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ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

SECTION 02722

GRADED CRUSHED AGGREGATE BASE COURSE FOR FLEXIBLE PAVEMENT
03/03

NOTE: This guide specification is issued by the
Atlantic Division, Naval Facilities Engineering
Command for regional use in Italy.

NOTE: This guide specification covers the
requirements for graded crushed aggregate base course
for use under flexible pavements only.

Comments and suggestion on this specification are
welcome and should be directed to the technical
proponent of the specification. A listing of the
technical proponents, including their organization
designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer
choices or locations where text must be supplied by
the designer.

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3017 (1996) Water Content of Soil and Rock in
Place by Nuclear Methods (Shallow Depth)

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

NOTE: A UNI Norm is a technical normative recognized as Italian Law, submitted by a private organization "Ente Nazionale Italiano di Unificazione" for Italy and is available only in the Italian language. It is the National Standard.

UNI CNR 10008	Test on road construction materials - Moisture content of soil
UNI CNR 10009	Test on road construction materials - Bearing capacity (cbr) of soil
CNR UNI 10014	(1964) Soil tests - Determination of the consistency (Atterberg) of a soil

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN)
(UNI EN ISO)(UNI ISO)

NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.

UNI EN 206-1	Concrete - Specification, performance, production and conformity
UNI EN 474-1	Earth-moving machinery - Safety - General requirements
UNI EN 474-1/A1	Earth-moving machinery - Safety - General requirements (Amendment)
UNI EN 474-7	Earth-moving machinery - Safety - Requirements for scrapers
UNI EN 474-8	Earth-moving machinery - Safety - Requirements for graders
UNI EN 500-1	Mobile road construction machinery - Safety - Common requirements
UNI EN 500-2	Mobile road construction machinery - Safety - Specific requirements for road-milling machines

UNI EN 500-3	Mobile road construction machinery - Safety - Specific requirements for soil stabilization machines
UNI EN 500-4	Mobile road construction machinery - Safety - Specific requirements for compaction machines
UNI EN 932-1	(1996) Tests for general properties of aggregates - Part 1: Methods for sampling
UNI EN 932-2	Tests for general properties of aggregates - Methods for reducing laboratory samples
UNI EN 933-1	Tests for general properties of aggregates - Methods for reducing laboratory samples method
UNI EN 1097-2	(1998) Tests for mechanical and physical properties of aggregates - Part 2: Methods for the determination of resistance to fragmentation
UNI EN 1097-3	(1998) Tests for mechanical and physical properties of aggregates - Part 3: Determination of loose bulk density and voids
UNI EN ISO 6165	Earth-moving machinery - Basic types - Vocabulary

NATIONAL RESEARCH COUNCIL (CNR)

CNR BU n. 22	(1972) Apparent Specific Gravity Weight of Soil in Situ
CNR BU n. 34	(1973) Determination of /weight Loss for Fragmentation of Aggregates with Los Angeles Apparatus
CNR BU n. 69	(1978) Code of Road Construction Materials - Compaction Test of Soil
CNR BU n. 139	(1992) Acceptance Criteria for Aggregates Used for Road Constructions
CNR BU n. 146	(1992) Plate Loading Soil Test
CNR BU n. 176	(199) Acceptance and Plating Criteria for Unbound Natural or Crushed Graded Aggregates used for Base and Subbase Course of Road Constructions

1.2 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item is required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Recommended codes for Army projects are "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-06 Test Reports

Gradation

Bearing ratio

Liquid limit

Plasticity index

Percentage of wear

[Dry weight of slag]

Density

Smoothness

Thickness

1.3 DELIVERY AND STORAGE

Inspect materials delivered to site for damage and store as to prevent segregation and contamination.

1.4 WEATHER LIMITATIONS

Do not construct base course when atmospheric temperature is below 2 degrees C or when rainfall or other weather conditions detrimentally affect the quality of the finished course. Any areas of completed base course that are damaged by rainfall or other weather conditions shall be brought to a satisfactory condition by the contractor in conformance with this specification without additional cost to the Government.

1.5 CONSTRUCTION EQUIPMENT

Equipment shall be dependable and adequate for the purpose intended. Maintain equipment in satisfactory and safe operating condition. Subject to approval, special equipment dictated by local conditions may be used. Calibrated equipment, such as scales, batching equipment, spreaders, and similar items, shall have been recalibrated by an approved calibration laboratory within [12] [_____] months of commencing work. All machineries shall comply with UNI EN 474-1 and UNI EN 474-1/A1, UNI EN 474-7, UNI EN 474-8, UNI EN 500-1, UNI EN 500-2, UNI EN 500-3, UNI EN 500-4 and UNI EN ISO 6165.

1.6 APPROVAL OF MATERIAL

The source of the material shall be selected 30 days in advance of the time materials will be required in the work. Tentative approval of the source will be based on an inspection by the Contracting Officer. Tentative approval of the material will be based on tests, including gradation, liquid limit, and plasticity index, performed on samples of production for the specific job. Final approval of both the source and the materials will be based on tests for gradation, liquid limit, specific gravity, and plasticity index, performed on samples taken from the completed and compacted base course.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aggregates

NOTE: Maximum amount of material passing 75 micrometers sieve for 50 mm maximum should not be more than 7 percent, for 38 mm maximum 8 percent, and for 25 mm maximum 9 percent, where frost is a factor in design.

NOTE: Delete percentage of wear and weight of slag not applicable to the project. For pavement designed for aircraft equipped with tires having pressure of 1725 kPa or more, the percentage of wear should not exceed 40; and for slag, the weight should be not less than 1120 kg per cubic meter; for tire pressures less than 1725 kPa, the percentage of wear may be increased to 45; and for slag, the weights may be reduced to 29.4 kg. The requirements of 40 or less for wear test under high pressure tires may be increased to 45 if a satisfactory service record can be demonstrated.

NOTE: Delete the sizes which are unsuitable for the thickness of the base course layer to be constructed or are not available. The compacted thickness of any compacted base course layer should be limited to a maximum of 150 mm and a minimum of 75 mm. The gradations may be modified to suit local conditions; however, the composite material must meet the required California Bearing Ratio. Prior to specifying any modified gradation, tests should be performed using the material to be incorporated in the base course to determine whether the modified gradation will provide the required California Bearing Ratio.

CNR BU n. 139 Graded aggregates generally are not considered suitable for base course of roads subject to heavy and very heavy traffic (as defined by CNR BU n. 176), unless appropriate testing and analysis or past experience demonstrate the suitability of such material. Sieve analysis shall be carried out in compliance with UNI EN 933-1. Gradation shall comply with the limits defined in table 1, CNR BU n. 176 and reported in the following lines:

Percentage by weight passing sieve analysis (table 1, CNR BU n. 176)

Sieves	Passing Percentage by Weight
40 mm	100%
25 mm	75-100%
15 mm	45-75%
10 mm	35-65%
4 mm	25-50%
2 mm	15-35%
0.4 mm	8-22%
0.18 mm	5-18%
0.075 mm	2-10%

The percentage of crushed aggregates shall be 70% for road constructions subject to light traffic loading, 100% in all other cases (medium, heavy and very heavy traffic). CBR factor shall be determined through laboratory testing on samples compacted at 100% maximum density with the modified AASHTO procedure (as per CNR BU n. 69) at the optimal moisture content (with a tolerance variation within plus or minus 2% of optimal value), after 4 days of soaking, and shall not be less than 80 (see UNI CNR 10009).

Also, loss of weight testing with "Los Angeles" procedure as per UNI EN 1097-2 (or CNR BU n. 34) shall be not greater than 25-30%. The compressive test on site through the circular plate loading method (as per CNR BU n. 146) shall give a modulus MD not less than 1000 kg/sqcm. The portion of material passing the 0.4 mm sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 as determined by CNR UNI 10014. Prepare samples in accordance with UNI EN 932-1.

PART 3 EXECUTION

3.1 BASE COURSE

Construct the graded aggregate base course on a [prepared subgrade] [previously constructed subbase course], as indicated. Provide line and grade stakes for control. Place grade stakes in lanes parallel to the centerline of areas to be paved and space for string lining or other control methods. The base course shall consist of aggregate processed, deposited, spread, and compacted on a prepared surface. The Contractor shall be responsible for protection of completed areas against detrimental effects. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions.

3.2 GRADE CONTROL

During construction, the lines and grades indicated for the base course shall be maintained by means of line and grade stakes placed by the contractor at the site of the work.

[3.2 OPENING AND OPERATION OF PITS

NOTE: If suitable material is available from stockpiles, it should be so stated and the location of the stockpiles shown or specified.

NOTE: Delete this paragraph when material is furnished by the Contractor from other than Government owned or licensed pits.

Perform stripping, clearing, processing, and blending in the opening of new pits and operation of existing pits as necessary to obtain acceptable material. Open pits in a manner to expose the vertical faces of the deposits for suitable working depths, following which the material shall be obtained in successive vertical cuts extending through the exposed strata.

Waste strata and pockets of unsuitable materials overlaying or occurring in the deposit. Change or modify the method of operating the pits, and the processing and blending of the material when necessary to obtain material conforming to the specified requirements. Upon completion of the work, condition pits to drain readily and leave in a satisfactory condition.

]3.3 MIXING OF MATERIALS

Mix aggregates in a stationary or traveling plant. Proportion aggregates by weight or volume in such quantities that specified gradation, liquid limit, and plasticity index requirements are met after the base course has been placed and compacted. Incorporate, during the mixing operation, water in quantities sufficient to provide the necessary moisture content for the specified compaction. Mixing operations shall produce satisfactory uniform blending and the method of discharging into trucks shall not produce segregation.

3.4 PLACING

Do not dump mixed materials in piles, but place on prepared subgrade or subbase in layers of uniform thickness with a spreader. When a compacted course 150 mm in thickness is required, place material in a single layer. When a compacted course in excess of 150 mm is required, place material in layers of equal thickness. Do not exceed 150 mm or have less than 75 mm in thickness for any compacted layer. Place layers so that when compacted, they will be true to grades or levels required with the least possible surface disturbance. Where the base course is constructed in more than one layer, clean previously constructed layers of loose and foreign matter. Maintain material water content during the placing period to obtain the compaction specified. Make adjustments in placing procedures or equipment to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to insure a satisfactory base course.

3.4.1 Stationary-Plant Method

Mix aggregates, binder material and water until a uniform homogeneous mixture is obtained. Do not dump materials in piles; place in layers of essentially uniform thickness, not to exceed 150 mm after compaction, by an approved spreader. Tail gate spreading will be acceptable only with permission, under conditions such as where space limitations prohibit use of the spreader.

3.4.2 Windrow Traveling-Plant Method

Place aggregates and binder materials in windrows of such cross section and proportions that, when picked up, mixed, and redeposited in windrows, the finished mixture shall conform to the specified requirements. Do not exceed the rated capacity of the traveling plant with the size of the windrow of the combined materials. Add water, in quantity sufficient to provide the necessary moisture content for compacting, to the aggregates at the time of mixing. Mix materials uniformly by the traveling plant, deposit in windrows of uniform cross section, and spread in a layer of uniform thickness to the required contour and grades.

3.5 COMPACTING AND FINISHING

NOTE: Specify method of determining in-place density by nuclear procedures for projects which require large quantities of base course material and provided that the available nuclear devices can be standardized for the graded aggregate base materials.

Immediately following the placing, spread the finished mixture uniformly in a layer and bring to optimum moisture content. The loose thickness and the surface of the layer shall be such that the specified density and the required thickness shall be obtained after compaction. Compact the layer with steel-faced, vibrating or pneumatic-tired rollers, or other suitable compacting equipment or combinations thereof. Continue compacting until the layer is compacted through the full depth to a field density of at least 100 percent of the maximum density at optimum moisture content tested in accordance with CNR BU n. 22 [UNI CNR 10008 and ASTM D 3017.] In areas not accessible to rollers or compactors, compact the mixture with mechanical hand tampers. If the mixture is excessively moistened by rain, aerate by blade graders, or other suitable equipment. Aerate until the moisture content of the material is that needed to obtain the required density. Finish the surface of the layer by a combination of rolling and blading. Final surface shall be smooth and free from waves, irregularities, and ruts or soft yielding spots.

[3.6 PROOF ROLLING

NOTE: Modify this paragraph as necessary to proof roll other areas. The areas given in this paragraph are as required by Design Manual 21.03 for Navy airfield pavements but may be modified if project requirements so dictate.

On the center 7.50 m of taxiways and on the center 30 m of runways, in addition to compacting the base course to the required density, proof roll the top surface of the completed base course by making eight passes with a heavy rubber-tired roller having four tires with each tire loaded to 13,600 kg or more and inflated to at least 1034 kPa. Make four passes over other areas to be paved, excluding the runway over-runs, blast protection areas, and shoulders. A pass is defined as one application of one tire print over each point in the surface of the designated area. When under the action of the proof rolling, the base course yields, pumps, or otherwise fails, remove, replace with suitable materials, and recompact materials in the base course or in the underlying layers indicated to be unsatisfactory. The speed of the roller shall not exceed 8 kph. Obtain approval upon completion of the proof rolling of the base course.

]3.7 FINISHING AT EDGES OF BASE COURSE

Place earth or other approved materials along the edges of the base course

in such quantity that it will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, place material to the thickness of each layer. In each operation, allow at least a 300 mm width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer.

3.8 FIELD QUALITY CONTROL

Approve materials and material sources in advance of the use of such materials in the work. Replace base where samples are removed. [Provide duplicate samples to the Contracting Officer on an average of [_____] samples a [week] [month]. Take duplicate samples at the same time and in the same manner as the original.]

3.8.1 Sampling

3.8.1.1 Aggregates at the Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with UNI EN 932-1. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 23 kg. Repeat above sampling when source of material is changed or when unacceptable deficiencies or variations from specified grading of materials are found in testing.

3.8.1.2 During Construction

Take one random sample from each [1000] [_____] metric tons of completed course material, but not less than one random sample per day's run. Take samples in accordance with UNI EN 932-1.

3.8.1.3 Sample Identification

Place each sample in a clean container, securely fastened to prevent loss of material. Tag each sample for identification and with the following information:

Contract No. _____
Sample No. _____ Quality _____
Date of Sample _____
Sampler _____
Source _____
Intended Use _____
For Testing _____

3.8.2 Testing

3.8.2.1 Aggregates

Test each sample of base course material without delay. Make gradation tests from each sample in accordance with UNI EN 933-1.

3.8.2.2 Smoothness Tests

Test surface with a 3 m straightedge, applied parallel with and at right angles to the center line of the paved area. Correct deviations in the surface in excess of [10] [13] mm by loosening, adding or removing material, reshaping, watering, and compacting. The smoothness requirements specified herein apply only to the top layer when base course is constructed in more than one layer.

3.8.2.3 Field Density Tests

NOTE: Specify method of determining in-place density by nuclear procedures for projects which require large quantities of base course material and provided that the available nuclear devices can be standardized for the graded aggregate base materials.

CNR BU n. 22 or [UNI CNR 10008 and ASTM D 3017]. Take one test for each [420] [_____] square meters of each layer of base course.

3.8.2.4 Laboratory Density Tests

In accordance with CNR BU n. 69, Method D.

3.8.2.5 Thickness Tests

Measure thickness of base course at intervals such that there will be a depth measurement for at least each [420] [_____] square meters of complete base course. Make depth measurements by test holes, at least 75 mm in diameter, through the base course. Where base course deficiency is more than 13 mm, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness is more than 13 mm thicker than indicated, consider it as the indicated thickness plus 13 mm for determining the average. The average thickness is the average of the depth measurements and shall not underrun the thickness indicated.

3.9 MAINTENANCE

After construction is completed, maintain the base course throughout, except where portion of the succeeding course is under construction thereon. Maintenance includes drainage, rolling, shaping, and watering, as necessary, to maintain the course in proper condition. Correct deficiencies in thickness, composition, construction, smoothness, and density, which develop during the maintenance, to conform to the requirements specified herein. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --