

A-JACKS® Concrete Armor Unit Specification

6 ft, 8 ft & 10 ft A-Jacks Units

PART 1: GENERAL

A. Scope of Work

The Contractor shall furnish all labor, materials, equipment, and incidentals required and perform all operations in connection with the installation of A-JACKS® concrete armor units in accordance with the lines, grades, design and dimensions shown on the Contract Drawings and as specified herein.

B. Submittal

The Contractor shall submit to the Engineer all manufacturers' hydraulic testing and calculations in support of the proposed cellular concrete mat system and geotextile.

The Contractor shall furnish the manufacturer's certificates of compliance for cellular concrete blocks/mats, revetment cable, and any revetment cable fittings and connectors. The Contractor shall also furnish the manufacturer's specifications, literature, shop drawings for the layout of the mats, and any recommendations, if applicable, that are specifically related to the project.

Alternative materials may be considered. Such materials must be pre-approved in writing by the Engineer prior to bid date. Alternative material packages must be submitted to the Engineer a minimum of fifteen (15) days prior to bid date. Submittal packages must include, as a minimum, the following:

1. Full-scale laboratory testing and associated engineered calculations quantifying the hydraulic capacity of the proposed cellular concrete mat system in similar conditions to the specific project.
2. A list of 5 comparable projects, in terms of size and applications, in the United States, where the results of the specific alternate revetment system use can be verified after a minimum of one (1) year of service life.

PART 2: PRODUCTS

A. General

The geometry of an A-JACKS® concrete armor unit consists of six arms extending from a central hub. A complete unit is made up of two identical halves, with each half consisting of a central core with three legs radiating outward at equal spacing. On each

half, two fillets are located between adjacent arms. These fillets provide additional structural strength and aid in the proper placement of the armor units.

When the symmetrical halves are interlocked, the resultant unit will have geometry, which exhibits six equally spaced arms, with each arm spaced at 90 degrees from the four adjacent arms. When placed in the most stable configuration, each unit will rest on three of the six arms.

B. Concrete Armor Units

1. Scope

1.1 This specification covers concrete armor units for erosion control used for coastal applications (shoreline, breakwaters, jetties, and other harbor structures), along with toe-protection and slope protection for streambank applications.

2. Materials

The 6 ft. (AJ-72) A-Jacks units, 8 ft (AJ-96) and 10ft (AJ-120) A-Jacks units will be produced with precast concrete.

2.1 Cementitious Materials - Materials shall conform to the following applicable ASTM specifications:

2.1.1 Portland Cements - Specification C 150, Type I, II, III or V.

2.1.2 Aggregates: ASTM C33 or C330

2.1.3 Water: Potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

2.1.4 Admixtures:

1. Air-entraining: ASTM C260

2. Water reducing, retarding, accelerating, high range water reducing: ASTM C494

3. Pozzolans, fly ash and other mineral admixtures: ASTM C618

2.2 A joint compound such as 4000 psi non-shrink grout, is required to join two half units. The grout will be applied by using a trowel. Fiber filled grout is also acceptable.

3. Physical Requirements

3.1 At the time of delivery to the work site, the units shall conform to the physical requirements prescribed in Table 1 below.

TABLE 1. PHYSICAL REQUIREMENTS			
Compressive Strength Net Area Min. psi (mPa)		Water Absorption Max., lb/ft³ (kg/m³)	
Avg. of 3 units	Individual Unit (min. required)	Avg. of 3 units	Individual Unit
4,500 (31.0)	4,000 (27.5)	10 (160)	12 (192)

3.2 When applicable, the manufacturer shall meet all requirements pertaining to a concrete unit's durability pertaining to a freeze-thaw environment.

3.3 Units shall be sampled and tested in accordance with ASTM C 140, Standard Test Methods of Sampling and Testing Concrete Masonry Units.

4. Visual Inspection

All units shall be sound and free of defects that would interfere with either the proper placement of the unit or impair the performance of the system. Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

Cracks exceeding 0.25 inches (.635 cm) in width and/or 1.0 inch (2.54 cm) in depth shall be deemed grounds for rejection.

Chipping resulting in a weight loss exceeding 10% of the average weight of a concrete unit shall be deemed grounds for rejection.

A-Jacks rejected prior to delivery from the point of manufacture shall be replaced at the manufacturer's expense. A-Jacks rejected at the job site shall be repaired with structural grout or replaced at the expense of the contractor.

5. Sampling and Testing

The purchaser or their authorized representative shall be accorded proper access to facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.

Field installation procedures shall comply with the procedures utilized during the hydraulic testing procedures of the recommended system. All system restraints and ancillary components (such as synthetic drainage mediums) shall be employed as they were during testing. For example, if the hydraulic testing installations utilize a drainage layer then the field installation must utilize a drainage layer; an installation without the drainage layer would not be permitted.

Additional testing, other than that provided by the manufacturer, shall be borne by the purchaser.

6. Manufacturer

The A-JACKS[®] concrete system shall have the following nominal characteristics:

A-JACKS Model	Total Length in (cm)	Arm Length in (cm)	Fillet Length in (cm)	Arm Width in (cm)	Volume ft³ (m³)	Weight lbs (kg)
AJ-72	72 (182.88)	11.04 (28.04)	5.52 (14.02)	11.04 (28.04)	15.14 (.429)	2120 (962)
AJ-96	96 (243.84)	14.72 (37.39)	7.36 (18.69)	14.72 (37.39)	35.87 (1.016)	5022 (2278)
AJ-120	120 (304.8)	18.4 (46.74)	9.2 (23.36)	18.4 (46.74)	70.69 (2.00)	9699 (4399)

The Armor unit shall be A-JACKS[®] as manufactured by:

ARMORTEC (A Contech Company)
9025 Centre Point Dr. Suite 400
West Chester, OH 45069

Phone: (513) 645-7000
Fax: (513) 645-7993

C. Performance Specifications –Coastal applications

C.1 To minimize the time and cost for installation, the armor unit should be able to meet the specified design conditions with the placement of a single layer of armor units.

C.2 Armor units should be sized for hydraulic stability under the specified wave conditions. The size and weight of an armor unit that is hydraulically stable for a given design wave condition and structure slope should be estimated using the Hudson formula:

$$W = \frac{(\gamma_{cc} H^3)}{K_D (\gamma_{cc} / \gamma_w - 1)^3 m} \qquad M = \frac{\rho_{cc} H^3}{K_D (\rho_{cc} / \rho_w - 1)^3 m}$$

where:

- M = weight of median size armor unit (kg)
- W = weight of median size armor unit (lb)
- γ_{cc} = armor unit weight (N/m³ or lb/ft³)
- H = wave height (m or ft)
- K_D = armor unit stability coefficient corresponding to “no damage” condition (defined actually as minimum acceptable damage expressed as a percent of armor unit rocking or displacement)
- γ_w = unit weight of water
- m = structure slope angle

C.3 Armor units may be user specified utilizing the default values below:

Default Values for Hudson Equation		
Variable	English Units	Metric Units
Hudson Coefficient	$K_D = 35$ (Random) $K_D = 50$ (Uniform)	$K_D = 35$ (Random) $K_D = 50$ (Uniform)
Concrete Density	$\gamma_{cc} = 145$ lb/ft ³ (wet cast)	$\rho_{cc} = 2325$ kg/m ³ (wet cast)
Water Density	$\gamma_w = 64$ lb/ft ³ (Seawater) $\gamma_w = 62.4$ lb/ft ³ (Freshwater)	$\rho_w = 1026$ kg/m ³ (Seawater) $\rho_w = 1000$ kg/m ³ (Freshwater)

C.4 To reduce the size of the structure, the armor unit should have a minimum K_D value of 35 as defined in the above Hudson formula for the specified structural slope.

PART 3: FOUNDATION PREPARATION, GEOTEXTILE AND PLACEMENT

A. Foundation Preparation

General. Areas on which filter fabric and cellular concrete blocks are to be placed shall be constructed to the lines and grades shown on the Contract Drawings and to the tolerances specified in the Contract Documents, and approved by the Engineer. A bedding layer of clean stone in conjunction with the filter fabric can appreciably enhance

the performance of A-Jacks while also adding protection to the underlying geotextile fabric during placement of the armoring units.

Grading. The slope shall be graded to a smooth plane surface to ensure that intimate contact is achieved between the slope face and the geotextile (filter fabric), and between the geotextile and the entire bottom surface of the cellular concrete blocks. All slope deformities, roots, grade stakes, and stones which project normal to the local slope face must be re-graded or removed. No holes, "pockmarks", slope board teeth marks, footprints, or other voids greater than 1.0 inch in depth normal to the local slope face shall be permitted. No grooves or depressions greater than 0.5 inches in depth normal to the local slope face with a dimension exceeding 1.0 foot in any direction shall be permitted. Where such areas are evident, they shall be brought to grade by placing compacted homogeneous material. The slope and slope face shall be uniformly compacted, and the depth of layers, homogeneity of soil and amount of compaction shall be as required by the Engineer.

Excavation and preparation for anchor trenches, side trenches, and toe trenches or aprons shall be done in accordance to the lines, grades and dimensions shown in the Contract Drawings. The anchor trench hinge-point at the top of the slope shall be uniformly graded so that no dips or bumps greater than 0.5 inches over or under the local grade occur. The width of the anchor trench hinge-point shall also be graded uniformly to assure intimate contact between all cellular concrete blocks and the underlying grade at the hinge-point.

Inspection. Immediately prior to placing the filter fabric and cellular concrete blocks, the prepared subgrade shall be inspected by the Engineer as well as the owner's representative. No fabric or blocks shall be placed thereon until that area has been approved by each of these parties.

B. Placement of Geotextile Filter Fabric

General. Filter Fabric, or filtration geotextile, as specified elsewhere, shall be placed within the limits shown on the Contract Drawings.

Placement. The filtration geotextile shall be placed directly on the prepared area, in intimate contact with the subgrade, and free of folds or wrinkles. The geotextile shall not be walked on or disturbed when the result is a loss of intimate contact between the cellular concrete block and the geotextile or between the geotextile and the subgrade. The geotextile filter fabric shall be placed so that the upstream strip of fabric overlaps the downstream strip. The longitudinal and transverse joints shall be overlapped at least two (2) feet. The geotextile shall extend at least one foot beyond the top and bottom revetment termination points. If cellular concrete blocks are assembled and placed as large mattresses, the top lap edge of the geotextile should not occur in the same location as a space between cellular concrete mats unless the space is concrete filled.