mixer. Weighing trucks before and after charging is an excellent check on the accuracy of the plant.

Where feasible, and when the equipment is adaptable, the sequence of weighing and discharging the aggregates, cement, and water from the batch plant should be such that a small amount of water enters the mixer in advance of the other ingredients; then, followed by a blended "ribbon" of all the other ingredients, together with the remainder of the required water. Extensive research has proven conclusively that the "ribbon" method of charging a mixer contributes greatly to the uniformity of the concrete within any given batch. The transit mixers should be periodically inspected to confirm that the drums are free of water before being charged

The Standard Specifications require that each batch shall be mixed for not less than 70 and no more than 100 revolutions, at mixing speed, except that the maximum may be increased upon approval of the Engineer. Any revolutions made beyond the 100 specified as maximum are required to be at agitation speed.

Specification 1006-4.03(A) permits mixing at the plant site or at the delivery site. This specification has been interpreted to mean that mixing may also be performed while the truck mixer is enroute between the plant and the delivery site. Remember the maximum time limit for mixing to begin.

If it is necessary to add water to the mix at the site, it is required that the mixer shall be turned a minimum of 20 revolutions at mixing speed before the concrete may be discharged. The amount of water added, and the additional mixing time (or revolutions) shall be recorded on the concrete delivery ticket and, where appropriate, on the test report. This additional mixing may be in excess of the maximum revolutions previously specified. Remember that if samples are taken, they should be taken after all the water has been added.

Regardless of the type of mixer, the mixer drum should be inspected for worn blades or hardened concrete, rate of rotation, and mixing time. Each mixer is required to have a nameplate attached showing capacity and recommended speed of operation.

If truck mixers are used they are to be inspected, and the inspection will be documented in compliance with the *Materials Policy and Procedures Directives Manual*, 96-10.

1006-6 Curing Concrete

Curing practices can significantly detract from, or enhance the long-term durability of concrete. Inspectors and concrete finishers usually don't place close attention to curing practices and to concrete while it cures, but they should. Research has shown that the service life of concrete slabs, decks, pavements and walls is increased when proper curing procedures are followed. Given the high cost of replacing existing highway pavements and structures, the extra amount of time and effort spent on properly curing concrete in its first 7 to 10 days can save literally tens of thousands of dollars over time.

Wet curing for 7 days is the most preferred method of curing. Contractors prefer to use liquid membrane curing since it is much less labor intensive. However, if given a choice, wet curing should be preferred over curing membrane since the added water will promote hydration.

1006-7 Acceptance Sampling and Testing

1006-7.02 Sampling and Testing of Concrete

In all cases, a diligent effort should be made to keep the consistency of the concrete within the range of slump and/or air as specified. However, when an occasional batch of concrete is found to have a slump or air content in excess of the maximum specified, corrective action must be taken.

Field tests will be made in accordance with the requirements of AASHTO T-119 on the concrete as it is discharged to determine the consistency in slump. One additional slump test will be made on a concrete batch that has failed to fall within the required slump range on the first test, unless the Contractor elects to make adjustments in the slump. If adjustments are made, the concrete batch will be tested twice after such adjustments. In either case, the average of the two tests for that batch shall be within the required slump range and no single test shall be less or greater than the required range by more than one inch. Concrete that does not conform to the above consistency requirements should be rejected.

High slump concrete which has been placed prior to obtaining slump test results is subject to adjustment in price or removal based on the 28-day compressive strength obtained. An additional set of cylinders should be made to represent the load or portion of a load of high slump concrete placed. The location of the concrete in the structure and the quantity represented by the extra cylinders must be recorded.

Proper fabrication, handling, and curing of the cylinders are extremely important. All personnel responsible for any of the tasks relating to cylinders should be thoroughly familiar with AASHTO T23, T119, T152, and all the latest revisions.

The relationship between the Contractor's and ADOT's testing programs should be discussed at the preconstruction conference and just prior to the beginning of concrete work. The Engineer should request that if the Contractor finds any fault with the ADOT sampling and testing procedures, he will be notified immediately. The Contractor should also be clearly informed that he will be promptly notified in writing of any shortcomings in his procedures.

It should be apparent that ADOT project personnel doing testing must perform the tests in exact conformity with the prescribed test method. The testing technique should be observed frequently and referee tests should be made often enough to assure that proper procedures are being followed.

Compressive strength is not the only measure of the quality of concrete. The compressive strength test does not measure actual field strength of concrete. Field curing procedures (Subsection 1006-6) are different than the test cylinder curing procedure. Field conditions, such as ambient temperature and relative humidity can vary, but test cylinders should be cured in a controlled environment.

Failure to meet the specified mix design criteria such as slump, air, mixing time, segregation, incorrect batching, unloading time, etc., may be sufficient reason for rejection regardless of any claim by the Contractor that the concrete is acceptable because it will meet the strength requirement.

Sampling of fresh concrete mix for testing purposes, fabricating cylinders, or beams shall be in accordance with the *Materials Testing Manual*.

Some Contractors and suppliers are doing independent concrete testing and are being observed by ADOT personnel. If the Contractor performs the test they should be observed and documented noting whether test procedures conform to ADOT procedures.

1006-7.03 Sampling Frequency for Cast-In-Place Concrete

The Standard Specifications state that a sample for a strength test will be taken at random for each 100 cubic yards (75 cubic meters) or fraction thereof consecutively placed concrete on a daily basis for cast-in-place concrete. The minimum number of required cylinder sets is listed on the materials checklist. An air content test should be taken every 50 cubic yards (38 cubic meters) at elevations above 3000 feet (1000 meters).

In order to eliminate bias, the sample for a strength test should be obtained from the truck or batch which contains a predetermined cubic yard of concrete. This predetermined cubic yard represents 100 cubic yards (75 cubic meters) or fraction thereof and should be selected by use of random numbers.

1007 RETROREFLECTIVE SHEETING

The material specified in this section is used on signs and markers and is intended to provide good visibility by day and night. The sheeting must be on the Department's Approved Products List. The current APL is available on the Internet from the Arizona Transportation Research Center (ATRC), through its PRIDE program. Certifications and test reports furnished by the Contractor should be submitted to Traffic Design Services for review and acceptance.

The Engineer must make inspections of the sheeting in the field to see that:

- the correct type of sheeting is used;
- it adheres properly to the support;
- colors, reflectivity are uniform; and
- it is free of dirt, scratches, and other unacceptable conditions.

When sheets from different production runs are used on the same panel, there may be an obvious difference in color or reflectivity that is not acceptable.

Bubbles and loose corners or edges are not acceptable.

1008 PRISMATIC REFLECTORS

This section covers the material requirements for reflectors used on delineators, markers, and letters, symbols, etc. on signs.

When used in arrays, such as for letters or numbers on a sign, all the reflectors are to be from the same manufacturer. Reflectors from different sources that vary in brightness or color and do not present a uniform appearance are not acceptable. The use of reflectors in delineators and markers is discussed in Specification 703.

The prismatic reflectors in button-copy signs should be attached to the frame of the letter.

1009 ASPHALT RUBBER MATERIAL

1009-2 Materials

Certificates of Compliance are required. The Inspector should verify that the certificate confirms the rubber is a crumb rubber derived from materials listed in the Standard Specifications and no waste products were generated during processing.

1009-2.02 Asphalt-Rubber Proportions

Asphalt rubber shall contain a minimum of 20% ground rubber by weight of the asphalt cement. The Inspector should check the proportions to ensure the required amount of rubber material is being incorporated into the asphalt-rubber mixture and is documented by the Contractor.

1009-3 Construction Requirements

1009-3.01 Mixing of Asphalt-Rubber

The temperature of the asphalt cement shall be between 350 °F (177 C) and 400 °F (204 °C) at the addition of rubber. The Inspector should review Section 1009-3 of the Standard Specifications for other requirements regarding mixing of asphalt-rubber. The Inspector should also check the Contractor's operation for compliance and that all information can be determined by temperature measuring devices on the storage and mixing tanks.

Prior to production, the Inspector should review the Contractor's proposed form for recording all the information that is required in Section 1009-3 of the Standard Specifications to ensure that all the information is included. Each batch of asphalt-rubber material should be produced so that all the requirements may be determined by the Contractor's documentation. Contractor's documentation should show all the requirements needed for each batch of asphalt-rubber.

1009-3.02 Handling of Asphalt-Rubber

Once the asphalt-rubber has been mixed, the Contractor's documentation should contain information that each batch of asphalt-rubber material is handled in accordance with Section 1009-3 of the Standard Specifications. Temperatures should be spot checked during the shift by the Inspector.

1010 DRAINAGE PIPE

Certificates of compliance for culvert pipe materials need to be carefully compared with the requirements of the Standard Specifications. Each type of culvert material may be covered by several Standard Specifications each of which must be cited in the certificates. Chapter 5 contains additional information on pipe culvert and storm drains.

An exhibit of the different gauges may be seen in Section 1325 of this Manual.

1011 JOINT MATERIALS

The items included under this section are rubber waterstops, PVC waterstops, joint sealant (hot poured), joint sealant (cold application), bridge deck joint seals (neoprene), preformed expansion joint filler, bituminous joint filler, non-bituminous joint filler, cellular plastic joint filler, and silicone joint sealant.

Certificates of Compliance are required for all joint materials. Each type of joint material will have installation procedures recommended by the manufacturer which are to be carefully followed. A copy of the recommended procedures furnished by the Contractor is to be included in the project records along with a statement that the material was installed as recommended by the manufacturer. Compare the certification with the specification requirements to be sure that the certification is complete. Also refer to the Sampling Guide Schedule in the *Materials Testing Manual* for instructions.

The specification for Bridge Deck Joint Seals (compression & strip seals) requires that one piece of the material shall be furnished 18 inch (0.5 meter) longer than needed. The extra material is cut off for a test sample.

1012 GUARDRAIL MATERIALS

The ARTBA Guide to Standardized Highway Barrier Rail Hardware is available from the District office. The ARTBA drawings are basically the same as some of the drawings in AASHTO M-180 and in the Standard Drawings but may contain more detail.

Reflector tabs made by stamping from galvanized metal sheet are acceptable. The ungalvanized edge is not considered detrimental to the nonstructural tabs.

The guidelines for the inspection of timber posts and blocks are found in the Materials Policy and Procedures Directive 02-01.

Post and block inspection for appearance and physical characteristics is a project responsibility.

1013 BEARING PADS

The Standard Specifications, Section 1013, describe several different types of bearing pads. It is important to note the type called for in the plans and to read the appropriate Special Provisions and Standard Specifications. All types must be sampled on varying schedules, and all require manufacturer's certification. Preformed fabric pads are tested by ADOT. The Contractor is responsible for assuring that elastomeric pads are tested.

Bearing pads should be visually inspected for workmanship and conformance to design tolerances. They should be free of damage from weather, handling or other hazards. At the time of installation, they should be clean and free of contaminants.

Installation at the proper position and orientation are critical. Pads must be set only on concrete surfaces which have been properly prepared in accordance with the Standard Specifications.

1014 GEOSYNTHETICS

Section 1014 of the Standard Specifications describes several different types of geosynthetics and their uses. It is important that each be used for the specific purpose specified.

Certificates of compliance are required before the material is incorporated into the work. Materials should be sampled and submitted for testing to the region laboratory. All materials should be visually inspected to see that they were shipped and handled in accordance with manufacturers' instructions and that care has been exercised to prevent damage. Materials should be free from tears and other obvious defects.

Materials should be installed in accordance with specifications and with the manufacturers' recommendations. Care should be taken to ensure proper overlaps, when appropriate, and anchors or staples should be installed properly. Wrinkles should normally be avoided. Geosynthetics must be installed over properly prepared surfaces. Most materials can be damaged by heavy equipment running directly on the fabric, and should be backfilled with care.

1015 EPOXY MATERIALS

All epoxy materials must be on the ADOT Approved Products List for the proposed use. Certificates of compliance must be supplied by the Contractor before any material is incorporated into the work.

Use should be in accordance with Standard Specifications and manufacturer's recommendations. Epoxy components that were stored at temperatures below 35 degrees (2 degrees Celsius) tend to crystallize or thicken excessively. The Inspector should verify that crystallization, or increased viscosity, or settling of pigments has not taken place. Components should be kept at a temperature between 60 and 85 degrees (16 and 19 degrees Celsius) just prior to mixing. Materials should be thoroughly mixed, unless installed through dual injection tips. Before application, surfaces should be properly prepared and clean and dry.

APPROVED PRODUCTS LIST

The Approved Products List (APL) is a list of products that are used in the construction and maintenance of the State's highway system. The APL process begins by manufacturers submitting products for testing. Once the products are tested, the Product Evaluation Committee decides whether they are suitable for highway use. When a product has been approved it is added to the APL.

The APL does not eliminate field testing requirements that are specified in the Standard Specifications, the *Materials Group Policy and Procedures Manual*, or the Special Provisions for each project. If a Contractor submits a product that is not on the APL, then it is left to the discretion of the Engineer to show that the product is of equivalent value before use.

REFERENCES

Standard Specifications for Road and Bridge Construction, Arizona Department of Transportation, Phoenix, AZ

Materials Policy and Procedure Directives Manual, Current, Arizona Department of Transportation, Phoenix, AZ

Materials Testing Manual, Current, Arizona Department of Transportation, Phoenix, AZ

Pay Item Documentation for Inspectors, Arizona Department of Transportation, Phoenix, AZ

Metrication Guidelines, Arizona Department of Transportation, Phoenix, AZ