SECTION 053000

METAL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in Table of Contents, shall be included in and made a part of this Section.

1.2 WORK INCLUDED

A. Provide labor, materials, equipment, services and transportation required to install and complete steel deck work shown on Drawings and as specified herein including but not limited to items noted below.

1. Two or three inch deep galvanized composite steel floor deck.
2. One and one-half or three inch deep galvanized steel roof deck.
3. Headed stud "shear connectors" required for structural steel composite beams.
4. Hanger tabs for suspended ceilings and fixtures as required and/or shown on the reflected ceiling plans.
5. Drainage and roof sump pans.
6. Steel deck accessories: closures, transition plates, welding washers, stoppers and cover plates.
7. Miscellaneous structural framing and connections for support of steel deck where required and not provided under Structural Steel Framing Section.
8. Cutting of holes and openings in steel deck in accordance with requirements under "Erection" in this Section.
9. Furnishing and application of approved field touch-up paint for scarred steel deck.
10. Furnishing of partition/deck closure pieces mated to deck system so chosen.
11. Furnishing of steel deck items, required to be built into or form part of work specified under other Sections, to appropriate trade at proper time with complete instructions to facilitate installation.
12. Unless specifically excluded, furnishing and installation of any other items of steel deck work indicated on Drawings, specified, or obviously needed to make work of this Section complete.

1.3 RELATED WORK:

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033000, Cast-in-Place Concrete
2. Section 051200, Structural Steel Framing
3. Section 054000, Cold-Formed Metal Framing
4. Section 095100, Coordination Drawings for Tab Locations, Cuts, Sumps, etc. (Division #1) (Division #15)
5. Section 078100, Applied Fireproofing
6. Section 099100, Painting
7. Section 220000, Plumbing
8. Section 230000, Heating, Ventilating, and Air-Conditioning (HVAC)

1.4 STANDARDS

A. Except as otherwise specified herein, perform work in accordance with specifications noted below, including latest editions of applicable specifications, codes, and standards cited therein, and latest applicable addenda and supplements. Copies of these items shall be kept available in shop and field.

1. "The Commonwealth of Massachusetts State Building Code", 9th Edition.
2. "Specification for the Design of Cold-Formed Steel Structural Members, 2012", American Iron and Steel Institute.
3. "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", AISC 360-10, American Institute of Steel Construction.
4. "Structural Welding Code - Steel" (AWS D1.1-11), American Welding Society.
5. "Structural Welding Code - Sheet Steel" (AWS D1.3-11), American Welding Society.
6. "Code of Standard Practice" (SDI COSP-2014), Steel Deck Institute.
7. "Fire Resistance Directory", Underwriters Laboratories Inc.
8. American Society for Testing Materials (ASTM) Standards referenced in this Section.
9. Steel Deck Institute Diaphragm Design Manual, 4th Edition, 2015.

B. Any material or operation specified by reference to published specifications of manufacturer or published standard shall comply with said specification or standard. In case of conflict between referenced specifications, most stringent requirement shall govern. In case of conflict between referenced specifications and Project Specifications, Project Specifications shall govern.

1.5 DESIGN CRITERIA

A. The General Contractor is responsible for detailed design of steel deck to safely sustain loadings shown on structural drawings and other dead loads indicated on drawings and in specifications.

1. Wherever possible, design deck so as to require no shoring.
2. Individual steel deck panels shall be continuous over two or more spans except where limited by structural steel layout.
3. Steel deck sections and calculation of their properties shall conform to "AISI Specification for the Design of Cold-Formed Steel Structural Members".
4. Deflection Requirements relative to supporting members for floor units (L=span):

    a. Under initial load of deck plus fresh concrete, deflection shall be less than L/180 or 5/8 inch, whichever is smaller.
    b. Under loads applied after concrete has set, deflection shall be less than L/360.

5. Deflection Requirements relative to supporting members for roof units (L=span):
    a. Under design live load, deflection shall be less than L/240.
6. Bending strength requirements for floor units:

    a. Initial loads (deck acting alone)

        Deck + concrete (including ponding) + 20 psf live load, maximum allowable deck stress = 0.60Fy.

        Deck + concrete (including ponding) + 150 lbs./foot midspan live load, maximum allowable deck stress = 0.80Fy.

    b. Superimposed loads - for composite behavior all spans shall be considered simple spans.

        Considering total dead plus superimposed load to be carried by composite action, maximum allowable deck stress = 0.60Fy (bottom fiber).

Considering combined stress on steel deck alone due to initial dead load, plus stress on composite section due to superimposed load, maximum allowable deck stress = 0.8Fy (bottom fiber).

Considering superimposed load alone, maximum allowable concrete stress = 0.45 f'c.

7. Bending strength requirements for roof units:

   a. Under total design load, maximum allowable deck stress = 20,000 psi.

8. Other strength requirements:

   a. Allowable shear (or shear/bond) and allowable end bearing shall be as recommended by the deck manufacturer if substantiated by tests by an independent Testing Agency. (Alternatively, certification of tests by a registered professional engineer who witnessed and/or supervised the tests will be acceptable.) Factor of safety shall be not less than 2.0.
   b. No loads shall be suspended from the deck or from the deck-slab system except for normal ceiling construction not to exceed 10 psf. (Note the load limitation of 100 pounds per hanger, also.) Not more than one hanger shall be suspended from any hanger tab.
   c. The roof diaphragm is designed based on the values supplied in Reference Standard 1.4.A.9. The deck supplier shall supply certification that deck as supplied, detailed and installed conforms to these values.

1.6 SUBSTITUTIONS

A. Substitutions for steel deck sizes, type, connection details or any other modifications proposed by the General Contractor will be considered by Architect only under following conditions:

   1. That request has been made and accepted prior to submission of Shop Drawings.
   2. That there is a substantial cost advantage or time advantage to Owner; or that proposed revision is necessary to obtain required materials or methods at proper times to accomplish work in time scheduled.
   3. That sufficient sketches, engineering calculations, and other data have been submitted to facilitate checking by Architect, including cost reductions or savings in time to complete work.

1.7 SUBMITTALS

A. Fire Rating Certification: Submit to Architect, in accordance with requirements of Section 013000, documentation and certification that composite steel deck as part of proposed structural system will qualify for the fire ratings specified prior to submitting detailed Shop Drawings.

B. Shop Drawings: Submit to Architect, in accordance with requirements of Section 013000, detailed Shop Drawings, including erection drawings and schedules, properly cross-referenced, showing: steel deck type; gage; finish; layout; identification mark; location; openings; dimensions; anchorages; laps; conditions requiring closures; supplementary framing and special jointing or other accessories; number, size, capacity, and layout of shear connectors; location and size of welding and/or mechanical fastening; and welding data.

   1. Architect's checking is a review for conformance with the design concept of the project and compliance with the information given in the Contract Documents. In accordance with Section 013000, the General Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction;

coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

2. Do not proceed with fabrication of material or performance of work until corresponding item on Shop Drawing has been reviewed by Architect.
3. Get the necessary information from all other trades requiring openings through steel deck and show all such openings, properly dimensioned and drawn to scale on the steel deck shop drawings before the latter are submitted for approval.
4. All submittals shall be prepared with an action stamp which includes Structural Engineer's name and date-received and date-returned box.

C. Steel Deck Design Calculations: Submit to Architect, in accordance with requirements of Section 013000, and prior to fabrication, complete design calculations for section properties of each type and gage of deck, calculated in conformance with AISI Specification; calculations of load carrying capacity and deflections for each combination of deck type, gage, span, and concrete type and thickness to be used.

D. Test Data: Submit to Architect, in accordance with requirements of Section 013000, tests to substantiate the calculated load capacities and deflections of proposed typical composite deck-slab assemblies. As a minimum, reports shall cover 3-inch structural floor system with 4-1/2 inch normalweight concrete topping and 3-inch non-cellular deck with 3-1/2 inch lightweight concrete topping each tested with the actual panel layout proposed for this project.

E. Hanger Attachment Devices: Submit to Architect, in accordance with requirements of Section 013000, complete description, including certified load tests, of hanger attachment devices proposed for use of hanging suspended ceiling construction from steel deck system to be used in actual construction.

F. Samples: Submit to Architect, in accordance with requirements of Section 013000, samples and/or descriptive literature of materials, products, and methods as requested by Architect.

1. Do not proceed with fabrication of material/product or performance of work until Sample has been approved by Architect.

G. Corrective Work: Submit to Architect, in accordance with requirements of Section 013000, drawings showing details of proposed corrective work prior to performing corrective work.

H. Affidavit: Submit to Architect, on request by Architect, manufacturer's and/or fabricator's and/or erector's affidavit stating that material or product provided complies with Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel deck floor units:

1. Nominal rib height shall not exceed 3 inches.
2. Sheet thickness shall not be less than 20 gage.
3. The wr/hr ratio shall not be less than 2.
4. Sufficient integral locking lugs shall be formed to transfer the horizontal shearing forces between the concrete slab and the floor unit and to prevent vertical separation of the slab from the deck.
5. Steel deck shall be manufactured from steel conforming to ASTM A653 Structural Quality (SQ) Grade 33 with a minimum yield strength of 33,000 psi.
6. Deck shall have a galvanized coating conforming to ASTM A924 designation G60.

B. Steel deck roof units:

1. Sheet thickness shall not be less than 22 gage.
2. Steel deck shall be manufactured from steel conforming to ASTM A653 Structural Quality (SQ) Grade 33 with a minimum yield strength of 33,000 psi.
3. Deck shall have a galvanized coating conforming to ASTM A924 with a minimum coating class of G60 as defined in A653-94.

C. Steel deck units shall have U.L. approved fire ratings for the construction assemblies specified.

D. Deck Accessories:

1. Fabricate deck accessories of 18 gage minimum sheet steel, with galvanized coating. Provide the following typical accessories and any additional accessories required by deck manufacturer's steel deck system to provide continuous support for the concrete and to prevent loss of any concrete fines through gaps and openings.

   a. Cover plates or flashing plates as required to close panel edge or end conditions and where panels change direction or abut.
   b. Horizontal flashing to close openings between steel deck and structural steel columns.
   c. Horizontal flashing to cover gaps between deck and structural steel or between deck units.
   d. Edge closures and screeds to provide boundary for concrete cast on steel deck. Unless a structural steel member is the edge form, provide edge forms at slab perimeter and at openings in slabs cast on steel deck. Edge closures and forms shall have (or shall be braced to have) sufficient strength and stiffness to retain the concrete with straight edges true to drawing details and dimensions. Edge closures shall not interfere with shear connector installation.
   e. Drain pans or sumps, flat or recessed to suit drains, formed of 14 gage galvanized steel.
   f. Welding washers - to be used where specified under PART 3 - INSTALLATION.
   g. Rust-inhibiting priming paint for touch-up: "TNEMEC-ZINC 92" by Tnemec Co. "Rust-Oleum 7085" by Rust-Oleum Co.; or "Aquapon UC-40059" by P.P.G, Industries.

E. Welding materials: conform to AWS Code and AWS filler steel specifications.

F. Auxiliary Structural Steel:

1. Steel shapes and plates shall be new steel conforming to ASTM A36.
2. Fabrication shall conform to AISC Specification.

G. Shear Connectors: Headed steel studs with ceramic arc shield. Studs shall conform to "Specification for Cold-Finished Carbon Steel Bars and Shafting", ASTM A108, grades 1010, 1015, 1017, or 1020, minimum yield strength = 50,000 psi and minimum tensile strength = 60,000 psi. See AWS Code D1.1, Section 4, Part F "Stud Welding" for additional material requirements.

PART 3 - INSTALLATION

3.1 INSPECTION

A. Examine all work prepared by others to receive work of this Section and report any defects affecting installation to the General Contractor for correction. Commencement of work will be construed as complete acceptance of preparatory work by others.

3.2 GENERAL

A. Install all components in accordance with the Contract Documents and the approved Shop Drawings. Erect steel deck only after the supporting structural steel has been aligned and connected as required by the Structural Drawings and Specifications.

B. Handle and stack materials carefully in order to prevent deformation or damage. During unloading and hoisting, take care to prevent damage to ends and sides of individual deck panels. Panels stored prior to installation shall be placed on skids and shall be protected and kept dry. Foreign materials on panels shall be completely removed prior to erection.

C. Replace damaged components with identical new units, unless repair or reinforcement is specifically permitted by the Architect.

3.3 AUXILIARY STEEL SUPPORTS

A. Erect auxiliary steel supports in accordance with provisions of Section 05 12 00 "Structural Steel" of the Specifications, and in conformance with the approved Shop Drawings.

B. Bearing surface of each auxiliary support shall be in the plane of the bottom of the deck, as established by adjacent structural steel members on which the deck is to bear.

3.4 STEEL DECK

A. Steel deck panels shall be shipped to the field cut to the proper length. All notching at columns, bevel cuts, or other similar fabrication shall be done by the steel deck erector.

B. No opening shall be cut in steel deck unless shown on the approved steel deck Shop Drawings or specifically approved by the Architect in writing. If an opening not shown on the Shop Drawings is required, Contractor shall submit to the Architect a sketch drawn to scale, showing the proposed opening and all other openings and supports in the immediate area. The deck shall not be cut until this sketch has been approved by the Architect. Any additional reinforcement or framing required because of such an opening shall be provided at Contractor's expense.

C. Holes and openings which are located and dimensioned on the Structural Drawings shall be cut by the steel deck erector. Holes required by other trades shall be shown on the steel deck Shop Drawings but shall be located and cut by the respective trades.

D. All cutting of steel deck panels shall be done in a workmanlike fashion by power shears, gas-torch, cold chisel or other means approved by the Architect.

E. Surfaces of structural steel members which are to receive shear connectors, and steel deck support surfaces which are to receive welding or shear connectors, shall be free of paint, ice, water, oil, dirt, rust or any other material detrimental to welding.

F. No steel deck shall be erected until the corresponding structural steel tier has been fully aligned and connected. If the supporting steel framework or concrete is not in proper alignment, or at the proper level, Contractor shall proceed with corrective action. The steel deck panels shall not be erected until the necessary corrections have been made.

G. Steel deck panels shall be placed on supporting steel or concrete and accurately aligned to final position before permanently fastened. Deck shall not be stretched or contracted in a transverse direction and shall have a minimum end bearing of 2 inches on the supporting steel or concrete. Steel deck panels shall rest tightly on the top flange of beams or girders, or any other support surfaces. Unless indicated otherwise, all steel beams in floor/roof areas where steel deck is used

shall have their top flanges in direct contact with and welded to the deck, for lateral stability of the beams.

H. Install sheet steel accessories welded in place, including closures, screeds, filler pieces, or cover plates, as appropriate, to close panel ends, where panels change direction or abut, to bridge from edges of panels to adjacent steel or concrete, at slab edges, and at other locations where shown or otherwise required to support and retain the concrete at each floor level.

I. Column closures shall be both cut and installed in the field.

J. All welding of steel deck panels, including accessories, shall be performed by welders who have been qualified by tests, as prescribed in the "Standard Qualification Procedure" of the American Welding Society.

K. Burning or weakening of the steel deck material around welds shall be cause for rejection. Deficient welds shall either be repaired or entirely removed and rewelded or the steel deck shall be reinforced or replaced, as directed by the Architect.

L. Steel deck panels shall be arc-welded to the supporting steel in accordance with the following minimum requirements:

1. Welding washers of a type approved by the Architect shall be used in connecting any steel deck material less than 20 gage in thickness.
2. Ends and end laps - 3/4 inch diameter puddle welds at a maximum spacing across the width of the panel, of 12 inches.
3. Intermediate supports - same as (2) above.
4. Where two panels abut, each panel shall be fastened as in (2) above.
5. Longitudinal edges and edge laps supported by steel framework - 3/4 inch diameter puddle welds at a maximum spacing of 2 feet 6 inches along the length of the panel.
6. See Drawings for additional requirements in special areas.

M. Longitudinal side laps of adjacent panels:

1. Deck shall be welded or mechanically fastened between supports at intervals not exceeding 2 feet 6 inches.

N. Longitudinal edge closures shall be fastened by tack welding at a maximum spacing of 2 feet 6 inches. Sheet steel screws shall not be used.

O. Locate drain pans or sumps to suit drain fittings and drain locations. Cut deck to receive drain and weld in pan or sump to reinforce deck openings.

P. Both welding to bottom of steel deck and field penetration through steel deck for hangers or hanger attachment devices are prohibited, unless specifically approved in advance by the Architect, or shown on the Structural Drawings. The Architect will not consider any hanger or attachment device proposal which in Architect's opinion would impair the local or overall load capacity of the deck-slab system, or would impair the fire resistance of the deck-slab assembly, or would result in a concentrated suspended load on the deck-slab system exceeding 500 pounds in any area of 50 square feet.

3.5 SHEAR CONNECTORS

A. Headed stud shear connectors shall be installed after erection of the steel deck, in accordance with the AWS Code, by experienced operators using automatic welding equipment, adequate electric power and ceramic shields, in accordance with the recommendations of the stud manufacturer.

B. Through-deck stud welding shall be used where gage thickness permits proper stud welding to develop required strength. Stud and/or steel deck manufacturer shall provide adequate test results to verify feasibility of through-deck stud welding for particular stud size and gage thickness involved. Stud and/or steel deck manufacturer shall satisfy requirements of stud installer for expeditious and proper installation. Manufacturer's requirements regarding cleanliness of steel and other items shall be met by installer.

C. If through-deck stud welding is unfeasible, studs shall be installed in pre-punched holes in deck. Pre-punched holes shall be provided only for studs involved and hole oversize shall be held to a minimum.

D. All shear connectors shall be headed steel studs. See drawings for spacing and size.

E. Stud spacing - Shall be in accordance with all spacing requirements of AISC. Space approximately uniformly between center (or designed zero shear point) of beam and each end or designated point, or as otherwise shown.

F. Horizontal Clearances - Minimum one inch from edge of any stud to face of concrete, deck rib or trench header.

G. Edge distance - Center of stud to edge of steel beam shall be preferably two inches, but in no case less than 1-1/4 inches.

H. After stud installation in each area, all ceramic shields shall be broken off and the material removed from the deck and steel surfaces to an area designated by the General Contractor.

I. Personnel welding shear connectors shall be qualified using elements of above procedure, prior to any production welding of shear connectors.

3.6 INSPECTION, TESTING, AND QUALITY CONTROL

A. Inspection and testing of steel deck work will be performed by an independent Testing Agency, under a separate contract with the Owner. Materials and workmanship shall be subjected to inspection and testing in shop and field by Architect and/or Testing Agency. Such inspection and testing shall not relieve Contractor of responsibility to provide additional inspection, testing, and quality control as necessary to furnish materials and workmanship in accordance with requirements of Contract Documents.

B. Notify Architect and Testing Agency prior to start of any fabrication, erection, or other phases of work so as to afford them reasonable opportunity to visit the site. Such notification shall be made at least 36 hours in advance.

C. Facilitate inspection and testing by Testing Agency. Contractor shall, at his own expenses, furnish Testing Agency, upon request, with:

1. Complete sets of approved Shop Drawings and corrective work procedures at shop(s) and in field.
2. Cutting lists, order lists, material bills, and shipping lists.
3. Information as to time and place of all rollings and shipments of material to shop(s) and field.
4. Representative sample pieces requested for testing.
5. Full and ample means and assistance for testing materials, and proper facilities for inspection of work, shop and field.

D. Testing Agency shall inspect and test steel deck and shear connector work as required by Architect.

E. Maintain records of welders employed and date of qualification. Such records shall be available for examination by Architect and/or Testing Agency, or certified copies submitted upon request to Architect and Testing Agency.

F. Before any welding of the steel deck is done, two specimens of each type of weld shall be prepared by each operator. These specimens shall be inspected, tested, and approved by the Owner's representative before that operator shall be permitted to weld on the structure.

G. All headed stud shear connectors shall be checked for the following indications of an insufficient weld:

1. Less than 360 degree fillet, voids, undercuts, or insufficient penetration.
2. Burn-off (reduction in length after welding) less than 1/8 inch.
3. Cold appearance of the weld.

H. If, after welding of any shear connectors, visual inspection indicates any of the imperfections listed above or any other questionable appearance, such stud shall be struck hard with a three-pound hammer and bent 15 degrees off perpendicular to beam and toward nearest end of beam. Studs which fail this test, as provided in the AWS Code, shall be replaced. Studs which show no sign of failure after this test may be left in bent position if no portion of the stud is less than one inch from a proposed concrete surface.

I. Do not remove any marks or tags applied by Testing Agency identifying rejected work.

J. Steel deck work which has been rejected by Architect and/or Testing Agency in shop or field shall be corrected without delay and at no expense to the Owner. Additional tests shall be performed at Contractor's expense to confirm compliance of corrected work.

END OF SECTION