

A-JACKS[®] Concrete Armor Unit Specification: Wave Attack

2 ft & 4 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 test results showing that the A-Jacks or approved armor units meet the required K_d stability coefficient, as utilized in the Hudson stability formula for coastal applications; or meet the required Factor-of-Safety (FOS) Methods for evaluating the hydraulic stability of the chosen armor units for stream bank applications.

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 a 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 inland applications.

2. Materials

The 2 ft. (AJ-24) A-Jacks units and 4 ft (AJ-48) A-Jacks units will be produced on a pre-determined concrete block machine.

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

2.1.1 Portland Cements - Specification C 150, for Portland Cement.

2.1.2 Blended Cements - Specification C 595, for Blended Hydraulic Cements.

2.1.3 Hydrated Lime Types - Specification C 207, for Hydrated Lime Types.

2.1.4 Pozzolans - Specification C 618, for Fly Ash and Raw or Calcined Natural Pozzolans for use in Portland Cement Concrete.

2.2 Aggregates shall conform to the following ASTM specifications, except that grading requirements shall not necessarily apply:

2.2.1 Normal Weight - Specification C 33, for Concrete Aggregates.

2.3 A joint compound such as 4000 psi grout or segmental retaining wall (SRW) adhesive to join two halves of AJ-48 units is required. Armortec can offer suggestions as to the proper compound for use on each project. The grout will be applied by using a trowel. The SRW adhesive will be applied by tube caulk. **AJ-24 units do not require joint compound.**

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/ft ³ (kg/m ³)	
Avg. of 3 units	Individual Unit (min. required)	Avg. of 3 units	Individual Unit
4,000 (27.5)	3,500 (24.0)	10 (160)	12 (192)

3.2 Durability. The manufacturer shall satisfy the purchaser by proven field performance that the concrete units have adequate durability even if they are to be subjected to a freeze-thaw environment. If a freeze-thaw test is required, it will be tested as stated in ASTM C1262-97.

3.3 Sample and test units in accordance with ASTM Methods C 140, Sampling and Testing Concrete Masonry Units.

4. Visual Inspection

4.1 All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Minor 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.

4.2 Broken units shall not be repaired or used in the matrix assembly.

5. Sampling and Testing

5.1 The purchaser or his 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.

6. A. Performance Specifications –Coastal applications

6.1.a. 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.

6.2.a. 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:

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

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

6.2.c. Armor units may be user specified utilizing the default values below:

Default Values for Hudson Equation		
Variable	English Units	Metric Units
Hudson Coefficient	$K_D = 20$ (Random) $K_D = 50$ (Uniform)	$K_D = 20$ (Random) $K_D = 50$ (Uniform)
Concrete Density	$\gamma_{cc} = 135$ lb/ft ³ (dry cast)	$\rho_{cc} = 2,165$ kg/m ³ (dry 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)

To reduce the size of the structure, the armor unit should have a minimum K_D value of 20 as defined in the above Hudson formula for the specified structural slope.

7. Expense of Tests

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

8. Manufacturer

A-JACKS[®] units are manufactured and sold by:

ARMORTEC (A Contech Company)
 9025 Centre Point Drive
 Suite 400
 West Chester, OH 45069
 Phone: 1-513-645-7000
 Fax: 1-513-645-7993

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 ft ³ (m ³)	Weight lbs (kg)
AJ-24	24 (60.96)	4.00 (10.16)	1.84 (4.67)	3.68 (9.35)	.56 (.016)	78 (35)
AJ-48	48 (121.92)	7.36 (18.69)	3.68 (9.34)	7.36 (18.69)	4.49 (.127)	629 (285)

