



REPUBLIC OF THE PHILIPPINES  
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
OFFICE OF THE SECRETARY  
MANILA

697.13 DPWH  
06.09.2014

JUN 06 2014

DEPARTMENT ORDER ) SUBJECT : DPWH Standard Specification for  
No. **63** ) Item 522A – Protection Systems for  
Series of 2014 ) Unstable Slope  
06.09.14 )

In line with the mandate of the Department in providing effective standard specifications in the implementation of various infrastructure projects and in view of the need of setting a standard specification for protection systems for unstable slope, the attached **DPWH Standard Specification for Protection Systems for Unstable Slope, Item 522A** is hereby prescribed, for the guidance and compliance of all concerned.

This specification shall form part of the revised edition of the DPWH Standard Specifications (Volume II – Highways, Bridges and Airports).

This Order shall take effect immediately.

  
**ROGELIO L. SINGSON**  
Secretary

Department of Public Works and Highways  
Office of the Secretary



WIN4U00914

**DPWH STANDARD SPECIFICATION FOR  
ITEM 522A - PROTECTION SYSTEMS FOR UNSTABLE SLOPE**

**522A.1 Description**

This item shall consist of furnishing high tensile wire mesh, drilling and installing anchor bolts, grouting and testing the soil nailing (pull out test) in accordance with this specification and to the details shown on the plans or as directed by the Engineer.

The Contractor shall inspect the site, study the soil investigation result and design details before preparation and submission of the installation procedure to the Engineer for prior approval (at least 7 days) before the commencement of works.

The contractor shall be fully responsible to provide all necessary and suitable resources and materials to complete all the soil nails strictly according to this specification. The Contractor shall install the trial or preliminary soil nails and carry out the verification pull-out test at locations selected by the Engineer

**522A.2 General**

**522A.2.1 Function**

The Slope Protection Systems shall be used to keep rocks in place and/or stop what comes loose from doing damage and safety to infrastructures and its users.

**522A.2.2 Design**

Slope Protection Systems must consider rock and soil types, the angle of the slope and conditions on top, and the toe of the affected area. Installation problems, which can be complicated by existing vegetation, access, aesthetics, and environmental issues or regulations, shall fall to the constructor responsible for installing slope and rockfall protection measures.

The General Contractor shall supply design computations, details, dimensions, quantities and cross-sections necessary to construct the system.

**The design calculations shall include:**

- a. Statement of all assumptions made and copies of all references used in the calculations.
- b. Analyses demonstrating compliance with all applicable earth and water surcharges, seismic, or other loads.
- c. Factor of Safety shall be  $\geq 1.2$
- d. Analyses or studies demonstrating durability and corrosion resistance of the system for the proposed location and environment. The designer shall

provide all corrosion protection devices necessary for the system to have a minimum service life of 10 years in the proposed location and environment.

### 522A.3 Materials Requirements

There are two (2) types of Slope Protection Systems, namely “active systems” and “passive systems”. A key distinction shall be made between active and passive systems so that the most suited type of protection is selected.

Active systems are those that act to prevent excessive movement of a rock detachment once it has occurred. It shall stabilize the rock mass surface layer containing potentially unstable rocks of any size.

Passive systems are those which do not affect the process of the rock detachment, but rather focus on containing and intercepting falling and sliding debris.

**Table 522A.3.1 Material Requirements for Active & Passive Systems**

Type of Barrier	Properties	Specification
1. Active	Carbon Steel/ High Tensile	3mm Ø (min.), 95% ZN & 5% Aluminum
2. Passive/Rockfall barrier	Carbon Steel/ High Tensile	3mm Ø(min.), 95% ZN & 5% Aluminum
3. Drapery	Carbon Steel/ High Tensile	2mm Ø(min.), 95% ZN & 5% Aluminum
4. Test requirements		
a. Tensile Strength (min)	ASTM 370-97	1700 N/mm <sup>2</sup>
b. Tensile Strength of Mesh (min.)	ASTM A 975-97:2003	150 kN/m
c. Wire coating (min.)	ASTM 856	95% ZN & 5% Aluminum
d. Accelerated weathering (Salt Spray Test) (min.)	ASTM B117	1000 Hrs. until 5% DBR

**Table 522A.3.2 Components of Active System**

Materials	Properties	
	Standard	Heavy duty
Wire Mesh	Wire Diameter : 3.0 mm (min) Wire Mesh Incircle : 65 mm (min.) Diameter	Wire Diameter: Three (3) Stranded wire@ 4 mmØ (min) per wire The tensile strength shall be 1700 N/mm <sup>2</sup> per single wire (min)
Spike Plate	10mm (thickness) x 190mm (width)x 330mm length	10 mm (thickness) x 190 mm (width)x 330 mm length
Connection Clips	4.0mmØ	4.0 mm Ø
Anchor Bolts	25mm Ø, 28mmØ or 32mmØ Galvanized	25 mm Ø, 28 mm Ø or 32mm Ø Galvanized
Anchor Bolts Length and Distance on Center	Subject to design calculations	Subject to design calculations

**Table 522A.3.3 Technical Specification of Passive System**

1. Energy *	500 KJ	1000 KJ	2000 KJ	3000 KJ	5000 KJ	8000 KJ
2. Mesh type						
3. Wire Ø	High Tensile Wire					
4. Post type	As per manufacturer specification					
5. Distance between posts	As per design calculation					
6. Post Height	As per design calculation					
7. Rope diameter max.	Min = 14 mm	} subject to design calculation				
	Max = 22 mm					
8. Barrier Height	Min = 2 m	} subject to design calculation				
	Max = 9 m					
9. ETAG 027 approval class A	Guidelines for European Technical approval of falling rocks with full crash test results					
10. Corrosion Protection	Average of 1250 hours exposure in salt spray test in accordance to EN ISO 9927 NSS (Neutral Salt Spray) until the occurrence of 5% dark brown rust					
11. Components of Rockfall Barrier	Post, Mesh, or Ringnets, Brake Elements, Support Ropes (Top, Bottom, Lateral and Retaining Ropes, Anchor Base Plates, Running Wheel, Shakes, etc.)					

#### **522A.4 Construction Requirements**

The Contactor shall provide the Methodology for the installation of Active / Passive Slope Protection Systems.

The Contractor shall keep records for each soil nail installation and shall submit one (1) signed copy to the Engineer not later than noon of the next working day after the soil nails have been installed. The record for each soil nail shall include soil nail reference number, date / time of commencement and completion of drilling and grouting, names of supervisor and operators, plus the necessary drilling and grouting details, etc. Only dry type drilling equipment shall be used to minimize slope disturbance.

#### **522A.5 Quality Control and Acceptance Requirements**

The Contractor shall provide all necessary resources including all torque wrenches, jacks, gauges, reaction frame, pump, load cell, bearing plates, and other equipment required to carry out the pull-out test of the soil nails specified.

Pull-out test shall be carried out at least seventy-two (72) hours after grouting or at least the specified 7 days strength (>20 MPa). Testing equipment including dial gauges, gauge supports, jack and pressure gauge, load cell, etc., shall be sufficient, rigid and shall be protected from sunlight and rain. The complete jacking system including hydraulic jack, pump, and pressure gauge should be calibrated as a single unit before use to an accuracy of not less than 5% of the applied load. The center and bearing plates of the jack system shall be

properly arranged so that the test nail will not carry the weight of the testing equipment. The gauge used to measure the nail head movement shall be aligned parallel with the axis of the nail and the support of the gauges shall be independent from the jack and the reaction frame. Load cell is important to maintain constant load hold during the creep test load hold increment. The jack and pressure gauges shall have a pressure range not exceeding twice the anticipated maximum test pressure. Pull out testing be sufficient to allow the test to be done without resetting the equipment.

#### **522A.6 Method of Measurement**

The quantities to be paid for under this Item shall be the number of square meters (m<sup>2</sup>) of active rockfall netting installed and accepted, and the number of linear meters (l.m.) of passive rockfall barriers of the required resistance, including the necessary posts, supports and energy dissipator devices, erected and accepted.

#### **522A.7 Basis of Payment**

The quantities measured as determined in Section 522A.6, Method of Measurement, shall be paid for at the contract unit price shown in the Bid Schedule which price and payment shall be full compensation for furnishing and installing/erecting Slope Protection Systems, for excavation, backfilling and construction of foundation blocks, and for furnishing all labor, equipment, tools and incidentals necessary to complete the item.

Payment will be made under:

Payment Item Number	Description	Unit of Measurement
522A (1)	Active Protection System	Square meter
522A (2)	Passive/Rockfall Barrier	Linear meter