



To: <p style="text-align: center;">SUPERSEDED BY <u>EB 06-057</u> EFFECTIVE <u>5/3/07</u></p>		<i>New York State Department of Transportation</i> ENGINEERING INSTRUCTION	EI 03-030
Title: REVISED SECTION 556 - REINFORCING STEEL FOR CONCRETE STRUCTURES			
Distribution: <input checked="" type="checkbox"/> Manufacturers (18) <input type="checkbox"/> Surveyors (33) <input checked="" type="checkbox"/> Main Office (30) <input checked="" type="checkbox"/> Consultants (34) <input checked="" type="checkbox"/> Local Govt. (31) <input checked="" type="checkbox"/> Contractors (39) <input checked="" type="checkbox"/> Regions/Agencies (32) <input type="checkbox"/> _____ ()	Approved:  G. A. Christian, Acting Deputy Chief Engineer (Structures) <u>9/24/03</u> Date		

ADMINISTRATIVE INFORMATION:

- This EI is effective with projects submitted for the letting of May 6, 2004.
- No EIs are superseded by this issuance.
- The Standard Specification sections issued with this EI will be incorporated into the next issuance of the Standard Specifications.

PURPOSE:

This EI issues a revised Section 556 and related Materials Specifications to the Standard Specifications of January 2, 2002.

IMPLEMENTATION:

- Main Office DQAB will insert the Shelf Note into contract proposals effective with the letting date of May 6, 2004.
- Standard Specification §709-03 is disapproved effective with the letting date May 6, 2004.
- Special Specification 16556.02 is disapproved effective with the letting date May 6, 2004.
- New contract pay items are: 556.0203 Galvanized Bar Reinforcement for Structures, 556.0204 Stainless-Steel-Clad Bar Reinforcement for Structures, 556.0205 Stainless Steel Bar Reinforcement for Structures, and the related Materials Specifications 709-12, 709-13, and 709-14.

TRANSMITTED MATERIALS:

Shelf note containing revised §556, new sections §709-12, §709-13 and §709-14, and related changes.

COMPANION REFERENCES:

EI-03-029 Design Guidance For Choosing Reinforcing Steel For Concrete Structures contains information to guide designers in the selection of reinforcement.

TECHNICAL INFORMATION:

The revised sections add galvanized, stainless-steel-clad, and solid stainless steel reinforcement, and also Grade 520 reinforcement for use in Structural Concrete.

- **Cost Impact:** None or reduced. Higher costs for new bar types should yield long-term savings over the life of the structure due to enhanced durability.

CONTACT:

Direct questions regarding this EI to Duane Carpenter of the Structures Design and Construction Division at 518-457-5715 or via e-mail at dcarpenter@dot.state.ny.us.

Make the following changes to the **STANDARD SPECIFICATIONS of January 2, 2002.**

Volume 2 of 3, page 5-73, line 33, *replace* “§556-3.02E” with “§556-3.02D”.

Page 5-74, *Delete Section 556, REINFORCING STEEL FOR CONCRETE STRUCTURES* in its entirety and *replace* with the following:

“SECTION 556 - REINFORCING STEEL FOR CONCRETE STRUCTURES

556-1 DESCRIPTION. The work will consist of furnishing and placing reinforcing steel for concrete structures, or stud shear connectors, in accordance with the contract documents, and in a manner satisfactory to the Engineer.

Reinforcing steel for concrete structures may be uncoated, epoxy-coated, galvanized, stainless-steel-clad, or stainless steel, as indicated in the contract documents.

556-2 MATERIALS. Materials for this work shall meet the requirements of the following subsections of Section 700, Materials and Manufacturing:

Uncoated Bar Reinforcement, Grade 420	709-01
Wire Fabric for Concrete Reinforcement	709-02
Epoxy-Coated Bar Reinforcement	709-04
Stud Shear Connectors	709-05
Epoxy-Coated Wire Fabric Reinforcement	709-08
Mechanical Connectors for Reinforcing Bar Splices	709-10
Galvanized Bar Reinforcement	709-11
Stainless-Steel-Clad Bar Reinforcement	709-12
Stainless Steel Bar Reinforcement	709-13
Uncoated Bar Reinforcement, Grade 520	709-14

556-2.01 Devices for Supporting and Tying Reinforcement. Chairs, tie wires, and other devices used to support, position, or fasten the reinforcement shall be made of or coated with, a dielectric (electrically insulating) material. Stainless steel chairs without polyethylene tips and meeting the requirements of ASTM A493, AISI Type 430, may also be used. The specific hardware that the Contractor proposes to use shall be approved by the Engineer.

When forms are to be removed in their entirety, uncoated steel chairs equipped with snug-fitting, high-density, polyethylene tips which provide 6 mm clearance between the metal and any exposed surface may be used.

556-3 CONSTRUCTION DETAILS

556-3.01 General

A. Ordering. Prior to ordering reinforcing steel, the Contractor shall carefully check all bar lists, and assume full responsibility for their accuracy. No change in the bar list shall be made by the Contractor unless approved by the D.C.E.S. If no bar list is provided in the Plans, then §557-3.16 No Bar List Provided shall apply.

B. Protecting Reinforcement Coatings

1. Epoxy-Coated Reinforcing Steel. All epoxy-coated reinforcement shall be stored above ground on wood or padded supports.

Epoxy-coated reinforcement stored on-site shall be protected from sunlight and moisture using opaque waterproof covers. Covers shall be placed in a manner that will permit constant air circulation so as to minimize the formation of condensation on the epoxy-coated surface.

All equipment for handling epoxy-coated steel shall have padded contact areas. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports, or a platform bridge so as to prevent steel-to-steel abrasion from sags in the bundle.

Steel shall not be dropped or dragged. Care shall be taken at all times to prevent damage to the epoxy coating.

Steel that is partially embedded in concrete shall have the exposed sections protected with opaque waterproof covers prior to any winter shutdown of a project.

2. Galvanized Bar Reinforcement. All galvanized bar reinforcement shall be stored above ground on wood or padded supports and arranged so that rainwater drains off the bars.

C. Placing and Fastening Reinforcing Steel. Prior to placing reinforcement, all grease, dirt, mortar, and any other foreign substances shall be removed.

Loose rust and loose millscale on uncoated reinforcement shall be removed by wire brushing.

Steel reinforcement shall be placed in the position indicated in the contract documents and within the allowable tolerances specified. Before concrete is placed, all reinforcement shall be securely fastened and supported with approved chairs or other approved devices.

D. Inspection. Concrete shall not be placed until the reinforcing steel is inspected, placement of the steel meets applicable tolerances, and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision will be rejected and removed.

556-3.02 Steel Fabric Reinforcement.

A. Field Repair of Coatings. Field repair will not be required on areas of minor damage. Minor damage is defined as any defect or break in the coating less than 6 mm x 6 mm. The maximum number of unrepaired minor damaged areas shall not exceed an average of six (6) per 300 millimeters of wire.

Reinforcing fabric having coating damage exceeding the above criteria shall be rejected and immediately removed from the work site.

B. Placement. Steel fabric reinforcement shall be placed as shown in the contract documents. Unless otherwise noted in the contract documents, steel fabric reinforcement shall be overlapped a minimum of the distance between adjacent wires in the panel. Overlapping panels of steel fabric reinforcement shall be wired together to ensure that the location and overlap of the mesh panels is maintained during concrete placement.

556-3.03 Bar Reinforcement

A. Field-Bending. The bar reinforcement shall be bent to the shapes shown in the contract documents. Unless shown otherwise in the contract documents or below, the radii of bends, measured to the inside face of the bend, shall be greater than, or equal to, three times the diameter of the bar. Bends in stirrups shall be greater than, or equal to, the diameter of the bar.

1. Uncoated Bar Reinforcement. When bars are heated for field-bending they shall not be heated to a temperature higher than that producing a dark cherry-red color. Only competent personnel shall be employed and proper equipment provided for cutting and bending.

2. Epoxy - Coated Bar Reinforcement. The alternatives of shop bending or field-bending of

epoxy-coated bar reinforcement will be at the option of the Contractor. Field-bending shall be done by cold methods only.

Field-bending operations will be allowed only when ambient and bar temperatures are 5°C or greater. When lower temperatures prevail, the Contractor may supply, for field-bending operations, fully enclosed space that is heated. Direct heating of the bars shall not be permitted.

Epoxy coatings damaged by field-bending work shall be evaluated and repaired or replaced, in accordance with the requirements of §556-3.03 B.1 Epoxy-Coated Bar Reinforcement.

3. Galvanized Bar Reinforcement. The galvanized bar reinforcement shall be shop bent before galvanizing. Up to 5% of the mass of bars may be field bent to replace missing, damaged, or incorrectly fabricated bars. Field-bending shall be done by cold methods only. When bending galvanized bar reinforcement size 22 and greater, the minimum bend radius measured to the inside face of the bend shall be increased to 4.5 times the bar diameter. For bars numbered 43 and 57, increase the bend radius to 5.5 times the bar diameter.

Field-bending operations will be allowed only when ambient and bar temperatures are 5°C or greater. When lower temperatures prevail the Contractor may supply, for field-bending operations, a fully enclosed space that is heated. Direct heating of the bars shall not be permitted.

The ends of bars cut after galvanizing shall be coated with zinc repair material following the procedures of §719-01, Galvanized Coatings and Repair Methods except that repair materials containing aluminum shall not be permitted.

Galvanizing damaged by field-bending work shall be evaluated and repaired, or replaced, in accordance with the requirements of §556-3.03 B.2 Galvanized Bar Reinforcement.

4. Stainless-Steel-Clad Bar Reinforcement. The stainless-steel-clad bar reinforcement shall be shop bent or field bent as shown in the contract documents. All ends of the bar reinforcement where the mild steel core is exposed shall be capped by one of the following:

- a. Heat-shrink cap applied in accordance with the cap manufacturer's instructions.
- b. Neoprene cap adhered with silicone or epoxy sealant.
- c. Stainless steel cap epoxied in place.
- d. Stainless steel seal weld.

The stainless-steel-clad bar reinforcement will be shop bent or field bent as shown in the contract documents. When shop bending is required, up to 5% of the mass of bars may be field bent to replace missing, damaged, or incorrectly fabricated bars. Field-bending shall be done by cold methods only.

5. Stainless Steel Bar Reinforcement. The stainless steel bar reinforcement shall be shop bent or field bent as shown in the contract documents. When shop bending is required, up to 5% of the mass of bars may be field bent to replace missing, damaged, or incorrectly fabricated bars. Field-bending shall be done by cold methods only.

B. Field Repair of Coatings

1. Epoxy-Coated Bar Reinforcement. The Contractor will be required to field repair damaged areas of the bar coating, and to replace bars exhibiting severely damaged coatings. The material used for field repair shall be that supplied by the coating applicator.

Field repair will be required on all areas of major damage. Major damage is defined as any defect or break in the epoxy coating 6 mm x 6 mm or greater. The total number of all major damaged areas which have been repaired with patching material shall not exceed five (5) in any three-meter length of bar.

Field repair will not be required on areas of minor damage. Minor damage is defined as any defect or break in the coating less than 6 mm x 6 mm. The maximum number of unrepaired minor damaged areas shall not exceed an average of six (6) per 300 mm on any individual bar.

A reinforcing bar having coating damage determined by the Engineer to exceed the above criteria shall be rejected and immediately removed from the work site. All such bars shall be replaced, in kind, by the Contractor at no additional cost to the State.

2. Galvanized Bar Reinforcement. The Contractor shall field repair damaged areas of the bar coating, and replace bars exhibiting severely damaged coatings. Severe damage is defined as more than five (5) 6 mm by 6 mm or larger areas in a three-meter length. The material and procedures used for field repair shall meet the requirements of §719-01, Galvanized Coatings and Repair Methods, except that repair materials containing aluminum shall not be permitted.

C. Splices. Splices will be permitted only where shown in the contract documents. Should the Contractor desire to splice bars at locations other than those shown in the contract documents, written permission to do so shall first be obtained from the D.C.E.S. Such permitted splices shall be well distributed or located at points of low tensile stress. Splices shall not be permitted unless a minimum of 50 mm can be provided between the splice and the nearest adjacent bar.

Splices for bar sizes No. 36 or smaller, shall be made by means of a mechanical connector or by placing the bars in contact and wiring them together for the full length of the splice. Splices for bars larger than No. 36 shall be made by use of a mechanical connector unless welding is specifically required by the contract documents. Mechanical connectors shall be installed in accordance with the manufacturer's written requirements.

Arc-welded splices shall be made and will be inspected in accordance with the provisions of the SCM.

Prior to welding of epoxy-coated reinforcing bars, the epoxy coating shall be removed for the length to be welded plus 150 mm on each side of the weld. After welding, the spliced area shall be cleaned in accordance with SSPC - Surface Preparation Specification No. 6 (SSPC-SP6), Commercial Blast Cleaning. The surface shall be blast cleaned to SSPC-SP6 Commercial Blast Cleaning standard. Photographs in SSPC-VIS 1, Guide And Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning, for B SP6, C SP6, D SP6, G1 SP6, G2 SP6, or G3 SP6, can be used as a guide to identify the desired cleaning, depending on the initial condition of the steel. However, the written standard for SP6 will be the primary means to determine conformance with blast-cleaning requirements. The photographs shall not be used as a substitute for the written standards. A compatible epoxy repair material supplied by the coating applicator shall be applied to the spliced area and overlap the original coating by 150 mm. The epoxy repair material shall be applied the same day as the cleaning.

Prior to welding galvanized bar reinforcement, the zinc coating shall be removed for the length of the weld plus 50 mm on each side of the weld. Cleaning shall be the same criteria as for epoxy-coated reinforcing. Coating repair shall be in accordance with the requirements of §556-3.03 B.2 Galvanized Bar Reinforcement.

D. Placement in Structural Slabs. Bar supports shall be spaced no farther apart than 1.2 m center-to-center, nor shall any bar support be closer than 150 mm from the edge of any future concrete surface. Bridge slab bar reinforcement shall be placed in accordance with the following tolerances:

Vertical	± 6 mm
Horizontal	± 13 mm

The structural slab bar reinforcement mats (top and bottom) shall be securely connected together. This

connection shall be accomplished by wiring or other means approved by the Engineer. Connections shall be placed no farther apart than 1.2 m on center. The bar supports may be utilized for this purpose. Connecting devices shall neither deflect the bar reinforcement nor interfere with the smooth flow of concrete.

Immediately prior to placement of concrete, the Engineer will verify that the reinforcing steel is positioned within the above-stated tolerances.

Subsequent to placement of concrete, the Engineer will verify, at random, that the vertical clear distance from the top of the structural slab to the top mat of main reinforcing, as shown in the contract documents, is correct within a tolerance of plus or minus 13 mm. If the allowable tolerance is exceeded, the Engineer will reject the work and so advise the Contractor and the D.C.E.S., in writing, stating the deficiencies upon which the rejection is based. The D.C.E.S. will review the nature and extent of the deficiencies and shall designate one or more of the following alternatives:

1. The affected concrete placement shall be removed and replaced in whole or in part.
2. The Contractor shall provide special corrective measures as directed by the D.C.E.S.
3. The concrete placement shall be accepted without corrective action.

556-3.04 Stud Shear Connectors for Bridges. Stud shear connectors shall be shop or field welded to the structural steel members at the locations indicated in the contract documents. This work shall be done in accordance with the provisions of the SCM.

556-4 METHOD OF MEASUREMENT

556-4.01 Steel Fabric Reinforcement. The quantity of steel fabric reinforcement satisfactorily installed will be measured for payment as the number of square meters of overall surface area of the deck or structure shown on the contract documents, not including clear distance to the edges, measured to the nearest whole square meter. No subtractions will be made for holes smaller than one-half of a square meter, and no additional payment will be made for overlaps.

556-4.02 Bar Reinforcement. These will be measured as the number of kilograms of steel bars placed. The mass of bar reinforcing will be computed by the Engineer utilizing the unit mass for each size bar as given in Table 556-1. No allowance will be made for the mass of any coating on the bars.

TABLE 556-1 UNIT MASS OF DEFORMED BARS											
Bar Number	10 (3)	13 (4)	16 (5)	19 (6)	22 (7)	25 (8)	29 (9)	32 (10)	36 (11)	43 (14)	57 (18)
Mass (kg/m)	0.560	0.994	1.552	2.235	3.042	3.973	5.060	6.404	7.907	11.38	20.24

Note. Numbers in parenthesis are bar sizes in numbers of eighths of inches.

556-4.03 Stud Shear Connectors for Bridges. Stud Shear Connectors will be measured as each connector placed.

556-5 BASIS OF PAYMENT

556-5.01 Steel Fabric Reinforcement. The unit price bid per square meter will include the cost of all labor, materials, and equipment necessary to complete the work. The removal of the concrete

placement and its subsequent replacement, or other corrective work which the Contractor is directed to perform, shall be accomplished at no additional cost to the State. No additional payment will be made for the replacement of defective fabric or the replacement of fabric with defective coatings.

556-5.02 Bar Reinforcement. The unit price bid per kilogram shall include the cost of all labor, materials, and equipment necessary to complete the work. The unit price shall also include the cost of chairs, supports, fastenings, connections, and splices not specifically shown in the contract documents. If the Engineer permits the substitution of larger bars than those specified, or the D.C.E.S. permits splices not shown in the contract documents, payment will be made only for the amount of steel which would have been required if the specified size and length had been used. No additional payment will be made for enclosures constructed for bending of bars or for replacement of defective bars or for replacement of bars with defective coatings.

556-5.03 Stud Shear Connectors for Bridges. The unit price bid per stud shall include the cost of all labor, materials, and equipment necessary to complete the work. If the use of any stud shear connector requires payment of a royalty to the manufacturer, the royalty shall be included in the unit price bid for this work.

Payment will be made under:

Item No.	Item	Pay Unit
556.0101 M	Uncoated Steel Fabric Reinforcement for Structures	Square Meter
556.0102 M	Epoxy-Coated Steel Fabric Reinforcement	Square Meter
556.0201 M	Uncoated Bar Reinforcement for Concrete Structures	Kilogram
556.0202 M	Epoxy-Coated Bar Reinforcement for Structures	Kilogram
556.0203 M	Galvanized Bar Reinforcement for Structures	Kilogram
556.0204 M	Stainless-Steel-Clad Bar Reinforcement for Structures	Kilogram
556.0205 M	Stainless Steel Bar Reinforcement for Structures	Kilogram
556.03 M	Stud Shear Connectors for Bridges	Each

Make the following additional changes to the **STANDARD SPECIFICATIONS of January 2, 2002.**

Volume 2 of 3, page 5-78, line 40, *delete*, "556-2.02".

Page 5-80, line 29, *replace* "and §556-3.02" with "through §556-3.03".

Page 5-80, line 31, *replace* "and §556-3.02" with "through §556-3.03".

Page 5-80, line 32, *replace* "§556-3.02E" with "§556-3.03D".

Volume 3 of 3, Page 7-95 delete line 35 and replace with the following: "**709-03 (VACANT)**"

Page 7-95, *delete* lines 36-39.

Page 7-96, *delete* lines 1-3.

Page 7-96, line 4; *delete* the following: "**GRADE 420**"

Page 7-96, line 9; *add* the following before the period that ends the sentence;

“or §709-14, Bar Reinforcement, Grade 520.”

Page 7-99, line 10; *add* the following after “Grade 420”: “or Grade 520,”

Page 7-100, line 2; *delete* the following: “Grade 300 or”
and *add* the following after “Grade 420”; “or Grade 520,”

Page 7-100, Line 6; *delete* the following: “, Grade 420;”

Page 7-102, line 32; *delete* the following: “, Grade 420”

Page 7-102, after line 36; *insert* the following paragraphs:

Mechanical connectors used on Galvanized Bar Reinforcement shall be galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods.

Mechanical connectors for Stainless Clad Reinforcement and Stainless Steel Reinforcement shall be fabricated from stainless steel meeting the requirements of ASTM A959 UNS S31600.

Page 7-103, line 6; *delete* the following: “, **GRADE 420**”

Page 7-103, line 11; *add* the following before the period that ends the sentence;
“or §709-14, Bar Reinforcement, Grade 520.”

Page 7-103, *delete* line 14.

Page 7-104, line 6; *add* the following after “Grade 420,”

“or §709-14, Bar Reinforcement, Grade 520,”

Page 7-194, line 36, *delete* the following: “or 709-03”

Page 7-104, after line 7; *add* the following:

709-12 - STAINLESS-CLAD-BAR REINFORCEMENT

SCOPE. This specification covers composite bar reinforcement consisting of a mild steel core with a bonded exterior layer of stainless steel.

MATERIAL REQUIREMENTS

Mechanical Properties. The composite bar reinforcement shall meet the mechanical property requirements of ASTM A615M, Grade 420 or ASTM A615M, Grade 520.

Stainless-Steel-Cladding. The stainless-steel-cladding shall meet the requirements of ASTM A959 UNS S31600. The completed composite bar reinforcement shall have a minimum stainless-steel-cladding thickness of 180 μm .

Quality Control. The manufacturer shall provide a quality control plan for review and approval by the Director, Materials Bureau a minimum of thirty (30) days prior to delivery. The plan shall clearly demonstrate the ability to manufacture, test, certify, maintain, and assure the identity of bars from manufacture to placement.

Inspection. The receipt of the manufacturer's quality control plan will serve as Department notification of the manufacturer's intention to supply reinforcing bars to Department work. The Materials Bureau will arrange for the inspection and sampling of bars by a Department representative. Department representatives shall have free access to the plant for inspection and/or sampling to verify specification compliance. Work done while any Department representative has been refused access shall be automatically rejected.

Randomly selected lengths of clad bars will be taken by the representative from the production run for test, to assure specification compliance. The manufacturer shall allow fourteen (14) days from the receipt of the samples in the Materials Bureau's laboratory for evaluation to verify the acceptability of the bars and subsequent authorization for shipment.

BASIS OF ACCEPTANCE. Subsequent to the review and approval of the manufacturer's Quality Control Plan, stainless clad reinforcing bars will be considered for acceptance in mill-banded, stock-lot quantities at manufacturing sites in accordance with procedural directives of the Materials Bureau.

709-13 - STAINLESS STEEL BAR REINFORCEMENT

SCOPE. This specification covers steel bar reinforcement consisting of stainless steel.

MATERIAL REQUIREMENTS

Material Properties. The stainless steel shall meet the requirements of ASTM A955 M and its designated grade, either 420 or 520, and shall also meet the requirements of either ASTM A 276 UNS S31653 or UNS S31803.

Quality Control. The manufacturer shall provide a quality control plan for review and approval by the Director, Materials Bureau, a minimum of thirty (30) days prior to delivery. The plan shall clearly demonstrate the ability to manufacture, test, certify, maintain, and assure the identity of bars from manufacture to placement.

Inspection. The receipt of the manufacturer's quality control plan will serve as Department notification of the manufacturer's intention to supply reinforcing bars to Department work. The Materials Bureau will arrange for the inspection and sampling of bars by a Department representative. Department representatives shall have free access to the plant for inspection and/or sampling to verify specification compliance. Work done while any Department representative has been refused access shall be automatically rejected.

Randomly selected lengths of stainless bars will be taken by the representative from the production run for test, to assure specification compliance. The manufacturer shall allow fourteen (14) days from the receipt of the samples in the Materials Bureau's laboratory for evaluation to verify the acceptability

of the bars and subsequent authorization for shipment.

BASIS OF ACCEPTANCE. Subsequent to the review and approval of the manufacturer's quality control plan, stainless reinforcing bars will be considered for acceptance in mill-banded, stock-lot quantities at manufacturing sites in accordance with procedural directives of the Materials Bureau.

709-14 BAR REINFORCEMENT, GRADE 520

SCOPE. This specification covers the material requirements for deformed billet steel reinforcing bars used in portland cement concrete. Plain and deformed steel for the fabrication of spirals is included.

MATERIAL REQUIREMENTS

Deformed Bar Reinforcement. Steel reinforcing bars shall be deformed billet steel bars meeting the requirements of ASTM A615, Grade 520.

Samples and Tests. Sampling and testing will be conducted as directed by the Materials Bureau.

BASIS OF ACCEPTANCE. Reinforcing bars and spirals will be considered for acceptance on the basis of the Manufacturer's name appearing on the Approved List, and certification, in accordance with the procedural directives of the Materials Bureau.

Alternately, reinforcing bars and spirals from a Manufacturer not appearing on the Approved List may be considered for acceptance in mill bonded, stock lot quantities at the fabricators or the epoxy coating applicators, based on sampling and testing in accordance with the procedural directives of the Materials Bureau.