



800 West Cummings Park, Suite 3950
Woburn, Massachusetts 01801

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Section 08 34 49 (08346)

RADIATION SHIELDING LEAD-LINED WOOD DOORS AND HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. The BIDDING REQUIREMENTS, CONTRACT FORMS, and CONTRACT CONDITIONS as listed in the Table of Contents, and applicable parts of Division 1 - GENERAL REQUIREMENTS, shall be included in and made a part of this Section.
- B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

1.2 SUMMARY

- A. The work of this Section consists of radiation shielding wood doors where shown on the Drawings, as specified herein, and as required for a complete and proper installation. Work includes, but is not limited to the following:
 - 1. Furnish and install the following:
 - a. Lead lined hollow metal frames for doors, complete with internal reinforcing.
 - b. Flush lead lined wood swinging doors.
 - c. Door hinges.

1.3 RELATED SECTIONS

- A. Section 01 73 00 - EXECUTION: Waste management and recycling during Final Cleaning.
- B. Section 08 71 00 - DOOR HARDWARE: Furnishing finish hardware, and installation templates for hardware cutouts.
- C. Section 09 91 00 - PAINTING: Applied opaque finish coatings.
- D. Division 26 - ELECTRICAL: Conduit and power wiring for door operators, controls, and interlock (as may be applicable).

1.4 REFERENCES

- A. Comply with applicable requirements of the following standards and those others referenced in this Section.
 - 1. American Conference of Government Industrial Hygienists – Industrial Ventilation Manual.
 - a. ASTM B 29 – Standard Specification for Refined Lead.
 - 2. Door and Hardware Institute (DHI): Publication DHI A115.1G - Installation Guide for Doors and Hardware.
 - 3. International Organization for Standardization (ISO): ISO 9001:2000.
 - 4. National Council on Radiation Protection and Measurements (NCRP):
 - a. NCRP Report No. 147 – Structural Shielding for Medical X-Ray Imaging Facilities.



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- b. NCRP Report No. 148 – Radiation Protection in Veterinary Medicine.
- c. NCRP Report No. 151 – Structural Shielding Design and Evaluation for Megavoltage X- and Gamma Ray Radiotherapy Facilities.
5. U.S. Department of Labor Occupational Safety and Health Administration (OSHA):
 - a. OSHA standard 29 CFR 1910.1025 – Lead.
 - b. OSHA standard 29 CFR 1926 – Safety and Health Regulations for Construction.
 - c. OSHA standard 29 CFR 1926.62 – Lead.
 - d. CAL-OSHA Title 8 Sec 1532.1, Sec 5198, and Sec 5216
6. All applicable federal, state, and municipal codes, laws and regulations for fire rated assemblies.

1.5 SUBMITTALS

- A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:
 1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties, and installation instructions for each item furnished hereunder.
 - a. Recycled material content: Indicate recycled content and provide manufacturer's written certification of recycled steel and lead products (LEED™ NC Version 2.2 Credits MR 4.1 and 4.2).
 - 1) Indicate percentage both post-consumer and pre-consumer recycled content per unit of product.
 - b. Local / regional materials (LEED™ NC Version 2.2 Credit MR 5.1):
 - 1) Indicate location of extraction, harvesting, and recovery; indicate the distance between extraction, harvesting, and recovery and the project site.
 - 2) Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
 - c. Include certification of data indicating Volatile Organic Compound (VOC) content of all joint sealants. Submit MSDS highlighting VOC limits. (LEED™ NC Version 2.2 Credit EQ 4.1)
 2. Product data sheets on door and frame products: Provide chemical, functional, and environmental characteristics, size limitations, and special application requirements. Identify available colors.
 3. Certification: Manufacturer's written certification stating that doors, frames, and all related items to be furnished hereunder, meet or exceed the requirements specified under this Section; that specified shop priming/finishing has been performed; and that all U.L. fire-resistive requirements for the indicated Labels have been met.
 4. Manufacturer's instructions: Manufacturer's installation instructions and diagrams for components installed under other trades.
 5. Shop drawings: Large scale design details of door and frame construction, including elevations and sections indicating all gages, reinforcing, and anchorage. All details bearing dimensions of actual measurements taken at the project

1.6 QUALITY ASSURANCE

- A. Obtain lead lined wood doors and lead-lined frames required for the Work of this Section from a single ISO 9001:2000 certified manufacturer.

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- B. Installers:
 - 1. Installers, foreman, and job supervisors for the Work of this Section shall be trained by, and approved by, product manufacturer. Foreman and job supervisors shall be certified by manufacturer to have not less than 5 years experience in the installation of neutron / radiation shielding.
 - 2. All construction workers, foreman, and job supervisors for the work of this section shall have a minimum certification of 10 hours of OSHA training in occupational safety and health.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate the work of this Section with the respective trades responsible for furnishing hardware and installing lead lined doors and frames.
- B. Ensure that the work performed hereunder is coordinated with issued templates authorized by the hardware supplier.
- C. Do not fabricate lead-lined doors or frames before receiving a copy of the approved hardware schedule, submitted by the hardware supplier, reviewed by the Contractor, and accepted by the Architect. Verify that issued templates are coordinated with the approved schedule; immediately notify the Architect, in writing, of any conflicts.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
- B. Prior to shipping, identify each lead lined frame and door with a removable metal or plastic label which corresponds with door schedule identifying opening number and location.
- C. Deliver doors and frames boxed or crated to provide protection during transit and job storage.
- D. Inspect doors and frames upon delivery for damage. Minor damage may be repaired provided the refinished items are equal in respects to new work and acceptable to the Architect; otherwise remove and replace damaged items.
- E. Store doors and frames at the building site upright and under cover. Place the units on wood dunnage and cover in a manner that will prevent rust and damage.

1.9 FIELD MEASUREMENTS

- A. Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of Work.

1.10 WARRANTY

- A. Provide the following warranties under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS. Warranties shall include de-lamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction, all as defined by WDMA industry standards.
 - 1. Warranty length: Manufacturer's lifetime warranty.



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2. Warranty coverage shall include all labor and material costs of delivery, re-hanging, refinishing, glass and glazing to produce a complete installation of replaced or repaired doors.

B. Submit the following warranties under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS:

1. Lifetime Warranty: For life of original installation, warranties shall include provisions to repair or replace doors which are considered defective by delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specified Manufacturer: To establish a standard of quality, design and function desired, Drawings and specifications have been based on "Radiation Shielded Swing Door System" as manufactured by NELCO, 800 West Cummings Park, Suite 3950, Woburn, MA 01801, www.nelco-usa.com (telephone 800-635-2613).

1. Manufacturing Facilities:

- a. NELCO Boston: 3 Gill St - Unit D, Woburn, MA 01801
- b. NELCO Houston: 4600 Homestead Road, Houston, TX 77028
- c. NELCO San Francisco: 1840 Williams Street, San Leandro, CA 94577

B. Alternative products (substitutions): Contractor must furnish appropriate and complete product data, proof of ISO 9001:2000 certification, worker OSHA certifications, environmental characteristics, and sample warranty with bid for the Architect to consider the substitutions as "equal" to the manufacturer, product specified and quality assurance requirements. Further additional information may be requested by the Architect for determination that the proposed product substitution is fully equal to the specified products. There is no guarantee that proposed substitutions will be approved, and the Contractor is hereby directed not to order any materials until said approval(s) are received in writing.

1. Requesting substitutions is at the Contractor's own risk, with regard to uncompensated delays of the Project. Time is required for sufficient review and for additional requests of information. Delays of work which result from substitution reviews and resubmissions are not grounds for additional time or cost change orders, and will not be considered by the Owner.

2.2 DOORS

A. General requirements: Conform to the requirements set forth in the designated Sections of the (WDMA) Industry Standard IS 1A-04, and the applicable requirements of U.S. Commercial Standard CS 171, as amended. Refer to the Drawings for sizes, locations of each type door, glazing cutouts in doors, and other characteristics of doors to be furnished hereunder.



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1. Door Grade: Custom.
2. Door Facing:

*Note to Specifier: SELECT DOOR FACING
WOOD VENEER /or/ MDO (for painted finish) /or/ PLASTIC LAMINATE*

- a. Face veneer: WDMA Industry Standard, "A" Grade veneer minimum 1/50 inch (0.6 mm) thick, mechanically sliced.
 - 1) Wood Species: _____, [Rift] [Quartered] [Plain] [Flat] [Rotary] Sawn.
 - 2) Matching of adjacent pieces of veneer: [Book matched] [Slip matched].
 - 3) Panel face assembly: [Balanced] [Running].
 - 4) Direction of Grain: [Vertical] [Horizontal].
- b. Face veneer: MDO (Medium Density Overlay) face veneer for paint finish.
- c. Face veneer: Decorative Laminate Facing, NEMA LD-3 General Purpose type laminate, 0.050 inch (1.3 mm) thick in color selected by Architect from full range available.
- d. Crossbanding: Hardwood veneer or composite product at least 1/16 inch thick.

2.3 LEAD LINED FIRE-RESISTANCE RATED 20 MINUTE LABEL DOORS

- A. General Construction: WDMA Industry Standard I.S. 1A-04, S-21 Veneer, Fire Rated Mineral Core, Premium Grade Door.
 1. Door thickness: 1-3/4 inches, unless indicated otherwise.
 2. WDMA Specification Description: "FD-20 MIN".
- B. Door facing: As specified herein above under Article – "Flush Faced Doors".
- C. Core construction:
 1. Core: Particleboard complying with ANSI A208.1 Type 1, Grade 1-LD-2 having a density of 33 pounds per cubic foot with Formaldehyde emissions limited to 0.30 ppm.
 - a. Provide divided core secured by lead covered bolts.
 - b. Lead sheets: located in door center, extended to outer edges of door.
 2. Stiles: Laminated strand lumber or hardwood mill option for inner ply of styles, minimum of 2-1/8 inches after trimming, with outer ply matching face veneer, or visually compatible hardwood species.
 - a. Provide divided stiles secured by lead covered bolts.
 3. Top and bottom rails: minimum 1-1/8 inch width. Provide divided rails secured by lead covered bolts.
 - a. Top and bottom rails with wood veneered faced doors: Maple or Birch, as standard with manufacturer.
 - b. Top and bottom rails with painted or plastic laminate faced doors: Maple, Birch, Poplar, Structural Composite Lumber (SCL), or UL approved composite material to meet label requirements.
- D. Adhesives:
 1. Face assembly: Type 1 (waterproof).
 2. Core assembly: Type II (water-resistant).



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- E. Accessories: For all fire-rated doors installed in pairs with both leaves active, provide 20-gage formed steel edges, without astragal, wrapped with veneer matching faces of doors.

2.4 LEAD LINED NON-RATED SOLID-CORE DOORS

- A. General Construction: WDMA Industry Standard I.S. 1A-04, S-9 Veneer, Particleboard Core Bonded, Premium Grade Door.
 - 1. WDMA Specification Description: "PC-5".
 - 2. Door thickness: 1-3/4 inches, unless indicated otherwise.
- B. Door facing: As specified herein above under Article – "Flush Faced Doors".
- C. Core construction:
 - 1. Core: Particleboard complying with ANSI A208.1 Type 1, Grade 1-LD-2 having a density of 33 pounds per cubic foot, with Formaldehyde emissions limited to 0.30 ppm.
 - a. Provide divided core secured by lead covered bolts.
 - b. Lead sheets: located in door center, extended to outer edges of door.
 - 2. Stiles: Laminated strand lumber or hardwood mill option for inner ply of stiles, minimum of 2-1/8 inches after trimming, with outer ply matching face veneer, or visually compatible hardwood species.
 - a. Provide divided stiles secured by lead covered bolts.
 - 3. Top and bottom rails: minimum 1-1/8 inch width. Provide divided rails secured by lead covered bolts.
 - a. Top and bottom rails with wood veneered faced doors: Maple or Birch, as standard with manufacturer.
 - b. Top and bottom rails with painted or plastic laminate faced doors: Maple, Birch, Poplar, or Structural Composite Lumber (SCL).
- D. Adhesives: Type 1 (waterproof) for both face and core assembly.

2.5 LEAD LINED HOLLOW METAL DOOR FRAMES

- A. General: Refer to the Drawings for various types of frames, sizes, and profiles, UL fire-resistive label frames, and other characteristics of frames and related items.
 - 1. Frame type:
 - a. Shop welded frames with mitered joints arc-welded, reinforced and ground smooth.
 - b. Knock-Down
- B. Materials for frames, reinforcement, anchors, anchor clips and related items: commercial grade cold-rolled steel conforming to ASTM A109 or commercial grade hot-rolled and pickled steel conforming to ASTM A415.
 - 1. Frame gage:

Note to Specifier: SELECT FRAME GAGE – LEVEL 2/3 IS TYPICAL

- a. Interior frames for Level 1 doors: 18-gage, 0.042 inch thick, except as otherwise required for specific U.L. Label.



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- b. Interior frames for Level 2 and 3 doors: 16-gage, 0.053 inch thick , except as otherwise required for specific U.L. Label.
 2. Hinge, lock, and strike reinforcement: 7 gage thick.
 3. Door closer reinforcement: 12 gage, minimum 0.093 inch thick.
 4. Floor clips: 16 gage thick.
 5. Glazing stops: 16 gage, minimum 0.053 inch (1.3 mm) thick, except as otherwise required for specific U.L. Label.
- C. Frame construction:
1. Fire-rated frame assemblies: Modify specified construction to meet all construction requirements required for fire-resistive rating.
 - a. Affix appropriate UL, FM, or Warnock Hersey labels to each rated frame assembly, indicating applicable rating.
 2. Shop-fabricate frames as whole single units per door opening, except when frame size is too large to ship as a single unit. Oversized frames may be shipped in large sections as practicable for field assembly with concealed splice plates or channels.
 3. Frame corner construction: As specified in paragraph A, above.
 4. Reinforcements, stiffeners, and base angle clips: Welded to interior surfaces of frames to provide a stable base and so as to not interfere with installation of hardware.
 5. Appearance of finished frames: Strong, rigid, completely free from warp and buckle, with miters well formed and in true alignment, and with surfaces smooth and free from defects of any kind.
 6. Plaster and mortar guards, if required, shall be provided by others.
 7. Silencer holes: Punch three holes in stop of strike jamb of doorframes for application of silencers.
 8. Glazing beads: Carefully place to properly accommodate the various thicknesses of glass and glazing materials, and loosely-attach to frames with flathead galvanized steel screws through pre-drilled holes having countersunk depressions.
 9. Line frames with sheet lead of same thickness as scheduled for partitions in which they occur.
 - a. Install sheet lead free of waves, lumps, and wrinkles with as few joints as possible.
 - b. Form and permanently adhere lead around and concealed behind the frame.
- D. Anchorage:

Note to Specifier: SELECT ANCHOR TYPE(S) BASED ON CONSTRUCTION

1. Anchor clips for frames in metal stud partitions: 16-gage steel z-shaped clips, 1-1/2 inch upturned and downturned legs, or equivalent type standard with the manufacturer, contained within the frames, for screw attachment to metal studs under Section 09 22 16 – NON-STRUCTURAL METAL FRAMING.
2. Anchor clips for frames in wood stud partitions: 18-gage steel with 3/4-inch high bendable straps, or equivalent type standard with the manufacturer, contained, for screw attachment to wood studs.
3. Anchors for frames in masonry walls (new construction): Adjustable, T-shaped, positively engaging the retainers on both flanges of each jamb member, when placed.



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The stem of the anchors shall be 2 inches wide by 12 gage, minimum, corrugated or perforated for mortar bond, and extend 10 inches into the masonry, unless otherwise indicated.

4. Anchors for frames in existing masonry walls: Counter-sunk bolts of minimum 3/8 inch diameter, set into masonry expansion shields.
5. Anchors for fire-resistive rated frames: Conform to all UL requirements for the specific fire-resistive ratings.
6. Provide not less than 3 anchors, clips, or bolts, per jamb, as applicable.

2.6 LEAD SHEET

- A. General Sustainability Requirements: Use maximum available percentage of recycled materials but not less than that required to meet LEED™ NC, Version 2.2 Credit MR 5.2
 1. Lead Backing: Lead sheet incorporated into the work shall contain not less than 100 percent of pre-consumer recycled materials.
- B. Lead sheet: Conforming to ASTM B 29 in uniform thickness(es) as required by Physicist of Record report(s).

2.7 LEAD GLASS

- A. Provide clear x-ray lead glass with a minimum lead oxide content of 55 percent, approximately 5/16 inch thick, and installed in single or multiple thicknesses to provide a lead equivalent as required by Physicist of Record report(s).

2.8 LEAD ACRYLIC GLAZING

Note to Architect: Typically available up to 6 by 8 feet in size. Larger by special order.

- A. Provide shatter-resistant, distortion-free optical clarity lead acrylic glazing.
- B. Fabricate lead acrylic glazing from acrylic copolymer resin into which lead is chemically introduced as an organolead salt compound. Provide polished lead acrylic glazing containing 30 per cent minimum lead by weight.
- C. Install in single or multiple thicknesses to provide a lead equivalent as required by Physicist of Record report(s).

2.9 FABRICATION

- A. Fabricate doors in accordance with specified manufacturer's requirements. Fabricated rated doors in compliance with WHI, or UL requirements as appropriate.
- B. Bond stiles and rails to cores, sand for uniform thickness. Factory sand assembled door leaf.
- C. Factory-machine doors to receive hardware from templates furnished under Section 08 71 00 - DOOR HARDWARE. Do not machine for surface hardware.
 1. Provide inner blocks at lock edge and top of door for closer hardware reinforcement.
 2. Cut and configure door edges to receive scheduled gasketing.
 3. Coordinate with locations of embedded fasteners in cores, stiles, and rails.

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D. Factory cut lite openings as scheduled.

2.10 FABRICATION TOLERANCES

A. Maximum variation for lead lined doors and frames: Maximum diagonal distortion 1/16 inch measured with straight edge, corner to corner.

2.11 HINGES

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. Hager Hinge Company, Saint Louis MO.
2. McKinney Products Company, Scranton PA.
3. Stanley Hardware, New Britain CT.

B. Number of Hinges required per door leaf:

1. Doors over 60 inches and not over 90 inches - 1-1/2 pair butts.
2. Doors over 90 inches high - 2 pair butts.

*Note to Specifier: SIZE BELOW IS FOR 1 3/4 INCH THICK, 36 INCH WIDE DOORS.
REVISE FOR LARGER DOORS.*

C. Size of Hinges required: minimum of 4-1/2 by 4-1/2 inches.

D. Hinge types:

1. Interior non-rated doors, ANSI 8112, heavy duty, brass or bronze, four ball bearing, 5 knuckle hinge.
 - a. Hager model N^o. BB1199.
 - b. McKinney model N^o. TA2714.
 - c. Stanley model N^o. FBB199.
2. Interior rated doors, ANSI 8111, heavy duty, steel plated, four ball bearing, 5 knuckle hinge.
 - a. Hager model N^o. BB1168
 - b. McKinney model N^o. T4B3768
 - c. Stanley model N^o. FBB168

Note to Specifier: SELECT ONE FINISH BELOW OR MODIFY.

E. Finish:

1. BHMA N^o. 605 (US 3), bright brass, clear coating finish.
2. BHMA N^o. 632 (US 3), bright brass plated, clear coating finish (over steel base).
3. BHMA N^o. 606 (US 4), satin brass, clear coating finish.
4. BHMA N^o. 633 (US 4), satin brass plated, clear coating finish (over steel base).
5. BHMA N^o. 625 (US 26), bright chromium plated finish (over brass/bronze base).



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6. BHMA N^o. 651 (US 26), bright chromium plated finish (over steel base).
7. BHMA N^o. 626 (US 26D), satin chromium plated finish (over brass/bronze base).
8. BHMA N^o. 630 (US 32D), satin stainless steel finish.
9. BHMA N^o. 652 (US 26d), satin chromium plated finish (over steel base).

*Note to Specifier: SELECT TRANSPARENT OR OPAQUE FINISH FOR DOORS.
Delete the following Article if doors have plastic laminate facing.*

2.12 FACTORY FINISHING

A. Frames:

1. Preparation: Pressure-sand all surfaces of all frames, accessory items, anchors, and related items, to remove blemishes and foreign matter and provide paint grip. Spot fill imperfections with metallic filler and sand smooth. Thoroughly clean the surfaces by applying hot or cold phosphate treatment standard with the manufacturer.
2. Following cleaning apply one dip or spray coat of rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer to all surfaces, including those which will be concealed after erection. Bake, or oven dry, the primer at time and temperature recommended by the manufacturer for developing maximum hardness and resistance to abrasion.

3.1 EXAMINATION

- A. Verify that opening sizes and tolerances are acceptable and in compliance with these specifications and applicable codes.

3.2 PREPARATION

- A. During the operation of work of this Section, protect existing work against damage by the exercise of reasonable care and precautions. Repair all existing materials which are damaged by Work of this Section, to match original profiles and finishes. Existing materials repaired shall be removed and replaced with new work to match existing.

3.3 INSTALLATION

- A. Doors, operators, and frame mounted equipment interlocks shall be installed by the manufacturer and as indicated on the approved shop drawings. Touch up shop applied prime coat as required and ready for finish paint.
1. Door speeds: Set by the manufacturer to comply with ANSI 156.10-2005
 2. Electrical connections: Frame mounted equipment interlocks shall be connected to the electrical distribution system under Division 26 – Electrical.

3.4 INSTALLED TOLERANCES

- A. Maximum variation from plumb or level: 1/8 inch.
- B. Maximum offset from true dimensional alignment: 1/8 inch.



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3.5 FIELD QUALITY CONTROL AND ADJUSTING

- A. Field inspection will be performed under the provisions of Section 01 45 00 - QUALITY CONTROL.
 - 1. Physicist testing will be performed under separate contract with Owner.

3.6 CLEANING

- A. General: Clean work under provisions of Section 01 73 00 - EXECUTION.
 - 1. Upon completion of the work of this Section in any given area, remove tools, equipment and all rubbish and debris from the work area.
- B. Daily clean work areas by disposing of debris, scraps, and lead. Vacuum floor surfaces with HEPA (High Efficiency Particulate Air filter) vacuum in compliance with OSHA Standard 1926.62.
- C. After completion of the work of this Section, remove rubbish, tools and equipment, and clean all wall, partition, and floor areas free from deposits of lead, and other materials installed under this Section. Vacuum surfaces with HEPA vacuum in compliance with OSHA Standard 1926.62.

3.7 PROTECTION

- A. General Contractor is responsible to protect finished work under provisions of Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.

End of Section