

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**
**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**
ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

DESCRIPTION

A. General

The work shall consist of designing, furnishing, installing and testing permanent cement-grouted tiebacks at the locations indicated on the plans, or where ordered by the Engineer.

The Contractor or subcontractor performing the work shall submit his design and methods of construction to the Deputy Chief Engineer Technical Services (D.C.E.T.S.) for approval. The design shall be accomplished by a Professional Engineer licensed to practice in New York State. The D.C.E.T.S. will require 20 working days to approve the submission after receipt of all pertinent information. No further work shall begin prior to approval by the D.C.E.T.S.

The Contractor or subcontractor performing the work described in this specification shall submit proof of: 1.) two projects on which he has installed grouted tiebacks in the past two years and 2.) the foreman for this work having supervised the installation of grouted tiebacks on at least two projects in the past two years.

B. Definitions

The following definitions shall apply:

- Contractor.- The contractor or subcontractor performing the work described in this specification.
- Tieback. A system used to transfer tensile loads from a structure to soil or rock. A tieback includes all prestressing steel (tendon), the anchorage, grout, coatings, sheathing, couplers and encapsulation if used.
- Tendon. The steel used to transfer load from the anchorage to soil or rock.
- Anchorage. That portion of the tieback, including bearing plate, nuts and wedges, that is used to transfer load from the structure to a tendon.
- Bond Length. That portion of the tieback which is bonded to the soil or rock and transfers the tensile force from the tendon to the soil or rock.
- Tendon Bond Length. The length of the tendon which is bonded to the grout. This is usually, but not necessarily, the same as the Bond Length.
- Stressing Length. That portion of the tendon which is not bonded to grout.

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**
**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**
ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

-Sheath. That portion of the tieback which encases the tendon in the stressing length only.

-Encapsulation. That portion of the tieback which encases or encapsulates the entire length of the tieback, including the sheath, to provide an additional barrier to corrosion.

-Total Movement. The total elongation of the tieback under load, measured at the anchor head.

-Residual Movement. The permanent set of the tieback resulting from stressing and releasing the tieback.

-Trumpet. A steel pipe or tube, integrally attached to the bearing plate, that surrounds the tendon in the vicinity of the structure.

-Creep Rate. The magnitude of total movement measured during a load hold per log cycle of time.

-Centralizer. A device used to center the bond length of the tieback in the hole to assure minimum grout cover over the tieback.

-Spacer. A device used in strand tendons to separate each strand in the bond length to permit the grout to bond with each strand.

-GUTS. The Guaranteed Ultimate Tensile Strength of the tendon.

MATERIALS

A. Tendons

The tendon shall consist of clean, straight, rust-free:

1. "Uncoated Seven-Wire Stress Relieved Strand for Prestressed Concrete" - ASTM A416, or "Uncoated Seven-Wire Compacted Stress Relieved Strand for Prestressed Concrete" - ASTM A779.

or

2. Continuously threaded "Uncoated High-Strength Steel Bar for Prestressing Concrete" - ASTM A722.

**ITEM 17203.174101 M - PERMANENT GROUDED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUDED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUDED TIEBACKS

The tendons shall be of such size that the design load does not exceed 53 percent of the GUTS of the tendons. At no time shall a test or temporary load on any tendon exceed 80 percent of the GUTS of the tendon.

B. Couplers

Couplers for tendons shall be capable of developing 100 percent of the GUTS of the tendon.

C. Anchorage

The anchorage shall be capable of developing 95 percent of the GUTS of the tendon and shall be set so that only axial loads are applied. Bar tiebacks shall be provided with spherical washers and spherical nuts at the anchorage.

D. Sheath

A sheath to provide corrosion protection shall encase the entire stressing length of the tendon. Acceptable sheaths for the stressing length shall be one of the following:

1. A polyethylene (PE) tube applied over a corrosion inhibiting grease coated strand. The polyethylene shall be Type II, III or IV as defined by ASTM D1248. The tubing shall have a minimum wall thickness of 1.5 mm.
2. A hot-melt extruded polypropylene tube applied over a corrosion inhibiting grease coated strand. The polypropylene shall be Type II 26500-D as defined by ASTM D2146. The tubing shall have a minimum wall thickness of 1.5 mm.
3. A heat shrinkable tube coated with an elastic adhesive applied over bar tendons. Prior to shrinking the tube shall have a nominal wall thickness of at least 0.6 mm and the elastic adhesive inside the tube shall have a nominal thickness of 0.5 mm . A smooth bond breaker shall be placed around the heat shrinkable tube in the free length.

E. Grease

A grease compounded to provide corrosion inhibiting and lubricating properties shall completely cover the steel in the stressing length. Acceptable greases for the stressing length shall be:

1. Exxon Rust Ban 326
2. Chevron Polyurea EP Grease, #2 Grade
3. Viscon Visconorust PT-1

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

or equal as approved by the Director of the Geotechnical Engineering Bureau.

Greases other than those above shall be submitted to an independent laboratory for analysis at the Contractor's expense. The test results shall be submitted to the Geotechnical Engineering Bureau for approval or rejection and shall not exceed the maximum allowable quantity of the substances shown on the following table:

SUBSTANCE	MAXIMUM ALLOWABLE QUANTITY -ppm	TEST METHOD
Chlorides	10	ASTM D512
Nitrates	10	ASTM D992
Sulfides	10	APHA-"Test Methods: Sulfides in Water"

F. Encapsulation

When the Contract Plans require encapsulation for the tendons, the encapsulation shall consist of a tube of corrugated PVC, high density polyethylene or steel. The encapsulation shall have sufficient thickness to resist damage due to shipping, handling and installation.

G. Centralizers and Spacers

Centralizers and spacers shall consist of plastic, steel or any material not detrimental to the tendon. Wood shall not be used.

Centralizers and spacers shall permit free flow of grout.

Combination centralizer/spacers will be permitted.

H. Grout

The grout shall consist of materials meeting the following specification requirements:

MATERIAL	SUBSECTION
Portland Cement, Type 1, 2, or 3	701-01
Grout Sand	703-04
Water	712-01

Epoxy resin will not be allowed as a substitute for cement grout.

I. Additives

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

Chemical additives to control bleeding or retard set, as approved by the Engineer may be used with the grout. Expansive additives shall not be used. Additives, if used, shall be mixed in accordance with the manufacturer's recommendations.

J. Trumpet

The trumpet shall be integral with the bearing plate. The trumpet shall consist of an epoxy coated steel pipe or tube conforming to the requirements of ASTM A53 for pipe or ASTM A500 for tubing.

The trumpet shall have an inside diameter equal to or larger than the hole in the bearing plate, and shall be long enough to accommodate movements of the structure during loading and testing. For encapsulated strand tendons, the trumpet shall be long enough to enable the tendon to make a transition from the diameter of the tendon in the stressing length to the diameter of the tendon at the anchor head without damaging the encapsulation.

A seal to retain grease or grout within the trumpet shall be provided between the trumpet and the stressing length corrosion protection. If grout is used to fill the trumpet, then the seal shall be a deformable seal. If grease is used to fill the trumpet, a description of the seal shall be submitted to the Engineer for approval.

CONSTRUCTION DETAILS

Shop drawings shall be submitted to the Engineer for written approval at least 30 working days prior to commencement of the work. Shop drawings shall conform to the size and type requirements of Subparagraph 2A- Working Drawings, Size and Type as given in Subsection 718-01 Prestressed Concrete Units (Structural), under Drawings. No work shall begin prior to receipt of the approval.

The shop drawings shall include, but not be limited to:

1. A tieback schedule giving:
 - tieback number;
 - design load for each tieback;
 - type and size of tendon;
 - total tendon length;
 - bond length, and tendon bond length if different from bond length;
 - stressing length.

2. A drawing of the tieback and corrosion protection including:
 - spacers and their location;
 - centralizers and their location;

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

- stressing length corrosion protection;
- bond length corrosion protection;
- anchorage and trumpet;
- anchorage corrosion protection system.

The Contractor shall submit a report to the Engineer within 20 working days after completion of the tieback work. The report shall contain:

- as-built drawings showing the locations of the tiebacks, total tendon lengths, stressing lengths and bond lengths;
- prestressing steel manufacturer's mill test reports for the tendons;
- grouting records indicating the cement type, quantity injected and grout pressures;
- tieback test results and graphs.

The Contractor shall be responsible for determining the tieback type, size and bond length necessary to develop adequate load capacity to satisfy tieback testing Acceptance Criteria for the design loads shown on the plans. The minimum bond length shall be 3 m in rock and 5 m in soil. The minimum tendon bond length shall be 3 m. The minimum stressing length shall be 5 m or as shown in the Contract Plans, whichever is greater. The tieback hole shall remain inside the right-of-way or easement limits shown on the plans.

The holes for the tiebacks may be either driven or drilled. The hole shall not be progressed in a location that requires the tendon to be bent in order to enable the bearing plate to be connected to the supporting structure. Subsidence or physical damage to existing site conditions caused by such operations shall be cause for immediate cessation of operations and repair to the satisfaction of the State. The Contractor shall immediately revise his operations to prevent reoccurrence of such damage. Any and all costs incurred due to this subsidence or physical damage shall be borne by the Contractor. If the hole will not stand open, casing shall be installed as required to maintain a clean and open hole. The hole shall extend a minimum of 0.6 m beyond the tendon length. The holes shall be located in elevation as shown on the plans, within a 75 mm tolerance. The holes shall be progressed to the inclination and alignment as specified on the contract plans, within a 3± degree tolerance. Unless otherwise indicated by a Special Note in the Plans, all tieback holes shall be progressed perpendicular to the direction of the wall, as seen in the plan. Holes in rock shall be thoroughly cleaned of all dust, rock chips, grease or other material which may affect bond prior to inserting the tendon.

A watertightness test will be required for all tiebacks bonded in rock if grout is injected at a pressure of less than 345 kPa. If artesian or flowing water is encountered in the drilled hole, pressure shall be maintained on the grout until the grout has reached initial set. The watertightness test shall be performed by filling the entire hole in the rock with water and subjecting it to a pressure of 35 kPa as measured at the top of the hole. If the stressing length portion of hole is in soil or fractured rock, a packer or casing shall be used to allow the bond length to be pressure-tested. If the leakage rate from the hole, over a ten minute period, exceeds

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

5 ml of water per millimeter of diameter per meter of length per minute, the hole shall be grouted, redrilled and retested. Should the subsequent watertightness test fail, the entire process shall be repeated until results are attained which are within leakage allowances.

The Contractor may eliminate the requirement for watertightness tests in rock by using pressure grouting techniques. Pressure grouting requires that the drill hole be sealed and that the grout be injected until a 345 kPa grout pressure, measured at the top of the hole, can be maintained on the grout for five (5) minutes without further grout injection.

In the bond length, centralizers and their installed locations shall be subject to approval by the Engineer. Centralizers shall be provided at a maximum of 3 m center to center spacing throughout the bond length so that not less than 13 mm of grout cover along the bond length is achieved. A centralizer shall be provided at the bottom end of the tendon. Sag of the tendon shall be taken into account when selecting centralizer diameter and spacing. Multi-element tendons shall also employ spacers at maximum 3 m intervals throughout the bond length to ensure grout cover on all elements.

When the Contract Plans require encapsulation to provide double-corrosion protection for the tendons:

-The tendon shall be encapsulated in a grout-filled corrugated tube of one of the types stated in the Materials section of this specification. The tendon may be grouted inside the encapsulation either before or after inserting the tendon into the drill hole. The bond length of the tendon shall be centralized to provide a minimum grout cover of 5 mm within the tube. Spacers shall be used along the tendon bond length for multi-element tendons to ensure good bond with the encapsulation grout.

-Centralizers shall be used to provide a minimum of 8 mm of grout cover over the tendon bond length encapsulation. Centralizers shall be securely attached to the encapsulation and shall be spaced at no more than 3 m. A centralizer shall be provided at the bottom end of the tendon bond length encapsulation. A centralizer shall also be located a maximum of 1.5 m from the top of the bond length.

The bond length of the tendon shall be degreased prior to installation by using Acetone, MEK, or MIBK. No residue shall be left on the tendon. Other substances may be used subject to approval by the Engineer.

The tendon shall be inserted in the casing or hole without difficulty. If the tendon cannot be completely inserted, the Contractor shall remove the tendon and clean or redrill the hole to permit insertion. Partially inserted tendons shall not be driven or otherwise forced into the hole. Tendons shall not be subject to sharp bends. Care shall be taken to prevent damage to the tendon's corrosion protection and centralizers during handling and installation.

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

The grouting equipment shall be capable of continuous mixing and shall produce grout free of lumps. The grout pump shall be equipped with a grout pressure gage capable of measuring the highest working pressures attained plus 345 kPa.

The annular space between the tieback and the drilled hole up to the level of the trumpet and between the tendon and encapsulation shall be filled with grout. In order to prevent air voids in the grouting operation, the hole shall be filled with grout progressively from bottom to top. Grouting of the stressing length shall be done at low pressure. The trumpet shall not bear on the top of the stressing length grout column during testing, to ensure that load applied to the tieback during testing is not transferred to the anchorage via the grout column.

The tieback shall be centered in the trumpet so that there is no contact between the two. The corrosion protection surrounding the stressing length of the tendon shall extend up beyond the bottom seal of the trumpet but shall not contact the bearing plate or anchor head during stressing and testing.

The anchor head shall be protected from corrosion during the interim between tieback installation and final corrosion protection installation by installing a temporary cap and filling the trumpet and anchor head with corrosion-inhibiting grease. Any detrimental corrosion shall be caused for rejection.

After installation, testing and acceptance of each tieback, the trumpet shall be filled with grout or corrosion inhibiting grease and the permanent corrosion protection of the anchorage shall be installed. The Contractor shall either:

- a. place a water-tight steel cap, filled with corrosion inhibiting grease or grout, over the anchor head, or
- b. encase the anchor head in concrete.

TESTING

Each tieback shall be tested. The following tests are required:

-Performance Tests

Unless otherwise specified by a Special Note in the Plans, the first three anchors installed shall be performance tested. These tests are used to determine residual movements.

-Creep Tests

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

Creep tests shall only be performed if and where specified by a Special Note in the Plans. These tests are performed to determine long term deformation behavior in plastic soils.

-Proof Tests

Proof tests shall be performed on all anchors not performance or creep tested. These tests are used to verify load capacity.

-Lift-Off Readings

Lift-off readings shall be taken on all tiebacks after the load has been transferred to the anchorage but prior to removing the jack.

-Lift-Off Tests

Lift-off tests shall only be performed on tiebacks in rock. If required, lift-off tests shall be performed on at least two (2) tiebacks at locations to be chosen by the Engineer. Additional tests, up to 10% of the total number of tiebacks may be ordered by the Engineer.

Copies of all test results and graphs shall be transmitted to the Director, Geotechnical Engineering Bureau as each test is completed.

Jacks shall have ram travel at least equal to the theoretical elastic elongation of the stressing length plus the bond length at the maximum test load, and be sufficient to accommodate wall movements. A pressure gauge shall be used with each jack. Gauges shall be calibrated with a single jack and shall not be used with any other jack. All gauges shall be accurate enough to read 690 kPa changes in pressure. For performance and creep tests, the jack used shall have two calibrated gauges; a master gauge and backup gauge. The pump shall be capable of applying each load increment in less than 60 seconds.

A load cell, which has been calibrated by an independent testing laboratory within 14 days prior to the start of testing, shall be used to measure the small changes in load during the load hold portion of the performance and creep tests. There will be no substitute for the load cell on testing of the performance and creep tests. Load cells are not required for proof tests. The Contractor shall provide the Engineer with the calibration curve for the load cell prior to testing.

For the performance and creep tests, the master gauge and backup gauge shall be connected to the same pressure hose between the pump and jack and be used to measure the applied loads. If the load measured by the master gauge and backup gauge differ by more than ten (10) percent, the jack, master gauge and backup gauge shall be recalibrated as a unit at no expense to the State.

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

At the completion of the test the tieback load shall be adjusted to the lock-off load and transferred to the anchorage. Unless otherwise specified in the contract documents, the lock-off load shall be 80 percent of the design load (0.80 P).

The alignment load necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. The movement of the tieback tendon at each load increment shall be recorded to the nearest 0.025 mm relative to an independent, fixed reference point.

A. Performance Tests

Performance tests shall be performed by incrementally loading and unloading the tieback in accordance with the schedule below. Residual movements shall be taken at the alignment load for each cycle. Total movement measurements shall be taken at the highest load in each cycle.

<u>Cycle</u>	<u>Load</u>
1	AL 0.25 P
2	AL 0.25 P 0.50 P
3	AL 0.25 P 0.50 P 0.75 P
4	AL 0.25 P 0.50 P 0.75 P 1.00 P
5	AL 0.25 P 0.50 P 1.00 P 1.25 P
6	AL 0.25 P 0.50 P

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

1.00 P
1.25 P
1.50 P

Adjust to lock-off of 0.80 P

P = design load for the tieback

AL= alignment load

The load shall be held at each increment just long enough to obtain the total movement reading. Except for the residual movement at AL, no movement readings need to be taken during unloading of the tieback.

The test load of 1.50 P shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 1 mm, the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15, 20, 25, 30, 45 and 60 minutes.

The Contractor shall plot the tendon movement versus load for each load increment. He shall also plot the creep movement for the load hold as a function of the logarithm of time.

B. Creep Tests

The creep test shall be made by incrementally loading and unloading the tendon in accordance with the schedule given below. At the highest load in each cycle the load shall be held constant in accordance with the observation periods below. A load cell shall be used to monitor the constant load.

<u>Cycle</u>	<u>Load</u>	<u>Observation Period (Min.)</u>
1	AL 0.25 P	10
2	AL 0.25 P 0.50 P	30
3	AL 0.25 P 0.50 P 0.75 P	30

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
 INSTALLED AND ACCEPTED**
**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
 TIEBACKS**
ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

4	AL 0.25 P 0.50 P 0.75 P 1.00 P	45
5	AL 0.25 P 0.50 P 1.00 P 1.25 P	60
6	AL 0.25 P 0.50 P 1.00 P 1.25 P 1.50 P	300

Residual movement measurements shall be taken at the alignment load for each cycle. Total movement readings shall be taken at the highest load in each cycle.

The times for reading the total movement during an observation period shall be 1 minute, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270, and 300 minutes.

The observation period shall begin when the pump starts to load the tieback from the next lower increment.

The Contractor shall plot the tendon movement and the residual movement measured in a creep test as described for the performance test. The Contractor shall also plot the creep movement for each load hold as a function of the logarithm of time.

If the creep rates are not acceptable as defined under Acceptance Criteria, the Contractor shall modify his installation method and perform creep tests until two successive acceptable creep tests on two different tiebacks have been performed.

C. Proof Tests

The proof tests shall be performed by loading the tieback in accordance with the following schedule:

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

Load

AL

0.25 P

0.50 P

0.75 P

1.00 P

1.25 P

1.50 P

Reduce to lock-off load of 0.80 P

The load shall be held at each increment just long enough to obtain a total movement reading, but not more than 1 minute.

The test load of 1.50 P shall be held for at least ten (10) minutes. The load hold time shall start when the pump begins to load the tieback from 1.25 P to the test load. Total movements shall be recorded at 1, 2, 3, 4, 5, 6 and 10 minutes. If the movement between the one (1) and the ten (10) minute readings is 1 mm or more, the test load shall be maintained for an additional 50 minutes and the movement measured. The additional movement shall be recorded at 15 minutes, 20, 25, 30, 45 and 60 minutes.

The Contractor shall plot the tendon movement versus load for each load increment. He shall also plot the creep movement for the load hold as a function of the logarithm of time.

D. Lift-Off Readings

Lift-off readings shall be taken and recorded directly after testing on all tiebacks. The load required to relieve the load from the tieback head shall be measured and recorded. If the lift-off load is not within 5% of the lock-off load the anchorage shall be reset and another lift-off reading taken.

E. Lift-Off Tests

Lift-off tests shall be performed on rock tiebacks only. Locations for lift-off tests shall be selected randomly by the Engineer prior to the commencement of any tieback testing. For each tieback subjected to a lift-off test, the Contractor shall leave an adequate length of tendon protruding over the anchorage to permit jacking.

Lift-off tests shall be performed at least 24 hours but no more than 7 days after the tieback has been set to lock-off load. The results of all lift-off tests shall be recorded.

If the lift-off load is not within 10% of the lock-off load, the anchorage shall be reset and another lift-off test performed according to the requirements in this specification.

**ITEM 17203.174101 M - PERMANENT GROUDED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUDED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUDED TIEBACKS

F. Acceptance Criteria

For all tiebacks:

-All tiebacks and components shall be free of detrimental corrosion.

-Lift-off readings shall show a load within five (5) percent of the specified lock-off load.

-Lift-off tests shall show a load within ten (10) percent of the specified lock-off load.

-The total movement at the maximum test load shall exceed 80 percent of the theoretical elastic elongation of the unbonded length, from the alignment load to the test load.

For performance or proof tested tiebacks with a ten (10) minute load hold, the tieback shall also resist the maximum test load with a creep rate that does not exceed 1 mm between one (1) and ten (10) minutes.

For performance or proof tested tiebacks with a 60 minute load hold, the tieback shall also resist the maximum test load with a creep rate that does not exceed 2 mm per log cycle of time.

For creep tested tiebacks, the tieback shall also resist the maximum test load with a creep rate that does not exceed 2 mm per log cycle of time.

For tiebacks that the Engineer finds unacceptable, the Contractor shall submit a written proposal containing a suggested course of action. The action to be taken will be subject to written approval by the Engineer. Tiebacks which do not meet the total movement criteria shall not be permitted to carry any load.

Conditional Acceptance Criteria

Tiebacks which meet the total movement criteria but do not meet the creep rate criteria may be accepted by the Engineer and locked-off at a load equal to one half their failure load. To determine the failure load, allow the load to stabilize for ten (10) minutes after the tieback has failed. The load after stabilization is the failure load.

A supplemental tieback shall be installed and tested in accordance with this specification at a location approved by the Engineer. The combined test capacity of the tiebacks shall equal or exceed 1.5 times the original design load. That is:

$$1.5 P = 1.5 P_s + 0.5 P_f$$

**ITEM 17203.174101 M - PERMANENT GROUTED TIEBACKS, FURNISHED,
INSTALLED AND ACCEPTED**

**ITEM 17203.174102 M - PERFORMANCE TESTS FOR PERMANENT GROUTED
TIEBACKS**

ITEM 17203.174103 M - CREEP TESTS FOR PERMANENT GROUTED TIEBACKS

Where: P = the design load for the original tieback
P_s = the design load for the supplemental tieback
P_f = the failure load for the original tieback

For tiebacks that do not meet the lift-off reading (or test) criteria, the anchorage shall be reset and another lift-off reading (or test) taken.

METHOD OF MEASUREMENT

For Item 17203.174101 M - Permanent Grouted Tiebacks, Furnished, Installed and Accepted, the quantity to be paid for shall be the number of tiebacks furnished, installed and accepted.

For tiebacks which do not meet all the acceptance criteria but do meet the conditional acceptance criteria, the original tieback and any required supplemental tiebacks(s) are, in sum, considered to be one tieback for payment purposes. The price of one tieback shall be paid upon acceptance of all the original and supplemental required tiebacks. No payment will be made for any additional wall connections required for installation of supplemental tiebacks.

For Item 17203.174102 M - Performance Tests for Permanent Grouted Tiebacks, and Item 17203.174103 M - Creep Tests for Permanent Grouted Tiebacks, the quantity to be paid for shall be the number of performance or creep tests performed, respectively.

BASIS OF PAYMENT

The unit price bid for Item 17203.174101 M - Permanent Grouted Tiebacks, Furnished, Installed and Accepted shall include the cost of furnishing all labor, equipment, and material required to satisfactorily complete the work. The cost for proof tests shall also be included.

The unit price bid for Item 17203.174102 M - Performance Tests for Permanent Grouted Tiebacks, and Item 17203.174103 M - Creep Tests for Permanent Grouted Tiebacks shall include the cost of furnishing all labor, equipment and material required to satisfactorily complete the tests.

Payment will be made under:

ITEM NUMBER	PAY ITEM	PAY UNIT
17203.174101 M	Permanent Grouted Tiebacks, Furnished, Installed and Accepted	Each
17203.174102 M	Performance Tests for Permanent Grouted Tiebacks	Each
17203.174103 M	Creep Tests for Permanent Grouted Tiebacks	Each