

3M Electrical Standing Specifications

APRIL 30, 2014

Revised Date: January 30th, 2015

SECTION 16120 - WIRES, CABLES AND BUSES

Added Part 3.2B: “All bolt-torque values for electrical connections shall follow manufactures specifications. If not specified by manufacture, CONTRACTOR shall follow NETA (InterNational Electrical Testing Association) Standards.”

3M Facilities Engineering

3M Standing Contract Specifications

April 30, 2014

These documents comprising the 3M Electrical Standing Specifications dated April 30, 2014 are the property of 3M Company and are not to be used for purposes other than work contractually directed under an executed Master Agreement, Standing Agreement, Sub-Agreement and/or One Time Agreement, which are collectively referred to as the "Agreement". All documents and data issued and information provided shall be treated as confidential. In the event your company's Agreement with 3M Company is terminated, you shall immediately return of the 3M Electrical Standing Specification, in its entirety, to 3M Company at the address listed in the Agreement.

Use of these documents acknowledges you have read the above conditions for use of these documents and accept the terms for their use.

3M Standing Contract Specifications

April 30, 2014

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- NOTE: (1) Vertical lines on the right hand margin signify a revision to that Section. Darken circles on the right hand margin signify deleted material from the earlier version of this Specification.
- NOTE: (2) Editable specification section available in the Long Form Construction Specifications. These specification sections are not included in the Contract Documents unless specifically included.
- NOTE: (3) Contact Corporate IT for updated specifications.
- NOTE: (4) 3M Engineering has adopted Process Industry Practices (PIP) Guideline
Link to PIP from Engineering Rules (Links > Process Industry Practices > 3M Employee Access).

SECTION 01012

SUMMARY OF THE WORK

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.

1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.

- B. CONTRACTOR shall complete the Work in accordance with the Contract Documents and/or reasonably implied by such, supplying incidental labor, materials and services required for a complete, functional installation.

1.2 MEASUREMENTS:

- A. The General Contractor shall layout the Work in accordance with Drawings, including all partitions and openings in partitions. It is understood that all other Contractors involved in this project will rely on this layout in the performance of their Work.

- 1. After the General Contractor has laid out their Work, all other contractors and subcontractors shall proceed to lay out their own Work.
- 2. The routing of conductor and/or raceways as shown on Drawings are proposed locations only. Ceiling areas containing proposed routing will be opened for inspection upon request from the CONTRACTOR. If the proposed routing cannot be installed as shown on Drawings, it shall be the CONTRACTOR'S responsibility to propose an alternate route prior to submittal of bids. No additional compensation will be allowed because of CONTRACTOR'S misunderstanding as to the amount of Work involved or their lack of knowledge of any of the conditions pertaining to the Work based on their neglect or failure to make examination of the Worksite.

2.0 PART 2 - PRODUCTS - NOT APPLICABLE

3.0 PART 3 - EXECUTION - NOT APPLICABLE

4.0 PART 4 - RELATED DOCUMENTS - NOT APPLICABLE

SECTION 01016

GENERAL PROVISIONS

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 – GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.

- 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.

1.1 PRECONSTRUCTION CONFERENCE:

- A. CONTRACTOR shall have their project superintendent, foreman and any of their subcontractors attend a preconstruction conference with OWNER'S Representatives at time and location as set up by OWNER. This conference will further define both the project and plant requirements and sequence in which the Work is to be performed and completed.

1.2 DAILY WORK SUMMARY:

- A. CONTRACTOR shall furnish OWNER'S Designated Representative with a daily Work summary. The summary shall include a general outline of the Work accomplished for the day and the manpower distribution on the project according to classification of workmen.

1.3 OCCUPANCY AND USE OF EXISTING BUILDING:

- A. OWNER will occupy and use existing building during the Work period. Work shall be conducted in a manner that will permit the full and uninterrupted operation of the facility. In the event that OWNER determines an interruption of manufacturing is unavoidable, CONTRACTOR shall work in cooperation with OWNER'S Designated Representative in order to keep any interruption to a minimum. If interruption of manufacturing is required, it shall be assumed for bidding purposes that all such Work will be accomplished during normal working hours.
 - 1. Where cut-ins to existing mechanical, electrical and/or similar services are required or where certain services are to be installed in any area, CONTRACTOR shall make these cut-ins or install such services only after receiving OWNER'S written permission and at an agreed upon time.
- B. OWNER'S Designated Representative shall designate entrance(s) and available times for CONTRACTOR'S use for the loading and unloading of construction material and equipment. No parking on OWNER'S access driveways will be allowed, except in designated parking areas. Movement of materials and equipment through the existing building shall be on rubber-tired trucks or platforms furnished by CONTRACTOR.
 - 1. CONTRACTOR'S personnel shall use the employees' entrance(s) as designated by OWNER'S Designated Representative.
 - 2. CONTRACTOR'S personnel shall visibly wear OWNER'S construction security badges, which will permit them to enter the existing building and construction Worksite areas only.

3. Access to warehouse and/or plant areas, other than the Worksite, will be on a limited and a security controlled basis with no meandering allowed.
- C. Work shall be conducted during the plant's normal working hours, Monday through Friday between the hours of 8am to 4pm, and/or as agreed to by OWNER'S Designated Representative. If CONTRACTOR desires to perform Work at other times, they shall make a special request to OWNER'S Designated Representative at least 48 hours in advance. OWNER shall have the right to grant or deny such a request.
- D. Unless prior permission is obtained from OWNER, CONTRACTOR shall not interfere in anyway with the normal operation of the building and shall not block for any reason the entrances or exits of the buildings, driveways or parking lots. CONTRACTOR'S materials, tools, supplies or debris shall not be allowed to accumulate in corridors, passageways, loading areas, driveways or similar areas.
- E. All CONTRACTORS shall limit their use of the existing building to the areas of the Work and areas designated by OWNER. CONTRACTOR'S tools, equipment and material shall be stored within the Work area or within other areas authorized by OWNER'S Designated Representative.
- F. CONTRACTOR shall use suitable precautions to prevent damage to pipes, conduit, and other underground structures. CONTRACTOR shall carefully protect from disturbance or damage all monuments and property marks until OWNER'S authorized agent has witnessed or otherwise referenced their locations, and shall not remove them until directed by OWNER.

1.4 OWNER'S EQUIPMENT USE AGREEMENT:

- A. The CONTRACTOR is responsible for providing for their use any equipment needed for lifting, moving or generally handling any material items, either furnished by the OWNER or by the CONTRACTOR, unless specified otherwise. OWNER owned/rental equipment shall not be used. If the 3M Plant Site personnel or OWNER'S Designated Representative, along with the CONTRACTOR, agree to use the OWNER'S equipment, 3M Form 17558 shall be completed and signed by both parties before any equipment shall be used.

1.5 MEASUREMENTS:

- A. Work shall be laid out in accordance with General Construction Drawings, including all partitions and openings in partitions, floors and roofs and/or existing partitions, floors or roofs. It is understood that all Contractors involved in this project will rely on this layout in the performance of their Work. Therefore, the CONTRACTOR agrees to indemnify and hold harmless OWNER from all liability and expense arising out of or in connection with the CONTRACTOR'S negligent preparation of such layout.
- B. All hanger inserts, pipe, conduit and duct sleeves to be incorporated into the general construction shall be furnished and installed in ample time to avoid delaying the work of other trades or causing unnecessary cutting and patching work.
- C. If cutting, patching or remodeling becomes necessary due to failure of CONTRACTOR to provide the proper opening sizes, proper sleeves and proper locations, the respective CONTRACTOR whose Work is involved, shall pay all costs involved for the installation, including cutting and patching.
 1. Whenever possible, employ the original installer to do the patching. Where the original installer is not available, employ workers highly skilled in the trade involved.

1.6 CHANGES TO DRAWINGS AND SPECIFICATIONS:

- A. Changes to the Drawings and Specifications may be made only in accordance with Article 20 of the Contract.

1.7 QUALITY ASSURANCE:

A. Product Standards:

1. Where products are specified by naming one manufacturer or vendor, CONTRACTOR shall supply the product so named. While this establishes the quality and style of the product to be furnished, if CONTRACTOR wishes to substitute another manufacturer or vendor's product, they must obtain written permission from OWNER to do so.
2. All CONTRACTOR furnished equipment, including its component parts, shall be the current standard products of the manufacturer in order to ensure prompt and continuing service and replacement of parts.
3. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the equipment need not be the product of the same manufacturer.
4. CONTRACTOR is cautioned to use particular care in the selection of equipment it proposes to furnish to ascertain that all equipment will meet the size and weight limitations of the space in which it is to be installed and that doors or other building openings made available to CONTRACTOR by OWNER'S Designated Representative are of adequate size to permit the entry of the equipment without alterations to building. The cost of any alterations caused by failure to comply with the above instructions shall be borne by CONTRACTOR.

1.8 CONCRETE EQUIPMENT BASES/PADS:

- A. CONTRACTOR shall provide concrete equipment bases/pads, including formwork and setting of anchor bolts and/or sleeves. Subcontractors or individual discipline contractors shall be responsible to provide an accurate drawing(s) of each equipment base/pad required with the location of each anchor bolt properly dimensioned, and before the concrete is placed, they shall check and approve the formwork and placement of anchor bolts.

1.9 DISPOSITION OF MATERIALS:

- A. CONTRACTOR shall promptly remove debris from the Worksite in accordance with the conditions of this Contract.
- B. Use rubber tired trucks when transporting the debris within buildings, debris to be covered to prevent the spread of dust and debris.
- C. Existing equipment and material which are removed during demolition of existing facilities shall become the property of the CONTRACTOR except for items identified by OWNER'S Designated Representative which are to remain the property of OWNER: All items that are to remain the property of the OWNER shall be placed on pallets and/or skids and delivered to the location on the Worksite as directed by OWNER'S Designated Representative.

1.10 CONTRACTOR'S CARE OF WORK AND THE WORKSITE:

- A. CONTRACTOR shall keep the Worksite reasonably free from accumulations of dirt, debris, cartons, crates, waste materials, tools, equipment and rubbish resulting from the performance of the Work by removing the same from the Worksite and properly disposing of it. OWNER shall have the right to request the removal of the same and CONTRACTOR shall comply with request immediately. If CONTRACTOR fails to do so, OWNER may remove the same and charge CONTRACTOR the cost of such removal.

1.11 FINAL ACCEPTANCE:

- A. Prior to final acceptance, or prior to OWNER'S partial or complete occupancy of the Work, CONTRACTOR shall do the following, unless OWNER requests otherwise:
 - 1. Clean completely all surfaces and spaces of the Work so that they are ready for OWNER'S use and occupancy without further cleaning; and
 - 2. Remove from the Worksite all temporary buildings or facilities erected by CONTRACTOR and all surplus materials and supplies which are the property of CONTRACTOR or over which CONTRACTOR has care, custody and control.

1.12 AS-BUILT (RECORD) DRAWINGS:

- A. CONTRACTOR shall prepare and maintain accurate redlined as-built drawings used solely for recording as-built conditions, including all the changes made during the progress of the Work and as required in other portions of these Specifications. At the completion of the Work, CONTRACTOR shall submit these redlined as-built drawings to the OWNER'S Designated Representative.
 - 1. Locate interior Work by dimensions from columns or other structural grid lines and invert elevation.
 - 2. Locate exterior Work by site grid coordinates and elevation.
- B. Final payment of the Contract will be delayed until complete and acceptable redlined as-built drawings are received by the OWNER'S Designated Representative.

2.0 PARTS 2 - PRODUCTS - NOT APPLICABLE

3.0 PART 3 - EXECUTION - NOT APPLICABLE

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENT:

- A. Equipment Use Agreement, Form 17558
 - 1. Refer to Appendix for a sample copy of the "Equipment Use Agreement" form referenced in this Section.

SECTION 01412

ACCOUNTING PROCEDURES

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.

1.2 PURCHASE ORDER (FIXED COST/LUMP SUM):

- A. CONTRACTOR shall furnish OWNER with a cost breakdown of labor, materials and equipment for evaluation and payment purposes. Cost breakdowns shall be submitted for each project ID and activity number.
 - 1. Project ID and activity numbers will be listed in the Work Description or issued upon release of Purchase Order.
 - 2. CONTRACTOR shall prepare and submit to OWNER the cost breakdown within 5 working days of receipt of Project ID and activity numbers.
- B. Monthly invoices shall be based on and shall list the percentage of Work completed for each project ID/activity number listed. Further breakdowns shall be given when requested.
- C. CONTRACTOR shall submit original invoice to the OWNER'S Invoice Receiver who will validate (by initialing) that all information is accurate and complete. OWNER'S Invoice Receiver shall submit to Purchase Order Requestor for payment.
- D. Changed Work and/or Extra Work:
 - 1. Charges for Changed Work and/or Extra Work will not be processed or paid by OWNER unless:
 - a. CONTRACTOR has followed the procedure set forth in the Agreement for Changed Work and/or Extra Work.
 - b. OWNER has issued a revised Purchase Order declaring the Work in question to be Changed Work and/or Extra Work. Consequently, CONTRACTOR is requested not to send an invoice for Changed Work and/or Extra Work until they have received a revised Purchase Order covering the Work in question.
 - 2. Prior to actual invoicing for Changed Work and/or Extra Work, CONTRACTOR shall submit a detailed summary of such charges, substantiated by documentation, including "Contractor's Proposal for Changed Work and/or Extra Work", to the Purchase Order Requestor for their validation.

1.3 PURCHASE ORDER (COST PLUS):

- A. OWNER shall provide project ID and activity number(s) for payment purposes.
 - 1. Project ID and activity numbers will be listed in the Work Description or issued upon release of Purchase Order.
- B. CONTRACTOR shall submit to OWNER'S Invoice Receiver the original invoice along with all supporting documentation as outlined in "Cost Plus Invoice Submittal Requirements".

- C. CONTRACTOR shall submit original invoice to the OWNER'S Invoice Receiver who will validate (by initialing) that all information is accurate and complete. OWNER'S Invoice Receiver shall submit to Purchase Order Requestor for payment.

1.4 COST PLUS INVOICE SUBMITAL REQUIREMENTS:

- A. For all work other than fixed cost, CONTRACTOR shall provide the following:
 - 1. OWNER'S canary copy entitled "Contractor's Daily Report of Cost Plus Work" (Form 5611) acknowledged on a daily basis by both OWNER'S and CONTRACTOR'S Designated Representative. Said form must list the following information:
 - a. Employee name and classification - e.g., foreman, journeyman;
 - b. Employee trade title - e.g., electrician, pipe fitter, carpenter, etc.;
 - c. Number of hours worked;
 - d. A list of CONTRACTOR-owned rental equipment describing the type of equipment utilized and the number of hours used;
 - e. A list of third-party rental equipment describing the type of equipment and the number of hours used;
 - f. Type and quantities of materials furnished from CONTRACTOR'S stock.
 - 2. If required by OWNER, a copy of CONTRACTOR'S payrolls.
 - 3. Invoices (originals if requested by OWNER) received from third party vendors for materials purchased; also, if requested by OWNER, receiving reports or signed packing slips.
 - 4. Invoices (originals if requested by OWNER) received from third parties showing transportation charges and rental for equipment.
 - 5. Invoices (originals including a cost breakdown if requested by OWNER) from subcontractors; if required by OWNER, receipts of payment in connection therewith; and
 - 6. An affidavit and relevant data in connection therewith showing in detail all other amounts for which payment is requested for the said prior period.

2.0 PART 2 - NOT APPLICABLE

3.0 PART 3 - EXECUTION

3.1 ADDENDUM

- A. If an Addendum is issued, the CONTRACTOR shall submit an Addendum Proposal and supporting cost information to the Purchase Order Requestor. If the CONTRACTOR'S Addendum Proposal is accepted, the Purchase Order Requester will then initiate a revised Purchase Order or Field Change Request (FCR) to incorporate the revised cost, if any, into the Contract.

3.2 FIELD CHANGE REQUEST (FCR):

- A. OWNER may require CONTRACTOR to perform Changed Work, Extra Work, or both by issuing a Field Change Request (FCR), see Standing Contract Agreement as it pertains to Changed Work and/or Extra Work. Work may not proceed until an FCR has been issued. If CONTRACTOR believes certain work constitutes Changed Work and/or Extra Work, CONTRACTOR will bring the work in question to the attention of the OWNER'S Designated Representative. A Field Change Request form will be filled out by both parties to document the Work in question.
- B. OWNER'S and CONTRACTOR'S Designated Representatives will determine the following:
 - 1. What is the Scope of the Work in question.

2. Is the Work in question Changed Work, Extra Work or both.
 3. The methods or means required to complete the Work.
 4. If the Work will be performed on a Cost Plus, Lump Sum or Unit Rate basis.
 5. The change in Contract Cost, if any.
 6. The change in or impact on the Project Schedule, if any.
- C. If, at the time of notification by CONTRACTOR, OWNER'S Designated Representative agrees the Work in Question is Changed Work and/or Extra Work, the OWNER'S Designated Representative will generate an FCR. Work may not proceed until an FCR is generated and signed by the Designated Representatives of both parties.
- D. If, at the time of notification, the nature of the Work in question is disputed with respect to whether or not it constitutes Changed Work and/or Extra Work, both parties will sign the original FCR as a record of CONTRACTOR'S request for evaluation of the Work in question. This allows the Work to continue and later determine if the Work is Changed Work and/or Extra Work. The CONTRACTOR is required to keep "Contractor's Daily Work Report – Cost Plus Work" (Form 5611) signed by OWNER'S Designated Representative while doing this Work. OWNER will notify CONTRACTOR in writing within 10 calendar days after the receipt of the FCR of its decision as to the nature of the Work in question.
- E. The Designated Representative for each party shall retain a signed copy of the printed FCR in their file at the worksite. The OWNER'S Designated Representative will send a copy of the signed FCR to the Purchase Order Requestor.
- F. CONTRACTOR cannot be paid and should not invoice OWNER for this Work, either for complete or partial payment, until a revised Purchase Order has been issued by OWNER.
1. For other than fixed cost FCRs, when the FCR is complete, the CONTRACTOR must submit the original, signed FCR and originals of all supporting documents, as listed in "Cost Plus Invoice Submittal Requirements" above, to the OWNER'S Designated Representative. CONTRACTOR is requested not to send an invoice but use CONTRACTOR'S letterhead stationery for listing all costs and mark-ups for each FCR. After review and approval by OWNER, a revised Purchase Order including the FCR amount(s) will be issued to the CONTRACTOR.
- G. Only the OWNER'S Designated Representative or the Purchase Order Requestor can generate and sign Field Change Requests. The CONTRACTOR shall only Work on a change provided that the FCR has been signed by both the OWNER and the CONTRACTOR.

3.3 RETENTION

- A. When retention is billed, a final lien waiver must be prepared and notarized. The final lien waiver shall be attached to the invoice for retention.
1. If an invoice is submitted for a partial payment of retention, a partial lien waiver must be submitted with the invoice.
 2. On lien waivers indicate the contract cost and amount paid to subcontractors and material suppliers.
 3. Use the following to determine which subcontractors and material suppliers to list:

<u>Original (Base) Contract</u>	<u>List Subcontractors And Material Suppliers with a Contract Amount</u>
Less Than \$100,000	Equal To Or Greater Than \$1,000
\$100,000 - \$500,000	Equal To Or Greater Than \$2,500
More Than \$500,000	Equal To Or Greater Than \$5,000

3.4 INVOICE INQUIRIES:

- A. After submittal of any of the above, CONTRACTOR may direct questions regarding payments, status of invoices, etc., to the Project Engineer as identified on the Contract Documents.

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENTS:

- A. Contractor's Proposal for Changed Work and/or Extra Work:
 - 1. Changed Work and/or Extra Work performed on a Cost Plus basis is subject to the mark-ups identified in Exhibit "A" of the Standing Contract.
 - a. Refer to Appendix for a copy of the "Contractor's Proposal for Changed Work and/or Extra Work" form referenced in this Section.
- B. Contractor's Daily Work Report - Cost Plus Work, Form 5611:
 - 1. The following form may be photocopied from this Specification:
 - a. Refer to Appendix for a sample copy of the "Contractor's Daily Work Report - Cost Plus Work" form referenced in this Section.
- C. Field Change Request Form
 - 1. The following form may be photocopied from this Specification or is available electronically from Sourcing Engineering Services (SES) on the 3M Intranet.
 - a. Refer to Appendix for a sample copy of the Field Change Request Form referenced in this Section.
- D. Lump Sum Invoice Format, Form 36268
 - 1. This form may be photocopied from this Specification:
 - a. Refer to Appendix for a copy of "Invoice Format, Form 36268" referenced in this Section.
- E. Cost Plus Invoice Format, Form 36269
 - 1. This form may be photocopied from this Specification:
 - a. Refer to Appendix for a copy of "Invoice Format, Form 36269" referenced in this Section.
- F. Contractor's Partial Waiver and Affidavit Form 15159-_-PWO:
 - 1. This form may be photocopied from this Specification:
 - a. Refer to Appendix for a copy of the "Contractor's Partial Waiver and Affidavit Form 15159-_-PWO " referenced in this Section.
- G. Contractor's Final Waiver and Affidavit Form 15159-1-_-PWO:
 - 1. This form may be photocopied from this Specification:
 - a. Refer to Appendix for a copy of "Contractor's Final Waiver and Affidavit Form 15159-1-_-PWO " referenced in this Section.

SECTION 01512

SUBMITTALS

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Additional submittal requirements are specified in individual product/execution sections.
 - 1. Prepare and process specific submittals as required in each section of the Contract Documents.

1.2 DEFINITION:

- A. Submittals include, but are not limited to, such information as letters, selection samples, record samples, shop drawings, product data, diagrams, schedules, lists, illustrations, performance charts, brochures, test reports, and inspection reports which are prepared by CONTRACTOR, or for themselves by a subcontractor, illustrating or certifying some part of the Work.
- B. Where submittals are required or referred to in this Specification by the term OWNER, this reference indicates the 3M Project Engineer or 3M Consulting Architect/Engineer to whom all submittals shall be sent.
 - 1. Where both the 3M Consulting Architect/Engineer and the 3M Project Engineer are given, send the submittals to the 3M Consulting Architect/Engineer. A copy of the transmittal shall be submitted to the 3M Project Engineer.

1.3 PROCEDURE:

- A. CONTRACTOR'S Receipt of Submittals
 - 1. CONTRACTOR shall order materials and equipment in sufficient time to allow the following submittal procedure to occur so as to cause no delay in the performance of the Work.
- B. CONTRACTOR'S Review:
 - 1. CONTRACTOR shall review, stamp and submit all submittals at appropriate times and in proper sequence so as to cause no delay in the performance of the Work.
 - a. CONTRACTOR shall coordinate their submittals such that they allow a 7 to 10 day turn around period for review of said submittals.
 - 2. At the time of submittal CONTRACTOR shall inform the OWNER in writing of any deviation in the submittals from the Contract Documents.
 - 3. By sending a submittal to the OWNER, CONTRACTOR certifies that they have reviewed and approved the submittal for conformance to the Contract Documents.
 - 4. OWNER'S approval of submittals is no authorization to CONTRACTOR to perform Extra Work and/or Changed Work.
 - 5. CONTRACTOR shall determine and verify all field measurements, field construction criteria, materials, finishes, fastenings, clearances, sequencing, abutting Work, electrical requirements, catalog numbers, availability, and the like. They shall check and

coordinate each submittal with the requirements of the Contract Documents and the particular needs of the Work.

- C. OWNER'S Review:
1. OWNER will review submittals only for conformance with the design concept of the project and with the information given in the Contract Documents.
 2. OWNER'S review of a separate item shall not indicate approval of an assembly in which the item functions.
 3. OWNER'S review of submittals shall not relieve CONTRACTOR of responsibility for any deviation from the requirements of the Contract Documents unless CONTRACTOR has informed the OWNER in writing of the deviation.
 4. OWNER'S review of submittals shall not relieve CONTRACTOR from responsibility for errors or omissions in the submittals.
 5. OWNER will acknowledge that each submittal has been reviewed and will return the submittal to CONTRACTOR together with notes pertaining to the conformance and/or non-conformance of the submittals to the design concept of the project and information given in the Contract Documents.
- D. Review and Corrections by CONTRACTOR:
1. CONTRACTOR shall review the OWNER'S comments, make any appropriate corrections, and resubmit the corrected submittals until no further submission is requested by OWNER.
 2. No portion of the Work requiring a submittal shall be commenced until the submittal has been reviewed and approved by OWNER. All such portions of the Work shall be constructed in accordance with the approved submittals.

1.4 FORM OF SUBMITTALS:

- A. Material List:
1. The material list submitted within 15 working days after award of Contract, and accepted by OWNER, shall be considered the list of material CONTRACTOR will furnish.
 2. Any substitutions for or deviations from this list shall be approved in writing by the OWNER.
 3. Identify each item on material list by manufacturer's trade name and catalog or other identifying number. The term "as specified" will not be accepted.
- B. Schedule of CONTRACTOR Furnished Materials:
1. CONTRACTOR shall submit an "Equipment and Material List" as defined in Section 01611 of this Specification. Upon request, OWNER will furnish blank forms or lists (refer to Part 4 of this Section) to the successful CONTRACTOR.
 2. CONTRACTOR shall update the list each month and resubmit to OWNER. Updates shall include name of carrier, purchase order numbers, revised anticipated delivery dates and actual delivery dates.
 3. CONTRACTOR'S material delivery schedule shall be expanded to include basic electrical materials such as wire, conduit, wireway and similar components. CONTRACTOR shall be responsible for reporting field delivery information on all listed materials and equipment. Abbreviations to be used with the schedule are as follows:
 - a. ARCH denotes: OWNER'S/Consulting Architectural Department
 - b. ELEC denotes: OWNER'S/Consulting Electrical Engineering Department
 - c. MECH denotes: OWNER'S/Consulting Mechanical Engineering Department
 - d. PI&CS denotes: OWNER'S/Consulting Process Instrumentation & Control System Department
 - e. DIV denotes: OWNER'S Division Engineering Department.
 - f. EC denotes: Electrical Contractor under contract to OWNER.
 - g. GC denotes: General Contractor under contract to OWNER.

h. MC denotes: Mechanical Contractor under contract to OWNER.

C. Letter Submittals:

1. Submittals in letterform are specified for certain products and methods for which name and statement of special qualities is sufficient. Such letters shall originate with, or shall be endorsed by CONTRACTOR.

D. Shop Drawings:

1. General:

- a. CONTRACTOR shall submit 6 sets, plus the number required for their own use, of all manufacturer's data, prints, and shop drawings covering equipment they furnish for approval by the OWNER. CONTRACTOR shall proceed with the Work after approval by the OWNER is received. The sets for CONTRACTOR'S use will be returned to them.
 - 1) Where an HVAC Commissioning Agent is used, CONTRACTOR shall furnish 2 additional sets of approved shop drawings for their use.
- b. CONTRACTOR shall identify shop drawings with project name and project number, Section and Article number, date and edition of submittal, and CONTRACTOR'S name and address.

2. Apparatus Specific:

- a. Submit information under subparagraphs as appropriate for the apparatus. CONTRACTOR shall refer to other sections of this Specification for additional shop drawing requirements.
 - 1) Submit unit assembly and manufactured products shop drawings detailing the following:
 - a) Manufacturer and model designation.
 - b) Rated capacities of the selected model.
 - c) Physical data including size, weight and weight distribution.
 - d) Furnished specialties and accessories.
 - e) Apparatus installation and start-up instructions including required clearances and connection points.
 - f) Fabrication, assembly and installation details, including plans, elevations, sections, details of components and attachments to other Work.
 - g) Code compliance certificates.
 - 2) Submit wiring diagrams and electrical connection requirements.
 - a) Manufacturer's electrical requirements.
 - b) Ladder type wiring diagrams showing all interlocks and controls.
 - c) Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
 - 3) Submit operation and maintenance data for each type of apparatus furnished.
 - a) Troubleshooting and maintenance procedures.
 - b) Furnish 6 copies of manufacturer's recommended spare parts list.
 - c) Provide name and address of authorized service organization and information for source of parts.
 - d) Recommended lubricant, lubrication instructions and lubrication intervals.

E. Operation and Maintenance Manuals:

1. Prepare 4 bound copies of an operating and maintenance manual containing the following documentation regarding each product item furnished and installed under this Contract:

- a. Product data sheets
 - b. Brochures and/or shop drawings
 - c. Parts list
 - d. Piping and wiring diagrams
 - e. Installation instructions
 - f. Operating instructions
 - g. Maintenance instructions
 - h. Name and address of authorized service organization
 2. The above documentation shall be bound in an 8-1/2" x 11" loose-leaf three-ring binder with hard cover. Use multiple binders if necessary.
 3. Manuals shall be organized by Section and Article number in the same format as the Specifications.
 4. Each binder shall have a Table of Contents, index tabs, and shall be identified by job name, date and name and address of Contractor.
 5. Include all information submitted under "Shop Drawings" in the maintenance manuals.
- F. Other Submittals:
1. Submit test and inspection reports and other verifications of Work performed in the form of signed originals or copies thereof.
 2. Submit reports, record drawing information, warranties, guarantees, service contracts, instruction manuals, etc. before submitting final invoice.
- 2.0 PART 2 - PRODUCTS - NOT APPLICABLE
- 3.0 PART 3 – EXECUTION – NOT APPLICABLE
- 4.0 PART 4 – RELATED DOCUMENTS
- 4.1 ATTACHMENTS:
- A. Refer to Appendix for a sample copy of the "Equipment and Material Procurement List" referenced in this Section.

SECTION 01612

CONSTRUCTION SCHEDULING

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.

- 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.

1.1 SUGGESTED CONSTRUCTION SCHEDULE:

- A. The Contract starting and completion dates shall be the dates set forth in the 3M Contract Documents. These dates shall establish the overall time frame of CONTRACTOR'S submitted construction schedule.

1.2 LONG DELIVERY EQUIPMENT AND MATERIAL SCHEDULE:

- A. Within 15 working days after award of Purchase Order, CONTRACTOR shall furnish OWNER with specific information regarding various equipment and materials indicated within this Specification and/or as shown on Drawings, which are in short supply or require long periods for delivery. This information shall make the OWNER aware of delays which may alter the progress or completion of the project.

1.3 SCHEDULING SOFTWARE:

- A. If requested by OWNER, the successful bidder shall submit an electronically generated Preliminary Schedule within 15 working days after award of Purchase Order. The software shall utilize the critical path method of construction scheduling. The CONTRACTOR shall update the schedule for each activity no later than 3 days after the construction review meeting.
 - 1. The acceptable software programs are Microsoft Project, Primavera, Suretrak or OWNER approved equal.
 - 2. If there are multiple CONTRACTORS on the project, all CONTRACTORS shall use the same software as directed by OWNER.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE:

- A. CONTRACTOR shall prepare and submit their own Schedule, which will show only their Work activities and that of their subcontractors. The Work activities on the schedule shall be arranged such that the sequence and performance time agrees with OWNER'S suggested schedule.
 - 1. The schedule shall show a unique activity identifier for each activity.
 - 2. If requested by OWNER, submit a Histogram and S-Curve with the Construction Schedule.
 - a. For each activity it shall include total anticipated labor in hours, actual labor to date in hours, start date, finish date, and % physical completion.
 - b. The schedule shall also show the overall percent project completion.

- B. CONTRACTOR'S Preliminary Schedule shall be submitted to OWNER for approval within 15 working days after receipt of the Purchase Order. CONTRACTOR shall report progress at each field construction progress review meeting on their Work activities and any changes in the Work or conditions, which affect their schedule. After the second schedule update the Preliminary Schedule will become the Construction Schedule. Subsequent Construction Schedules shall retain the original Construction Schedule time periods as "target bars".
1. Approved Field Change Request(s) and Addendum(s) shall be incorporated into the Schedule.
 - a. The Work activities and that of subcontractors involved in the above change(s) shall be included in the revised Schedule.
 2. In the event that an extension of time has been granted under the provisions of the Contract (See Articles 3.3 and 3.4) CONTRACTOR will be required to submit a revised Schedule reflecting such approved extension of the completion date and its effect on individual Work activity.

1.5 TWO WEEK LOOK AHEAD SCHEDULES:

- A. If requested by OWNER, a two week Look Ahead Schedule shall be prepared in the same frequency that the field construction progress review meetings occur.
1. The Look Ahead Schedule may be hand drawn and shall be presented at each field construction progress review meeting.
 2. The Look Ahead Schedule shall show the schedule in specific detail for each activity to be performed in the next two weeks.
 3. The comments and decisions made at these meetings are to be incorporated into the Construction Schedule update.

1.6 RECOVERY SCHEDULE:

- A. If the actual percent complete falls 10% or more below the scheduled percent complete the CONTRACTOR shall prepare and submit a Recovery Schedule.
1. The goal of the Recovery Schedule is to restore the original Construction Schedule.
 2. The Recovery schedule shall indicate how (additional workers, overtime, etc.) the construction progress will be restored to the original Construction Schedule.
 3. Submit a revised Histogram and S-Curve with the Recovery Schedule.

1.7 REPORTING:

- A. The updated Construction Schedule, Look Ahead Schedule, Histogram, and S-Curve shall be submitted to the OWNER'S Designated Representative no later than 3 days after the construction review meeting.
1. This information shall be submitted in electronic form or as agreed to by OWNER.

2.0 PART 2 - PRODUCTS - NOT APPLICABLE

3.0 PART 3 - EXECUTION - NOT APPLICABLE

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENTS:

A. Sample Construction Schedule

1. Refer to Appendix for a sample copy of a "Construction Schedule" referenced in this Section.

SECTION 01712

QUALITY CONTROL

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 – GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- A. Certificates of Compliance:
 - 1. Test reports, certificates, etc., indicating compliance of materials and specialized workmen with the requirements of these Specifications are required by OWNER prior to delivery of the materials to the Worksite, or commencement of Work by the specialized workmen. If no testing requirements are described, but OWNER decides that testing is desired, OWNER may require testing to be performed under current pertinent standards for testing. Examples of reports and certificates include, but are not limited to the following:
 - a. High voltage shielded cable - D.C. high potential test reports.
 - b. Ground system - resistance test reports.
 - c. High voltage motors, high voltage transformers, and high voltage non-shielded cable - "MEGGER" resistance test reports.
 - 2. Inspections and tests required by codes, ordinances, or by a plan approval authority, shall be responsibility of CONTRACTOR unless otherwise provided in the Contract Documents.
 - a. Where required and with OWNER'S approval, CONTRACTOR shall request presence of authority having jurisdiction, allowing sufficient time to enable them to be present.
- B. OWNER'S Right to Inspect Work:
 - 1. During the performance of the Work, OWNER may inspect all or portions of the construction and installation Work to determine whether or not it meets the specified requirements. OWNER is not, however, obligated to inspect.
 - 2. OWNER may provide inspection services using OWNER'S Designated Representative and/or an outside consultant.
 - 3. OWNER'S inspections do not constitute acceptance of the Work and do not relieve CONTRACTOR of its sole responsibility to meet specified requirements, even if OWNER fails or neglects to direct CONTRACTOR'S attention to defective Work.

1.1 QUALITY ASSURANCE:

- A. Codes and Standards:
 - 1. Testing, when required, will be in accordance with all pertinent codes and regulations and with selected standards of the American Society for Testing and Materials (ASTM) or other standard specifications of governmental, technical or trade organizations. If not noted, the latest edition of these Specifications shall be used when reference is made to them.

1.2 REPORT HANDLING:

- A. Promptly process and distribute all required copies of the test and inspection reports, including certificates, and related instructions to allow all necessary retesting and/or replacement of materials with the least possible delay in progress of the Work. Such copies shall be distributed to the following:
 - 1. OWNER'S Designated Representative
 - 2. 3M Project Engineer (2 copies minimum)
 - 3. 3M Consulting Architect/Engineer
 - 4. CONTRACTOR

2.0 PART 2 - PRODUCTS

2.1 PAYMENT FOR TESTING AND INSPECTION SERVICES:

- A. Certificates of Compliance:
 - 1. Certificates of Compliance required by these Specifications shall be paid for by CONTRACTOR, unless otherwise specified.
 - 2. Code compliance testing and inspection shall be paid for by CONTRACTOR.
- B. Testing Services:
 - 1. Testing services specifically required by the Specifications to determine compliance with these Specifications shall be paid for by CONTRACTOR, unless otherwise specified.
 - 2. Tests other than those required in subparagraph 1 above will be paid for by OWNER. If tests indicate non-compliance, then CONTRACTOR shall pay for such tests.
 - 3. Tests ordered by OWNER to confirm CONTRACTOR'S test submittals shall be paid for by OWNER. If these tests indicate non-compliance, CONTRACTOR shall pay for such tests.
 - 4. When any above mentioned tests indicate non-compliance with the Contract Documents, CONTRACTOR shall pay for the cost of all subsequent retesting required until compliance is shown.
- C. CONTRACTOR'S Convenience Testing:
 - 1. Inspection or testing performed for CONTRACTOR'S convenience shall be paid for by CONTRACTOR.

3.0 PART 3 - EXECUTION

3.1 ACCESS TO WORK:

- A. CONTRACTOR shall provide access and shall schedule operations in such a way that field tests and inspections may be made and samples taken.

3.2 TESTS:

- A. CONTRACTOR shall test the entire electrical installation and any part thereof, when and as requested by OWNER'S Designated Representative. CONTRACTOR is responsible for the testing of both OWNER furnished and CONTRACTOR furnished systems and equipment. CONTRACTOR shall correct all defects to the satisfaction of OWNER'S Designated Representative. All testing equipment, unless otherwise specified, shall be provided by CONTRACTOR.
- B. Refer to Section 16010 Article 1.3 for Tests required.

4.0 PART 4 - RELATED DOCUMENTS - NOT APPLICABLE

SECTION 01812

TEMPORARY FACILITIES AND CONTROLS

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 – GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.

1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.

1.1 OFFICE AND STORAGE FACILITIES:

- A. CONTRACTOR may at their discretion provide and maintain a field office at Worksite for the use of their supervisory staff. CONTRACTOR shall furnish heat, cooling, electric service, and communications as required.
1. If available and OWNER accepted, OWNER'S Designated Representative may designate space within the Worksite to be used for the CONTRACTOR'S field office. However when OWNER needs a designated space for its own occupancy, CONTRACTOR will move their own office at their own expense to other areas designated by OWNER'S Designated Representative.
- B. CONTRACTOR shall provide temporary weather tight storage structures of sufficient size to properly house all perishable materials and equipment to be used in the performance of the Work.
1. Specific storage instructions under respective technical divisions or sections shall be followed.
- C. CONTRACTOR shall meet with OWNER'S Designated Representative before Work begins to locate offices, storage buildings, storage areas and parking areas and designated smoking areas.
- D. CONTRACTOR furnished field offices and storage buildings shall remain the property of CONTRACTOR. After completion of the Work, they shall be removed from Worksite and all used or occupied areas shall be restored to their original condition or to the condition required by Drawings and Specifications.
- E. There will be no space available for shop fabrication and storage or protection of materials on the Worksite, except in portions of the work area designated by OWNER'S Designated Representative. No stockpiling in the Work area will be permitted by CONTRACTOR without permission of OWNER'S Designated Representative.
1. CONTRACTOR shall verify with OWNER'S Designated Representative the time and procedure of unloading and transporting material from the designated receiving area to the area of Work.
2. Specific storage instructions under respective technical sections shall be followed.
- F. CONTRACTOR shall confine their operations to the areas to be remodeled and to those other areas (such as lunchrooms, change rooms and vending machine areas) authorized by OWNER'S Designated Representative.

1.2 SANITARY FACILITIES:

- A. OWNER will specifically designate which toilet facilities in the building section or area will be made available for the use of CONTRACTOR and subcontractors' personnel.
- B. If CONTRACTOR is informed by OWNER'S Designated Representative that such facilities are not available to CONTRACTOR, CONTRACTOR shall provide suitable weather tight, sight-tight, self-contained, portable, chemically equipped toilets of sufficient number to accommodate all contractors and/or subcontractors working at Worksite. Units shall comply with state and local sanitary regulations.

1.3 WEATHER PROTECTION AND TEMPORARY HEAT:

- A. Construction heat shall be all sources of heat, whether furnished by temporary heating units or by the permanent heating system, necessary to allow CONTRACTOR to perform their Work prior to OWNER'S assumption of responsibility for the building heat.
- B. Before the building is enclosed and at any time Work is performed prior to building enclosure, CONTRACTOR shall provide all enclosures, insulated blankets, heating equipment, fuel, labor, supervision and maintenance necessary to protect their Work and materials against damage from the elements. CONTRACTOR shall provide OWNER approved temporary heating devices, electrical power, adequate and proper fuel, ventilation and other energy sources required for performing the Work of their trades.
- C. After the building is properly enclosed to the satisfaction of OWNER'S Designated Representative, OWNER will provide heating equipment and fuel to maintain a minimum temperature of 55 degrees Fahrenheit for all areas of buildings in which general construction Work is being performed and a minimum temperature of 65 degrees Fahrenheit in areas in which Work requiring higher temperatures is being performed. Temperature shall be measured 4 feet above floor.
- D. Electrical energy furnished by OWNER shall not be used as a source to operate any temporary heating units.

1.4 TEMPORARY WATER:

- A. OWNER will provide the water service to a terminal point at the building site. CONTRACTOR shall provide all temporary lines and connections from this point to construction areas.
 - 1. Drinking water will also be made available at the Worksite, but CONTRACTOR shall provide their own coolers, ice and cups.
- B. CONTRACTOR shall remove all temporary lines and connections prior to completion of the Work or when directed by OWNER.
- C. OWNER'S Designated Representative shall have the authority to stop indiscriminate use of water.

1.5 TEMPORARY LIGHT AND POWER:

- A. OWNER will furnish necessary electricity from existing electrical equipment. It will be CONTRACTOR'S responsibility to run temporary power from OWNER'S designated source to area of the Work. Any special electric service shall be the responsibility of CONTRACTOR and arranged at their expense. CONTRACTOR shall ascertain the type of electricity and the voltage available at the plant/building and appropriate equipment shall be furnished.
- B. Electrical energy within the capacity of the service will be used only when authorized by OWNER'S Designated Representative. The electrical energy furnished by OWNER shall not be used for electric heating.
- C. The cost of the furnished electrical energy (unless noted otherwise) will be assumed by OWNER.

- D. OWNER shall not be responsible for its inability to furnish electrical energy when such failure is caused by acts of God, strikes or by other unavoidable causes beyond its reasonable control.
- E. If OWNER'S Designated Representative determines at any time that a connected or proposed electrical load is of such a magnitude as to jeopardize the integrity of OWNER'S service for all contractors, then said load will be required to be connected to an additional and/or separate service. OWNER will select and provide the point of origin for this service. All costs associated with such temporary connections, including removal costs shall be borne by CONTRACTOR requiring same.
- F. If it is determined by CONTRACTOR that the installation schedule for OWNER'S temporary power is not compatible with their needs, then they shall be required to furnish, at their own expense, their own temporary power until such time as OWNER'S service becomes available. Such temporary power shall be furnished by a portable generator or any other means approved by OWNER.
- G. Temporary wiring shall be installed in accordance with national, state and local codes. The system shall consist of the following minimum requirements:
 - 1. One 120 volt, 20 amp, GFI and properly protected duplex receptacle per 1000 square feet of floor area in all areas where Work is to be performed. Plugs shall be equipped with heavy duty, UL listed, grounded electric cords with connections and insulation maintained in a safe condition.
 - a. Proper protection shall be provided for all electrical cords or conduit subjected to wheeled traffic
 - b. Where required, provide transformer to convert the temporary electric service voltage to 120 volts.
 - c. Provide panelboard/load center as required.
 - 2. As many fixtures (fluorescent, incandescent or H.I.D.), lamps and outlets as may be required to provide a minimum intensity of 5 foot candles in all areas where Work is to be performed.
 - a. Lamps shall be equipped with approved guards to prevent accidental contact with bulb. Lamps shall not be suspended by their electric cords, unless designed for same.
 - b. Additional lighting as required by OWNER'S Designated Representative in areas where finished Work is being performed.
 - 3. If project required, power for testing and temporary operation of one elevator for construction purposes.
- H. All temporary service distribution and branch circuit system (other than that which is to be part of the permanent installation) shall be removed and disposed of after construction of the Work and with approval of OWNER'S Designated Representative.
- I. Completed portions of the permanent installation shall not be used in the temporary Work without specific approval of OWNER'S Designated Representative.
- J. At no time shall electric energy be wasted. Furthermore, electrical power to the plant/building shall not be interrupted in any way by the CONTRACTOR unless approved by OWNER'S Designated Representative.
- K. Provide equipment grounding continuity for entire electrical system with use of ground fault circuit interrupter type switches.
 - 1. In lieu of above, use portable "GFI" type receptacles for individual pieces of electrical equipment.

1.6 COMPRESSED AIR:

- A. CONTRACTOR shall furnish all compressed air required in the performance of their Work.

- B. In no case shall air from portable compressors be distributed through the permanent plant compressed air system.

1.7 SMOKE PIPES:

- A. Smoke pipes and exhausts from heaters, engines and the like shall, in all cases, be extended above the roof of the building as directed by OWNER'S Designated Representative, unless OWNER'S Designated Representative approves a substitute arrangement.

1.8 CONSTRUCTION POLLUTION CONTROL FACILITIES:

- A. CONTRACTOR shall refer to Section 01900 (Contractor Safety Requirements) of this Specification regarding additional material storage and disposal requirements.
- B. All tanks, drums and containers used in the storage of gasoline, kerosene, fuel oil, cleaning fluids and other flammable materials on OWNER'S property shall be stored in impermeable earthen diked areas of sufficient volume to contain the volume of liquids stored within. Remove dikes when no longer required and restore or construct area as shown on Drawings.
- C. Waste oil, gasoline, cleaning fluids and similar materials resulting from Work performed on OWNER'S property shall be collected in containers and removed from Worksite. These waste liquids shall not be drained into the soil. CONTRACTOR shall be responsible for the proper cleanup and disposal of any spill contained within OWNER'S property. Cleanup also includes the removal, disposal and replacement of the contaminated soils.
- D. It shall be CONTRACTOR'S responsibility to immediately notify the appropriate agency in the event a spill of the above items gets to a sanitary sewer, storm sewer or any water source. CONTRACTOR shall also immediately notify OWNER of any spill. CONTRACTOR shall be responsible for the cleanup associated with any spill and any costs or damages incurred. Copies of reports of spills and cleanup procedures submitted to agencies shall be given to OWNER.

2.0 PARTS 2 THROUGH 4 - NOT APPLICABLE

SECTION 01900

CONTRACTOR SAFETY REQUIREMENTS

3M STANDING CONTRACT SPECIFICATIONS

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- 1.0 Part 1 - General
 - 1.1 Purpose, Scope and Philosophy
 - 1.2 Referenced Standards
 - 1.3 Owner's Facility Safety Indoctrination
 - 1.4 Permits
 - 1.5 Fire Protection and Prevention
 - 1.6 Welding, Cutting and Spark Production
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- 2.0 Part 2 - Not Applicable
- 3.0 Part 3 - Not Applicable
- 4.0 Part 4 - Related Documents
- 4.1 Attachments

1.0 PART 1 – GENERAL

1.1 PURPOSE, SCOPE AND PHILOSOPHY:

- A. This Section defines safety requirements, which CONTRACTOR shall comply with and enforce on all 3M Company's Worksites. This section also addresses conditions of work and the manner in which OWNER expects work on their premises to proceed.
- B. Failure of this Section to reference specific laws, ordinances, codes, rules, regulations or orders does NOT excuse CONTRACTOR or CONTRACTOR employees from following those regulations that may be applicable to the scope of work being performed by CONTRACTOR.
- C. The safety requirements may be exceeded by the specific safety rules and procedures of individual operating plants or facilities.
- D. CONTRACTOR shall not permit any person to enter upon the premises of OWNER at the Worksite or elsewhere, except in accordance with the safety and security requirements of OWNER, or such governmental authority having an interest in the work. Should any unforeseen

considerations or problems arise, they shall be resolved by mutual agreement, recognizing that personnel safety is of paramount importance.

1.2 REFERENCED STANDARDS:

- A. The publications listed below and its supplements, including but not limited to, form a part of these requirements:
 - 1. U.S. Department of Labor - Occupational Safety and Health Administration (OSHA).
 - 2. National Fire Protection Association (NFPA).
 - 3. National Electrical Code (NEC) - Refer to NFPA 70.
 - 4. American National Standards Institute, Inc. (ANSI).
 - 5. The Material Handling Institute, Inc. (MHI) - Refer to Crane Operators Manual.
 - 6. Environmental Protection Agency (EPA)
 - 7. Uniform Fire Code or applicable fire code
 - 8. Uniform Building Code or applicable building code
- B. Where a standard is referenced in this document, the subject referenced (equipment, material or work) shall be in compliance with the most recent edition of that standard.
- C. The referenced standards are minimum requirements. Where the requirements of this document are in excess of, but not contrary to, the referenced standards, CONTRACTOR shall comply with the more stringent requirements.

1.3 OWNER'S FACILITY SAFETY INDOCTRINATION:

- A. CONTRACTOR shall obtain from OWNER any safety rules and regulations in effect at OWNER'S Worksite. CONTRACTOR will be responsible for requiring all of CONTRACTOR'S employees to receive and ensure comprehension of this information prior to beginning work.
 - 1. These rules will include an explanation of OWNER'S emergency alarm system and emergency response procedures, if such is present.
- B. CONTRACTOR shall keep records showing to whom this information has been given. In the event there is a change in personnel on CONTRACTOR'S work force, CONTRACTOR is responsible for providing any new employees with this information and maintaining all necessary records.

1.4 PERMITS:

- A. The OWNER requires a daily work permit system to keep track of all work at the Worksite. All contract work on the Worksite will require a "3M Daily Work Permit" for each job. This must be initiated by CONTRACTOR'S Designated Representative at least the day before the work starts.
 - 1. CONTRACTOR will not be allowed to enter the facility unless a "3M Daily Work Permit" is at the proper facility entrance. On an emergency basis a telephone call can be made to allow a CONTRACTOR to enter, however, a "3M Daily Work Permit" must be completed before work begins.
 - a. Refer to Part 4 for a copy of the "3M Daily Work Permit".
 - 2. Failure to comply with the daily work permit requirement shall be cause for immediate dismissal from the Worksite.
 - 3. CONTRACTOR shall provide the next days work schedule to OWNER'S Designated Representative at the conclusion of each day's operation.
- B. Additional permits may be required for certain work activities on OWNER Worksites. Examples include, but are not limited to the following:
 - 1. Entry into confined space shall require a "Confined Space Entry Permit" by CONTRACTOR to be completed before work begins. This entry permit shall require standby personnel outside the confined or enclosed space at all times while work activity

- is being performed in the confined space. Refer to Article 1.24 for confined space requirements. Refer also to Articles 1.13 and 1.14 for equipment requirements.
- a. Refer to Part 4 for a copy of the "Confined Space Entry Permit".
 2. Any work such as drilling, chipping, caulking, soldering, welding, lead-burning or other work which may burn or produce a flame, including the use of an open flame or any other heat-generating or spark-producing device shall require an "Open-Flame and Spark Hazard Permit" by CONTRACTOR to be completed before work begins. Refer to Article 1.6 for welding, cutting and spark production requirements.
 - a. Refer to Part 4 for a copy of the "Open Flame and Spark Hazard Permit".
 3. To perform any excavation or digging in accordance with Article 1.21.
 4. To use a "linebreaking permit" for processes which may be hazardous.
- C. It is imperative that the conditions noted on the permit(s) are identical to the actual job conditions. When the nature or conditions of a job change in any way, or when new tools are required or different methods are employed to do the job, other than those originally covered in the initial permit, WORK SHALL STOP IMMEDIATELY because the permit is invalid. The permit is only good for what it describes - no more. Work cannot progress until the situation can be carefully analyzed and a new permit issued for the new conditions.
- D. Communication is the key to enhancing the effectiveness of the work permits system. CONTRACTOR'S employees, agents, delegates, invitees and subcontractors and OWNER'S Designated Representative, including operators and facility supervisors, must all be aware of the permit process and the specific requirements of each permit. This then allows each to review the ongoing work and look for possible changing conditions or deviations during their daily work routine. Permits may only be requested and obtained by CONTRACTOR'S Designated Representative. After the permit has been issued, but before any work has been performed, the CONTRACTOR'S copy of the permit shall be read and initialed by OWNER'S Designated Representative. This assures both CONTRACTOR and OWNER Designated Representative's knowledge and involvement. After the permits have been initialed by OWNER'S Designated Representative, the CONTRACTOR'S Designated Representative shall distribute the permit to CONTRACTOR employees performing that work. CONTRACTOR'S Designated Representative shall make sure CONTRACTOR employees read the permit requirements. These permits must be posted in the work area. If the permit cannot be posted, it must be carried by one of CONTRACTOR supervisors in that area. OWNER'S Designated Representative will, as a routine, periodically question CONTRACTOR employees as to the location of the permit and its requirements. Permits are valid for only one day. Permits shall not remain in CONTRACTOR'S trailer. Permits shall be returned to the OWNER'S Designated Representative at the end of the day.

1.5 FIRE PROTECTION AND PREVENTION:

- A. CONTRACTOR'S personnel shall observe OWNER'S fire safety rules and regulations and evacuation procedures.
- B. CONTRACTOR shall provide the number of fire extinguishers and fire protection devices required by law and any additional protection devices required by OWNER. CONTRACTOR shall also maintain the equipment in good operating condition (i.e., fully charged). All fires and types of extinguishing equipment used shall be promptly reported to OWNER'S Designated Representative.
 1. A fire extinguisher, rated not less than 2A, must be provided for each 1,500 square feet of the protected building area with travel distance from any point to the nearest extinguisher not to exceed 75 feet.
- C. CONTRACTOR shall be responsible for the development of a fire protection program to be followed throughout all phases of the construction work and shall provide for the fire fighting equipment in accordance with OSHA regulations, these guidelines, and the requirements appropriate to the type of construction being performed. This shall include, but not be limited to:

1. All fire fighting equipment provided by CONTRACTOR shall be conspicuously located, free for access, periodically inspected, and maintained in good operating condition. Defective equipment shall be replaced immediately. CONTRACTOR shall give particular attention to training CONTRACTOR'S personnel in the use of fire extinguishers and their limitations.
 2. Installation of an automatic sprinkler protection system(s) must follow the construction work sequence as soon as possible and be placed in service as soon as applicable laws permit.
 3. The telephone number(s) of the nearest appropriate fire department(s) and OWNER'S security/emergency number(s) shall be conspicuously posted.
 4. "Strike anywhere" matches or disposable butane lighters are not allowed on the Worksite.
 5. All smoking areas shall be designated by OWNER'S Designated Representative. Smoking shall be prohibited on all roofs and in areas where flammable or combustible liquids and materials are used and stored.
- D. Fire prevention program shall also include analysis of potentially hazardous materials, identifying hazardous area classifications, developing guidelines for storage and handling and using items such as fuel oils, flammable gases, solvents, plastics and paints.
- E. Refer to Article 1.4 for "Open-Flame and Spark Hazard Permit" requirements.

1.6 WELDING, CUTTING AND SPARK PRODUCTION:

- A. CONTRACTOR'S personnel shall observe OWNER'S safety regulations regarding welding, cutting and spark production.
- B. Proper precautions (isolating welding and cutting, removing fire hazards from the vicinity, providing a fire watch, etc.) for fire prevention shall be taken in areas where welding or other "hot work" is being done. The "Open-Flame and Spark Hazard Permit" must be issued by the facility designated person at the request of the OWNER'S Designated Representative prior to any welding, cutting or other "hot work" being performed. No welding, cutting or heating shall be done where the application of flammable paints or the presence of other flammable compounds or ignitable dust concentration creates a fire hazard. Refer to Article 1.4 for details on permits.
1. Refer to Part 4 for a copy of the "Open-Flame and Spark Hazard Permit".
- C. CONTRACTOR shall exercise extreme care in the use of all open flame equipment. OWNER'S Designated Representative shall be informed daily of all such activities. The following items are of particular importance and shall be strictly enforced by CONTRACTOR:
1. CONTRACTOR shall enforce strict compliance with the above "Open-Flame and Spark Hazard Permit".
 2. CONTRACTOR'S welding, cutting or spark production shall be permitted in flammable liquid areas only if vapor checks are made and automatic sprinklers are in service.
 3. CONTRACTOR shall use fire-resistant tarpaulins to contain sparks and hot metals.
 4. CONTRACTOR shall confine flammable liquids in approved safety containers.
- D. CONTRACTOR shall perform welding and cutting in accordance with OSHA regulations. These shall include, but not be limited to:
1. All exposed combustible materials located below the welding and cutting area shall be removed to a safe location, covered with a fire-resistant material or protected by an approved spark catcher to contain all sparks and slag.
 2. A fire extinguisher suitable for the hazards must be within the immediate area of any welding, cutting, or open flame work. A welder's helper or fire watcher shall be required whenever cutting or welding is performed in locations where a fire might develop.
 3. The user shall inspect all leads, grounds, clamps, welding machines, hoses, gages, torches and cylinders before they are put into operation. Leads must not be placed in traffic areas.

4. All fittings, couplings and connections are to be "leak-free".
 5. Provide adequate ventilation while cutting, welding, soldering or working on galvanized material and while working within enclosed shelters.
 6. All work shall have a separate and adequate ground, pulled from the welding machine to the item being welded.
 7. At the end of each shift (or when not in use for extended periods or unattended), the welding machine shall be turned off.
 8. An approved welding helmet shall be worn.
 9. Electric welding is prohibited from any metal ladder. (Metal ladders are not permitted on site.)
 10. Compressed gas cylinders shall be secured vertically to an adequate support while in storage or transit. The protective cap must be on during storage and transit. All oxygen cylinders shall be separated while in storage from any flammable gas such as LP or acetylene cylinders by a 5 foot high fire barrier having a 1/2 hour fire rating or separated by a minimum distance of 20 feet. Under no circumstances shall acetylene cylinders be laid down.
 11. Keep oil and grease away from oxygen regulators, hoses and fittings. Do not store wrenches, dies, cutters or other grease covered tools in the same compartment with oxygen equipment.
 12. Approved cutting goggles shall be worn.
 13. Gloves shall be worn to protect hands and wrists. Flying chips and weld slag travel a considerable distance and may be dangerous to other personnel in the area and, therefore, shall require screening or shielding. Heavy leather work gloves, long sleeve shirts or jackets and goggles or a full face shield shall be worn when welding, cleaning, grinding and brushing surfaces. The same precautions shall be taken for wirebrushing and power brushing. Flame-resistant aprons of leather or other suitable material shall be worn as protection against radiating heat and sparks. Clothing should be free of oil and grease.
 14. Torches shall never be left in a vessel due to potential leaks.
 15. Oxygen shall not be used to operate pneumatic tools, pressurize a container, blow out lines or as a substitute for compressed air or other gases.
 16. Cylinders and hoses shall be placed where they are not exposed to sparks and slag from a welding or cutting operation.
 17. Cylinders shall be raised to upper levels with approved rigging gear. Do not lift them with slings or by the protective cap.
 18. Do not strike an arc on cylinders or use them as rollers.
 19. Cutting/burning units must have hoses bled and gages zeroed when not in use.
- E. Welding and cutting on barrels or other containers shall be in accordance with all prevailing codes, ordinances and regulations, including all procedures directed by OWNER'S Designated Representative.

1.7 ELECTRICAL WORK AND LOCKOUT (TAGGING) PROCEDURES:

- A. General Requirements:
1. All electrical work shall be performed by qualified personnel. Work shall be performed on locked out de-energized circuits whenever possible. Exceptions include: testing of circuits, working on a portion of a continuous industrial process where shutdown of the entire process is not feasible, etc. Work on energized parts shall follow requirements of OSHA.
 2. All electrical work, installation, and wire capacities shall be in accordance with the pertinent provisions of NFPA 70 (latest revision) and area classifications.
 3. The construction and installation of permanent and temporary electrical power shall comply with OSHA standards.
 4. CONTRACTOR shall be in compliance with Lockout/Tagout (1910.147) prior to starting electrical work, which involves cutting, splicing or tapping existing cables.

CONTRACTOR will request OWNER to tag and identify all cables present in the area. CONTRACTOR shall check to make sure that the circuit to be worked on has been de-energized and the source locked out. CONTRACTOR shall use its own padlock on the disconnect device. Review one line diagram to be sure there are no alternate power sources.

- a. CONTRACTOR will check for energized cable with a device intended for the purpose before cutting into the cable or opening a splice or termination. Solidly ground the cable to a KNOWN low resistance ground point while working on the cable.
- b. Electrical lines shall be de-energized while work is performed with the energy control source locked out. When it is necessary to work with energized lines, only qualified personnel and effective means of personal protection shall be utilized such as, but not limited to, rubber gloves and blankets which have been tested regularly in accordance with ANSI.
- c. At least two people shall be assigned to work on any energized lines or in substations.
- d. When it becomes necessary to transport equipment or machinery under overhead lines in a mover that encroaches on specified clearances, the job shall be scheduled so the lines can be de-energized.
- e. Operations conducted adjacent to overhead lines shall not be initiated until coordinated with the local utility officials.
- f. Materials and supplies shall not be stored under overhead transmission and distribution lines due to CONTRACTOR'S potential exposure to overhead contact with electrical energy during storage and removal.
- g. Operations adjacent to overhead lines shall be prohibited unless one of the following conditions is satisfied:
 - 1) Power has been shut off and positive means taken to prevent the lines being energized.
 - 2) Equipment, or any part, does not have the capability of coming within the following minimum clearance from energized overhead lines or the equipment has been positioned and blocked to assure no part, including cables, can come within the following minimum clearances:

Power Lines Nominal <u>System</u> <u>kv</u>	Minimum Required <u>Clearance</u>
50 or under	10 feet (3.04m)
51 – 75	12 feet (3.66m)
115; 161	15 feet (4.57m)
230; 285	20 feet (6.10m)
345	25 feet (7.62m)
500	35 feet (10.67m)

B. Grounding Requirements:

1. All electrical circuits shall be grounded in accordance with the NEC, unless otherwise noted in this Specification.
2. A ground shall be provided for non-current-carrying metallic parts of equipment such as: generators (if not exempted by NEC 250-6), electrically powered welders, switches, motor-controller cases, fuseboxes, distribution cabinets, frames, non-current-carrying rails used for travel, motors of electrically operated cranes, electric elevators, metal frames of non-electric elevators to which electric conductors are attached, other electric equipment and metal enclosures around electric equipment.
3. Portable and semi-portable electrical tools and equipment shall be grounded by a multiconductor cord having an identified grounding conductor and a multicontact polarized plug-in receptacle.

4. Semi-portable equipment, flood lights and work lights shall be grounded. The protective ground of such equipment shall be maintained during moving unless supply circuits are de-energized.
5. Tools protected by a system of double insulation, or its equivalent, need not be grounded. Double-insulated tools shall be distinctly marked and listed by UL or FM.
6. Grounding circuits shall be checked to ensure that the circuit between the ground and a grounded power conductor has a resistance, which is low enough to permit current flow sufficient to cause the fuse or circuit breaker to interrupt the current.
7. Conductors used for bonding and grounding stationary and movable equipment shall be of ample size to carry the anticipated current. When attaching bonding and grounding clamps or clips, a secure and positive metal-to-metal contact shall be made. The ground end shall be attached first and the other end shall be attached and removed by insulated tools or other suitable devices. When removing grounds, the grounding device shall first be removed from the line or equipment using insulated tools or other suitable devices. Such bonding and grounding attachments shall be made before closures are opened and material movements are started and should not be broken until after material movements are stopped and closures are made.
8. All 120-volt single-phase 15 and 20 ampere receptacle outlets which are not a part of the permanent wiring of the building or structure shall have ground-fault circuit interrupters (GFCI) for personnel protection or an assured equipment-grounding conductor program. Permanent wiring of electrical circuits shall be grounded in accordance with NEC. GFCI's may be sensitive to some equipment such as concrete vibrators. In these instances, other precautions shall be taken to protect the equipment.

C. Temporary Wiring:

1. Temporary wiring shall be guarded, buried or isolated by elevation to prevent accidental contact by workers or equipment.
2. Outdoor lighting strings shall consist of lamp sockets and connection plugs permanently molded to the conductor insulation.
3. Flexible/extension cord sets shall be of a type listed by the UL. Flexible/extension cord sets used on construction Worksites shall contain the number of conductors required for the service, plus an equipment ground wire. The cords shall be hard usage or extra-hard usage as specified in the NEC. Approved cords may be identified by the word "outdoor" or letters "WA" on the jacket. All portable receptacle boxes must be approved for outside use (free of knock out plugs).
4. Bulbs attached to festoon lighting strings and extension cords shall be protected by wire guards or equivalent unless deeply recessed in a reflector.
5. When temporary wiring is used in tanks or other confined spaces, an approved switch suitable for the hazards present e.g., explosion proof, identified and marked, shall be provided at or near the entrance to such spaces for cutting off the current in emergencies.
6. Exposed empty light sockets and broken bulbs shall not be permitted.
7. Temporary lights shall be equipped with heavy-duty electric cords with connections and insulation maintained in safe condition. Temporary lights shall not be suspended by their electric cords unless cords and lights are designed for this suspension. Splices shall have insulation equal to that of the cable.
8. Portable electric lighting used in moist and/or hazardous locations such as drums, tanks, vessels and confined spaces shall be operated at a maximum of 12 volts.
9. Temporary lights shall be equipped with guards to prevent accidental contact with the bulb.
10. Attachment plugs for use in work areas shall be constructed so that they will endure rough use. They shall be equipped with a cord grip to prevent strain on the terminal screws.
11. Additional requirements for temporary wiring are as listed in the Section of this Specification entitled "Temporary Facilities and Controls".

1.8 MOTOR VEHICLES AND EQUIPMENT:

- A. CONTRACTOR'S personnel shall observe OWNER'S roadway vehicle safety rules and prevailing OSHA regulations when operating vehicles and moving equipment at OWNER'S facilities.
- B. The driver of each vehicle is responsible for the safety of all passengers and the stability of materials being hauled or handled by the equipment.
- C. All vehicles, which are not necessary for work, shall park in areas designated by OWNER'S Designated Representative.
- D. All CONTRACTOR vehicles must be covered by CONTRACTOR'S insurance requirements as indicated in OWNER'S Contract.
- E. Blocking of OWNER'S roadways is prohibited except where specifically authorized by OWNER'S Designated Representative.
- F. Speed limits shall be strictly followed on OWNER'S Worksite.
- G. All CONTRACTOR'S equipment (i.e., backhoes, cranes, front end loaders, dozers, earth movers, etc.) shall have functioning backup warning devices.
- H. All stationary equipment shall be grounded or isolated, when working near, above or below grade energized lines or equipment.

1.9 CRANES AND HOISTS:

- A. CONTRACTOR shall comply with the manufacturer's specifications and limitations applicable to the operation of any and all cranes and hoists. Attachments used with cranes shall not exceed the capacity, rating or scope recommended by the manufacturer. A copy of the crane manufacturer's operating manual shall be available in the cab of each crane at all times. Manufacturer's load rating plates (in view of the operator) shall be attached to all load hoisting equipment.
- B. All equipment used for hoisting shall be inspected daily by CONTRACTOR before operations are begun. Cranes or equipment that have been idle shall be inspected by CONTRACTOR before being put into operation. Maintenance and inspection of cranes or equipment shall be in accordance with ANSI standards.
 - 1. Inspection records shall be made available to OWNER'S Designated Representative if requested by OWNER.
- C. Operating cranes or equipment in the vicinity of overhead power lines must include an action plan developed by the CONTRACTOR and implemented to insure safe operation. This plan must include building barricades, warning signs, a limited device for boom extension, grounding of equipment, use of nylon slings, wearing insulated gloves and boots, and/or limited access. These are preventive measures. First consideration shall be given to alternative methods and routes that will keep equipment away from these areas.
- D. The riding of crane hooks and/or "headache balls" is prohibited. Doing so may result in immediate dismissal from the Worksite.
- E. Rigging equipment shall be certified and inspected by qualified state or manufacturer representatives prior to use and as necessary during its use to ensure that it is safe. Inspection documentation shall be submitted to OWNER'S Designated Representative upon request.
- F. Only personnel qualified by training and experience shall operate cranes or hoists. Upon request, CONTRACTOR shall provide qualification and experience resumes for all operators.
- G. One person shall be designated to perform signaling.
- H. During assembly and disassembly of crane booms and hoist sections, all components shall be adequately supported so that these components will not shift or fall.

- I. When making a lift with a crane, CONTRACTOR shall have the area cleared, roped or barricaded off, and shall have someone supervising the lift. No one shall stand or pass under suspended loads. Tag lines shall be used for controlling loads.
- J. Cranes and hoists shall not be refueled while in operation.
- K. When working near energized lines and equipment, the cranes shall be grounded or isolated.
- L. All cranes and hoists not in use shall be properly secured.
- M. Outriggers shall be fully extended for any lift. Where cribbing is used under the outrigger, it must only be used under the pedestal.
- N. The use of a crane or hoist to hoist employees on a personnel platform is prohibited, except when the erection use and dismantling of conventional means of reaching the Worksite; such as a personnel hoist, ladder, stairway, aerial lift, elevating work platform or scaffold would be more hazardous, or is not possible because of structural design or Worksite conditions.

1.10 CONTRACTOR'S SAFETY TRAINING AND EDUCATION:

- A. CONTRACTOR shall instruct each employee in the recognition and correction of unsafe acts, behavior and conditions and the regulations applicable to CONTRACTOR'S work environment. The employee shall use these instructions to control or eliminate any hazards or other exposure to illness or injury.
- B. CONTRACTOR shall acquaint each CONTRACTOR employee with the safety and emergency equipment available and the procedures to be followed in each type of emergency.
- C. At a minimum, each Contractor shall be required to conduct weekly safety meetings with CONTRACTOR personnel and subcontractors. Minutes must be kept and submitted to the OWNER'S Designated Representative, if requested.
- D. CONTRACTOR shall provide a qualified employee who is responsible for maintaining Worksite safety during all phases on Worksite. The qualified employee shall conduct safety meetings with all personnel weekly, monitor site safety continuously, and thoroughly investigate all accidents and near misses. Depending on the size and type of project, the qualified employee may have other Worksite responsibilities.
- E. All CONTRACTOR personnel shall receive an initial indoctrination by CONTRACTOR'S safety supervisor into CONTRACTOR'S safety procedures and the requirements of this Section.
- F. Before work begins, CONTRACTOR shall provide to OWNER a hazardous chemical inventory for contractor-supplied hazardous materials and corresponding MSDS'S. Contractors are required to inform OWNER'S Designated Representative of hazardous substances brought on Worksite and to update the hazardous chemical inventory.
 - 1. The hazardous chemical inventory, along with all update information shall be made available to OWNER'S Designated Representative on a regular scheduled basis with copies of MSDS'S as requested by OWNER.
- G. Contractors are required to strictly enforce container labeling. Labels are to include the identity of the substance and the appropriate hazard warning on all containers of hazardous substances.
 - 1. In the event that containers suspected of containing hazardous substances are received without the manufacturer's label, the shipment shall be rejected. All containers of hazardous substances shall be appropriately labeled and identified.
 - 2. If a shipment of properly labeled containers is received by CONTRACTOR without a MSDS, CONTRACTOR shall immediately request the MSDS from the manufacturer, a copy of the written request shall be submitted to OWNER'S Designated Representative.
 - a. The MSDS is not required for subsequent deliveries of the same product.

- H. Contractors are responsible for educating their personnel on the requirements of the Federal Hazard Communication Standard regarding hazardous chemical inventories, MSDS's, container labeling and evacuation procedures.
- I. Documentation of employee training is of paramount importance to ensure Federal Hazard Communication Standard compliance. CONTRACTOR shall keep complete and accurate records of CONTRACTOR personnel training and attendance. This documentation, as well as the hazardous chemical inventory and MSDS file, shall be ready for audit at any time by either OWNER'S Designated Representative or an OSHA inspector.

1.11 RECORDING AND REPORTING OF INJURIES:

- A. Every CONTRACTOR and subcontractor shall keep occupational injury and illness records for employees which shall include the following forms:
 - 1. Supplementary Record of Occupational Injuries and Illnesses or a "First Report of Injury/Illness" as required by the state.
 - 2. Log and Summary of Occupational Injuries and Illnesses.
 - 3. Any state safety and health records required.
- B. CONTRACTOR shall notify OWNER of the name of CONTRACTOR'S employee who will be knowledgeable in the prevention of accidents at the Worksite, and whose duty will be to report immediately in writing to OWNER all accidents and injuries occurring at the Worksite. If CONTRACTOR is required to file an accident report with a public authority, CONTRACTOR shall provide a copy of the report to OWNER.
- C. CONTRACTOR shall investigate each OSHA recordable accident to determine the cause and implement future corrective measures. CONTRACTOR shall present a written copy of its investigation report and corrective action measures to OWNER'S Designated Representative.
- D. Every CONTRACTOR and subcontractor shall provide the total employee hours worked each day on the Worksite to the OWNER'S Designated Representative or according to the local facility procedures.

1.12 FIRST AID AND MEDICAL ATTENTION:

- A. All first aid and medical attention for CONTRACTOR'S workers shall be handled by CONTRACTOR in accordance with OSHA regulations.
- B. CONTRACTOR shall set up a first aid station in compliance with OSHA and state regulations.

1.13 PERSONAL PROTECTIVE EQUIPMENT:

- A. CONTRACTOR is responsible for providing and requiring employees to wear appropriate personal protective equipment for all operations where there is an exposure to hazardous conditions, where there is the need for using such equipment to reduce the hazards to employees, where required by the specifications or where required by plant operating procedures. The most stringent requirements shall take precedence and shall include, but not be limited to:
 - 1. Hard hats (metal hard hats shall not be worn), safety glasses and full-length trousers are required personal protective equipment and must be worn at all times when on the Worksite. Flexible slip-on side shields are acceptable. Additional personal protective equipment such as ear plugs, goggles, conductive shoes, grounding straps, safety harness and energy-absorbing lanyard, gloves, safety nets, respirators and similar safety items may be required depending on the nature of the work area and the work involved. Safety belts are not to be used on any 3M Worksite.
 - 2. When the possibility of loose particles or flying projectiles exists, the proper safety wearing apparel and safety protection devices shall be worn. A full face shield may be allowed at the discretion of OWNER'S Designated Representative.

3. Safety shoes are recommended.
 4. Contact lens may not be worn in operating areas.
- B. CONTRACTOR shall have extra safety glasses and hard hats available on the Worksite. Safety glass cleaner shall also be made readily available to all CONTRACTOR employees on the Worksite.
- C. Before entering any area or confined space where toxic airborne contaminants (vapor) or oxygen-depleted atmospheres are possible or suspected to exist, the CONTRACTOR must ensure proper safety equipment is used, including a recovery line and backup person. Refer to Article 1.24 for confined space entry requirements.

1.14 RESPIRATORS:

- A. If required, respirators shall be provided by the CONTRACTOR for their workers and any of their subcontractors.
- B. The respirator shall be applicable and suitable for the purpose intended.
- C. CONTRACTOR shall be responsible for the establishment and maintenance of the respirator protective program and shall include the requirements as outlined below:
1. Respirators shall be selected on the basis of hazards to which the worker is exposed.
 2. The user shall be instructed and trained in the proper use of respirators and their limitations.
 3. Where practical, the respirators should be assigned to individual workers.
 4. Respirators shall be cleaned, disinfected and filters replaced as per manufacturer's recommendations.
 5. Persons should not be assigned to tasks requiring use of respirators, unless it has been determined that they are physically able to perform the work and use the equipment. CONTRACTOR'S physician shall determine what health and physical conditions are pertinent.
 6. CONTRACTOR shall contact and meet regularly with the OWNER'S Designated Representative to establish the type of respirator required, vapors, gases, dust, mists or fumes which are present and areas where respirators are required.
- D. CONTRACTOR shall pay particular attention to and comply with OSHA Code of Federal Regulations 1926.103 regarding respiratory protection for the Construction Industry.

1.15 PERSONAL CONDUCT:

- A. Horseplay, fighting, gambling, explosives, possession of firearms, drinking alcoholic beverages, use of regulated drugs, being under the influence of drugs or alcohol, theft, vandalism, sabotage and distribution of unauthorized literature shall be cause to bar those involved from the Worksite.
- B. Cameras are prohibited to protect proprietary processes. No photographs may be taken without following the local procedure.

1.16 SAFETY INSPECTION AND HOUSEKEEPING:

- A. At a minimum, CONTRACTOR shall check the work area daily at the beginning and at the end of each work shift to ensure safe working conditions are maintained and all safety procedures are followed.
- B. During the course of the work, CONTRACTOR shall be responsible for properly organizing all activities on the Worksite to the extent that good housekeeping shall be practiced at all times. This shall include, but not be limited to:
1. As the job progresses, work areas shall be kept clean at all times.

2. All materials, tools and equipment shall be stored in a stable position to prevent rolling or falling. Materials and supplies shall be kept away from edges of floors, hoistways, stairways and floor openings. When exterior walls are being built, materials and supplies shall be kept away from the perimeter of the building.
3. A safe access way to all work areas and storage areas shall be maintained. All stairways, corridors, ladders, catwalks, ramps, passageways and work platforms shall be kept clear of loose material and trash.
4. Forms and scrap lumber with protruding nails and all other debris shall be cleared from work areas, passageways, stairs and in and around buildings or other structures.
5. Combustible scrap and debris shall be removed at regular intervals. Safe means shall be provided to facilitate such removal.
6. CONTRACTOR shall supply an adequate number of dumpsters to insure a clean working area at all times. CONTRACTOR shall load and transport all refuse and debris to a suitable disposal area away from the Worksite and make disposition in a lawful manner. CONTRACTOR shall be responsible for weekly cleanup of common areas, such as parking lots and roadways.
 - a. CONTRACTOR'S parking and staging areas shall also be maintained clean and free of all debris at all times.
7. The eating areas shall be maintained in a clean and orderly condition. Garbage containers shall be placed in these areas and frequently emptied. Eating and drinking shall not be permitted in the construction work areas.
8. Contractor shall restrict the use of flammable liquids and gases to a minimum. Store all flammables not actually needed for immediate use outside building, in a secure shelter. Store flammables outside building during non-work hours. Store rags or wiping waste with oily or flammable residue away from flammable liquids in approved metal containers.
 - a. CONTRACTOR shall collect and dispose of flammable debris and dust as it is accumulated.
 - b. Storage locations for gasoline or other flammable materials used for vehicles or equipment shall be in areas agreed to by OWNER'S Designated Representative. These areas shall be diked to retain spilled material and have an appropriately placed fire extinguisher.
 - 1) Refer to Section entitled "Temporary Facilities and Controls" of this Specification regarding construction pollution control facilities.
 - c. All items must be properly labeled.
9. Cords and hoses shall be kept a minimum of 7 feet overhead or laid flat outside of walkways.
10. Tools and equipment shall not be strewn about where they might cause tripping or falling hazards and shall, at the end of each workday, be collected and stored in the toolroom or craft gang boxes.
11. Each employee shall be instructed to practice required housekeeping as part of assigned duties.

C. Housekeeping and care of the Worksite shall be in accordance with the Contract.

1.17 MATERIAL HANDLING AND STORAGE:

A. General:

1. CONTRACTOR shall be responsible for using safe methods of handling, storage and disposal of materials on the Worksite.
2. CONTRACTOR'S personnel shall observe OWNER'S safety rules and regulations for receiving, handling, storage and disposal of all materials. See Article 1.25 for proper environmental disposal procedures.

- B. Material Handling:
 - 1. Rigging equipment for material handling shall be of the proper size and rating. All rigging equipment shall be inspected by CONTRACTOR prior to use on each shift and as necessary during its use to ensure that it is safe. Defective rigging equipment shall be removed from service. All rigging equipment not in use shall be properly secured.
 - 2. Tagline shall be used for controlling loads.
 - 3. Special custom design grabs, hooks, clamps or other lifting accessories (for such units as modular panels, prefabricated structures and similar materials) shall be marked to indicate safe working loads and shall be proof tested prior to use to 125 percent of their rated load.
- C. Material Storage:
 - 1. All materials stored shall be stacked, braced, racked, blocked, interlocked or otherwise secured to prevent sliding, rolling, falling or collapse.
 - 2. Flammable material storage shall be as previously described under Article 1.16 of this Section.
 - 3. Materials stored inside buildings under construction shall not be placed within 6 feet of any hoistway or inside floor opening, nor within 10 feet of an exterior wall, which does not extend above the top of the material stored.
 - 4. Materials stored on existing structurally supported floors and roofs shall not exceed the uniform design load capacity of floor or roof.
 - 5. Materials shall be stored in a manner to provide unobstructed access to all exits.
 - 6. Storage location shall be approved by OWNER'S Designated Representative.

1.18 VERTICAL AND HORIZONTAL WORK SAFETY ACCESS CONTROL:

- A. Ladders:
 - 1. The use and erection of ladders shall comply with OSHA regulations and shall include, but not be limited to:
 - a. Each user must visually inspect each ladder for defects before using.
 - b. While ascending or descending a ladder, carry nothing which will prevent holding onto the ladder with both hands. Use a handline if necessary to raise or lower materials.
 - c. Metal ladders shall not be used.
 - d. Ladders shall be securely tied off.
 - e. When working from ladders, work facing the ladder with both feet on the rungs.
 - f. All ladders shall have appropriate shoes or footings.
 - g. Workers shall not stand on the top or second step of step ladders.
- B. Scaffolds:
 - 1. The use and erection of scaffolds shall comply with OSHA regulations and shall include, but not be limited to:
 - a. All scaffolds shall be erected on a firm base.
 - b. Never exceed safe working loads on scaffolds.
 - c. Never rig from scaffold handrails or braces.
 - d. Scaffold handrails, midrails or brace members shall not be climbed. Use ladders for access.
 - e. Appropriate hand and toe rails and cleats are required.
 - f. Since federal standards are quite detailed in their specifications for the dozens of types of scaffolds, OSHA 29 CFR Part 1926.451 must be referred to for each particular job's scaffolding requirements.
- C. Safety Harnesses:
 - 1. The use of safety harnesses shall comply with OSHA regulations and shall be used on Worksites. Safety harnesses with energy-absorbing lanyards are required to be worn and tied off when working on:

- a. Sloping roofs.
 - b. Flat roofs without handrails within 10 feet of the edge of the roof or an opening.
 - c. Open-sided floors or platforms.
 - d. Any suspended scaffolds, platforms or stages.
 - e. Any scaffold with incomplete handrails
 - f. All steel erection (first connection shall be made as defined by OSHA).
 - g. Confined spaces, such as manholes, tanks, pressure vessels and tunnels.
 - h. Generally any elevated work area that is without protection to prevent workers from falling.
 2. Safety belts are not allowed on the Worksite.
 - D. Openings in Floors, Walls and Stairwells:
 1. The protection of unguarded openings in floors, walls and stairwells shall be in compliance with OSHA regulations.
 2. All holes or openings through floors, decking or walls at all elevations shall have properly identified hole covers or be barricaded immediately. Floor openings shall be guarded by a standard railing and toeboards or a cover. All open-sided floors or platforms, 4 feet or more above adjacent floor or ground level, shall be guarded by standard railings or the equivalent on all open sides, except where there is an entrance to a ramp, stairway or fixed ladder.
 3. Equipment or material shall not be stored on a hole cover.
 4. Covers for holes in floors, roofs and other walking/working surfaces shall meet the following requirements:
 - a. Covers located in roadways and vehicular aisles shall be capable of supporting, without failure, at least twice the maximum axle load of the largest vehicle expected to cross over the cover.
 - b. All covers shall be capable of supporting, without failure, at least twice the weight of employees, equipment and materials that may be imposed on the cover at any one time.
 - c. All covers shall be secured when installed so as to prevent accidental displacement by the wind, equipment or employees.
 - d. All covers shall be color coded or they shall be marked with the word "HOLE" or "COVER" to provide warning of the hazard.
- Note: This provision does not apply to cast iron manhole covers or steel grates used on streets or roadways.
- E. Stairways, Platforms, Runways, Walkways and Ramps:
 1. The fabrication and use of temporary stairways, walkways and ramps shall be in compliance with OSHA and ANSI regulations.
 2. On all structures of two or more floors, stairways, platforms, runways, walkways and ramps shall be provided for employees during the construction period.
 - a. Handrails and guardrails shall be as required by OSHA capable of withstanding a minimum force of 200 pounds in any direction.

1.19 MISCELLANEOUS PROVISIONS:

- A. General:
 1. CONTRACTOR is solely responsible for CONTRACTOR equipment and goods. OWNER is not responsible for any losses by theft (or by whatever nature) of CONTRACTOR'S property.
 2. Loose clothing, rings and other jewelry shall not be worn around operating tools or machines. Keep sleeves buttoned.
- B. Illumination:

1. CONTRACTOR shall ensure that construction areas, aisles, stairs, ramps, runways, corridors, offices, shops and storage areas where work is in progress shall be adequately lighted with either natural or artificial illumination. Refer to OSHA Standards for illuminated light levels in all work areas.
- C. Hand and Power Tools:
1. All hand and power tools and similar equipment, whether furnished by CONTRACTOR or CONTRACTOR employees, shall be maintained in a safe operating condition. Damaged tools shall be immediately repaired or replaced. Tools shall be used only for the purpose for which they were designed.
 2. Any tools that are designed to have guards must have those guards in place at all times. Any worker removing a guard or using an unguarded tool shall be subject to dismissal from the Worksite.
 3. Grinders are particularly hazardous. Workers shall be trained in their use. While the grinders are rotating, the operator shall assure that he/she is in a balanced position and that the momentum of the disc will carry the tool away from the operator if it becomes stuck.
- D. Sanitation:
1. CONTRACTOR shall furnish an adequate supply of potable water, waste containers and disposable cups to CONTRACTOR employees for drinking water.
 2. CONTRACTOR shall furnish adequate toilet facilities for CONTRACTOR employees. All portable toilets shall be kept clean, sanitary and located in an easily accessible area. If they are to be used at night, the area shall be well lighted.
 3. Refer to Section entitled "Temporary Facilities and Controls" of this Specification for additional requirements regarding water and toilet availability.
 4. State and federal requirements shall be met.
- 1.20 SIGNS, SIGNALS AND BARRICADES:
- A. The fabrication and use of barricades and handrails shall be in compliance with OWNER'S safety rules and with OSHA and ANSI regulations. Special attention shall be given by CONTRACTOR to the following items:
1. To protect workers from injury, CONTRACTOR shall construct removable replaceable handrails, temporary barricades or secured covers for all openings in the roof and floors, open trenches in the roof and floor, open trenches crossing roads and pedestrian walkways and open manholes in accordance with all applicable safety regulations. Such handrails, barricades and covers may be removed only when removal is necessary for the performance of work near the opening, trench or manhole. They shall be replaced when any of the following occur:
 - a. The workers take a break and leave the area; or
 - b. The work is not completed by the end of the working day; or
 - c. As soon as their absence is no longer necessary for the performance of the work.
 2. When such handrails, barricades or covers are removed by CONTRACTOR or any subcontractor, they shall be replaced or rebuilt as necessary by CONTRACTOR or subcontractor who removed them.
 3. CONTRACTOR shall post areas where it is necessary to do overhead work.
- B. CONTRACTOR shall be responsible for posting, installing and maintaining signs, signals and barricades to detour the passage of persons or vehicles at all locations where potential hazards exist.
- C. CONTRACTOR'S employees shall obey all signs, signals and barricades, which are posted to warn of potential or existing hazards.
- D. Barricades shall be 42 inches high, square and level. Barricade shall be kept 4 feet back from the edge excavations, trenches, holes, platforms and roofs.

- E. The selection and use of signs and tags shall be in conformance with the appropriate ANSI standard.
 - 1. CONTRACTOR shall be responsible for attaching danger tags to a piece of equipment (or part of a structure) to warn of potential or immediate hazards.
- F. Flag persons must wear red or blaze orange vests. Flags must be of color and size meeting OSHA standards. Refer to Article 1.9 for crane and hoist signals.

1.21 EXCAVATIONS AND TRENCHING:

- A. The sides of all excavations and trenches must be properly sloped, shored or sheeted before entering according to OSHA regulations and shall be capable of withstanding all soil pressures, including stresses which can be exerted by water, heavy loads or vibrations.
 - 1. Shoring and sheeting procedures shall be reviewed by CONTRACTOR'S Designated Representative before work begins.
 - 2. Shoring and sheeting shall be removed after trenching installation work has been fully completed.
 - 3. CONTRACTOR may use OSHA approved movable steel plate trench boxes or shields during trenching work.
- B. Location of all underground structures or utilities shall be verified before digging begins and CONTRACTOR shall take all necessary precautions to prevent any hazard from developing. In the event any underground structure is encountered, CONTRACTOR shall provide proper support to the structure as required to maintain its integrity and stability.
 - 1. Refer to Section entitled "Summary of the Work" of this Specification for additional requirements regarding underground structures.
- C. All excavations and trenches must have safe accessways and be properly barricaded. Barricades with flashing lights are required at night. Excavated material may be used to barricade one side of the excavation or trench. The edge of the excavated material shall be at least 2 feet from the edge of the excavation or trench. Excavated material must be piled at least 3 feet high when used as a barricade.
- D. Check for soil erosion and stability of all excavation walls before entering and after a heavy rain or thaw. Check shoring and sheeting daily or more often in extremely wet weather for stability and for accumulation of water. Checking shall be done by a person who is competent and knowledgeable for this type of work.
 - 1. Workers will not be permitted in trenches or excavations until accumulated water has been totally removed.
- E. The area shall be cleared and approved by CONTRACTOR'S Designated Representative prior to the start of excavation. Refer to Article 1.4 for work within an existing building or operating area.
- F. Workers will not be permitted in trenches or excavations while equipment is being used next to the edge.
- G. The use of explosives will not be allowed at any time, unless written approval from OWNER'S Designated Representative is first obtained.

1.22 CONCRETE, CONCRETE FORMS AND SHORING:

- A. All equipment and materials used in concrete construction and masonry work shall be as required by OSHA and also the applicable ANSI standard. Wall shoring shall also be designed to meet applicable federal and state codes.
- B. Form work and shoring shall be designed, erected, supported, braced and maintained so that it will safely support all vertical and lateral loads that may be imposed upon it during placement of concrete.

- C. Structural calculations regarding strength and stability of form work and shoring shall be made available to OWNER'S Designated Representative upon request.
- D. Forms shall not be removed until the concrete can support its own weight and any superimposed load.

1.23 STEEL ERECTION:

- A. The erection of new structural steel and removal of structural steel from existing structures shall comply with OSHA regulations. CONTRACTOR shall also comply with OWNER'S safety regulations regarding welding, cutting and spark production when work encompasses any existing facility equipment or structures, including the posting of area(s) where it is necessary to do overhead work.
- B. During the placing of solid structural members, the load shall not be released from the hoisting line or lifting equipment until the members are secured with not less than two bolts (or the equivalent) at each connection and drawn up wrench tight.
 - 1. Taglines shall be used for controlling loads.
- C. CONTRACTOR shall provide and maintain all necessary temporary guying, bracing, falsework, cribbing or other elements required of steel frame to resist safely all wind or seismic forces and construction loads during erection.
- D. All partially erected structural steel shall be braced or secured in an approved manner during interruptions of work or at the end of the working day.
- E. Loads shall not be placed on structural supports until members are positively secured from movement or accidental displacement.

1.24 CONFINED SPACE ENTRY:

- A. Definition:
 - 1. A confined or enclosed space is defined as a special configuration that could result in any of the following:
 - a. Atmospheric condition - a condition in which a dangerous air contamination, oxygen deficiency <19.5 percent or oxygen enrichment >23.5 percent may exist or develop, except where state law requires otherwise.
 - b. Entry/Exit access - a condition where the emergency removal of a suddenly disabled person is difficult due to the location or size of the access opening.
 - c. Engulfment condition - a condition where the risk of engulfment exists or could develop.
 - 2. Entry into a confined space such as, but not limited to, tanks, silos, storage bins, hoppers, vaults, pits, diked areas, sewers, manholes or any other confined space with limited openings for entry or exit, unfavorable natural ventilation or not designed for continuous work occupancy.
 - 3. Confined or enclosed space entry means any action resulting in any part of the worker's face breaking the plane of any opening of the confined space, and includes any ensuing work activities inside the confined space.
- B. General:
 - 1. Entry into a confined space shall require a "Confined Space Entry Permit" issued by the facility designated person at the request of the OWNER'S Designated Representative before work begins. Refer to Article 1.4 for permit requirements. Refer also to Articles 1.13 and 1.14 for personal protective equipment requirements.
 - 2. CONTRACTOR shall provide proper barriers with appropriate warning signs and lighting for night-time visibility must be provided around uncovered manholes. Stacked up equipment or poorly braced rails are not adequate.

3. No underground space shall be entered until tested and found free of dangerous atmospheres, such as flammable or explosive mixtures, toxic/hazardous vapors or oxygen deficiency. Manholes shall be tested through a hole in their cover. If there is no hole, the cover should be raised only far enough to clear the test probe. Potentially hazardous mixtures are usually heavier than air, so additional testing at the bottom of the space should be done once the cover is raised.
 4. All water must be pumped out. Where seepage is unavoidable, a pump must be kept running rather than waiting for a build-up. Rubber footwear shall be worn in damp or wet locations.
 5. An adequate supply of oxygen (minimum 19.5 percent) shall be maintained using positive pressure. One person shall remain outside the confined space.
 6. A safety harness with retrieval line attached shall be worn by the person or persons working in the confined space. Provide and have in place equipment for retrieval.
 7. Access ladders shall be free of defects and shall not be made of metal.
 8. Access ladders must extend three feet above the top step-off surface.
- C. Electrical:
1. Refer to Article 1.7 for required safety precautions during any work activity in a confined space where energized electrical cable and grounding cable is present.

1.25 ENVIRONMENTAL REQUIREMENTS:

- A. Contractor Supplied Materials:
1. CONTRACTOR shall provide the OWNER'S Designated Representative with a MSDS for all hazardous and/or toxic material before they are brought on site. All hazardous and/or toxic material brought on site must be approved by OWNER'S facility management or an appointed alternate.
 2. All containers must be properly labeled and kept sealed when not in use.
 3. Chemicals that are environmentally safe and compatible are to be used whenever possible.
 4. Portable tanks (if capacity exceeds 110 gallons each) brought on site must have secondary containment.
- B. Ozone Depleting Chemicals:
1. The following ozone depleting chemicals shall not be used at 3M facilities, including use in cleaning equipment parts:
 - CFC-11
(CAS #75-69-4)
 - Fluorocarbon 11
 - Fluorotrichloromethane
 - Trichlorofluoromethane
 - Freon 11
 - Trichloromonfluoromethane
 - CFC-12
(CAS #75-71-8)
 - Dichlorodifluoromethane
 - F-12
 - FC-12
 - Fluorocarbon 12
 - Freon 12
 - CFC-113
(CAS #76-13-1)
 - FC-113
 - Freon 113
 - 1, 1, 2-Trichloro-1, 2, 2-tetrafluoroethane

1, 2, 2-Trichlorotrifluoroethane
CFC-114
(CAS #76-14-2)
1, 2-Dichloro-1, 1,2-tetrafluoroethane
FC-114
Freon 114
Sym-Dichlorotetrafluoroethane
CFC-115
(CAS #76-15-3)
Chloropentafluoroethane
Fluorocarbon 115
Freon 115
Carbon tetrachloride
(CAS #56-23-5)
Tetrachloromethane
Perchloromethane
Methyl Chloroform
(CAS #71-55-6)
1, 1, 1-Trichloroethane
Chloroethene

2. Refrigeration and air conditioning equipment containing CFCs may continue to be used until feasible substitutes exist. However, when such equipment is disposed of or replaced, the CFCs should be collected for reclamation or proper disposal.
 3. CONTRACTOR shall notify OWNER'S Designated Representative for packaging and disposal requirements.
 4. CONTRACTOR is responsible for ensuring employees handling CFCs are trained and certified.
- C. Permits and Notifications:
1. All required environmental permits and notifications must be in hand before installation, modification, or operation of equipment or process begins.
- D. Polychlorinated Biphenyls (PCBs):
1. Polychlorinated Biphenyls (PCBs) and PCB-containing equipment shall not be used at or installed in 3M facilities and equipment.
 2. All PCB light ballasts and capacitors removed from equipment at a 3M facility remain the property of 3M.
- E. Spills:
1. CONTRACTOR shall notify the OWNER'S Designated Representative for instructions on all waste management issues, including packaging and disposal.
 2. CONTRACTOR shall take steps necessary to minimize the risk of releases of any fuel, oils, solvents, paints and other liquids. This includes releases to the ground, surface waters, sewers and/or atmosphere.
 3. CONTRACTOR must report spills immediately to the OWNER'S Designated Representative or site security.
- F. Waste Management:
1. CONTRACTOR is responsible for ensuring their employees are trained and certified.
 2. CONTRACTOR shall maintain good housekeeping procedures.
 3. CONTRACTOR shall notify OWNER'S Designated Representative for instructions on all waste management issues including packaging and disposal. CONTRACTOR shall comply with applicable federal, state and local regulatory requirements, laws and ordinances.
 4. Waste may not be discharged to the sewer without prior approval from OWNER.
 5. No materials used on site may be left on site without prior approval from OWNER.

6. Refer to the "3M Compactor/Dumpster Procedure" in Part 4 for additional waste management requirements.
- G. Asbestos:
1. Asbestos-containing material (ACM) will not be installed in any 3M facility or equipment.
 2. Only CONTRACTORS trained and licensed in asbestos removal techniques may remove or otherwise disturb ACM.
 3. CONTRACTOR must contact the OWNER'S Designated Representative prior to beginning work in an area to identify the presence or absence of ACM. No work may be conducted that may potentially disturb ACM. If work in an area has already begun, the CONTRACTOR is to stop work and contact the OWNER'S Designated Representative to verify any question as to the presence of asbestos in any material to be disturbed.
- H. Lead:
1. CONTRACTOR must contact the OWNER'S Designated Representative prior to beginning work in an area to identify the presence or absence of lead in painted, coated or other suspected materials that may be disturbed during the course of work.
 2. CONTRACTOR must comply with the federal, state and local regulations related to construction activities involving lead-containing materials.
- 2.0 PART 2 - NOT APPLICABLE
- 3.0 PART 3 - NOT APPLICABLE
- 4.0 PART 4 - RELATED DOCUMENTS
- 4.1 ATTACHMENTS:
- A. Refer to Appendices (Table of Contents) for sample copies and are hereby incorporated and made part of this Section:
- 3M Daily Work Permit (Form 38194)
 - Open-Flame and Spark Hazard Permit (Form 4345)
 - Confined Space Entry Permit (Form 5669)
 - 3M Compactor/Dumpster Procedure
 - Contractor Representative Safety Walk-Through Checklist (Form 37832)

SECTION 01912

CUTTING AND PATCHING

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 – GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement shall apply to the Work specified in all Contract Documents.

- 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.

- A. CONTRACTOR shall be responsible for all cutting and patching required by their work and that of their subcontractors. This Section forms a part of all other sections of the Contract Documents and shall be coordinated with such additional cutting and patching of new or existing work as may be specified in other sections.

1.1 CUTTING AND PATCHING:

- A. CONTRACTOR shall keep cutting to the minimum necessary for proper installation of the work. Perform cutting by methods least likely to adversely affect adjacent materials. Use sawing and grinding tools rather than hammering and chopping tools. Core drilling shall be used where practical.
- B. To avoid unnecessary cutting of the building structure, all inserts and conduit or cable sleeves required in the general construction for completion of the Work, specified herein, shall be furnished and installed by CONTRACTOR in time to avoid delay in the general construction. Should any cutting of the building structure be required to provide sleeves, and other openings, CONTRACTOR shall perform all the necessary cutting and patching. Patching shall be done by the proper skilled tradesman.
- C. Under no circumstance shall any cutting or burning of a structural part of the building be undertaken without a permit from the OWNER'S Designated Representative.
- D. See Section 16110 Article 3.1 of this Specification for requirements of raceway sleeves, curbs, and/or fire barrier materials.
- E. CONTRACTOR shall employ the roofing contractor designated by the OWNER to cut required openings through existing roofing and do any necessary patching of it. Proper flashing and sealing per OWNER'S standards is required. Contractor shall be responsible for damage caused by their workers that can result in voiding any existing warrantee or guarantee of the roofing system.
- F. CONTRACTOR shall patch base and substrate materials with materials of identical qualities and with joints that are durable and as inconspicuous as possible. Restore exposed finishes and surface decoration of patched areas. Where necessary, extend finish restoration onto adjoining retained work in a manner that will essentially eliminate any evidence of patching.
 - 1. Whenever possible, employ the original installer to do the patching. Where the original installer is not available, employ workers highly skilled in the trade involved.

2.0 PARTS 2 THROUGH 4- NOT APPLICABLE

SECTION 16010

GENERAL PROVISIONS – ELECTRICAL

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. CONTRACTOR shall comply with the individual requirements in this Section wherever pertinent to the Work shown on Drawings or specified in the individual product/execution Sections of these Specifications.
- C. Hypot Testing:
 - 1. Hypot testing shall be provided by the CONTRACTOR. Equipment along with personnel specifically trained, qualified and experienced in working with this equipment shall be provided. The OWNER'S Designated Representative must be in attendance to observe the Work being done.
- D. Special Job Conditions:
 - 1. 3M Company considers work on energized circuits to be hazardous and requires safe work procedures meeting the requirements of NFPA 70E whenever there is justification to work energized.

1.2 STANDARDS:

- A. The following industry standards (latest edition) shall be considered as minimum requirements:
 - 1. Rules and regulations of the National Fire Protection Association (NFPA).
 - 2. National Electrical Code (NEC).
 - 3. National Electrical Manufacturer's Association (NEMA) Standards.
 - 4. The Insulated Power Cable Engineers Association.
 - 5. National Electrical Safety Code (NESC).
 - 6. Product Directories and Supplements of an independent nationally recognized testing laboratory (NRTL), such as Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), Intertek Testing Services (ISTNA) See <http://www.osha.gov/dts/otpc/nrtl/> for a complete list.
 - 7. Rules and regulations of the local jurisdictional authority and local power company.
 - 8. Consumer Electronics Association Rules and regulations of the U.S. Department of Labor - Occupational Safety and Health Administration (OSHA).

1.3 TESTING:

- A. CONTRACTOR shall test the entire electrical installation and retest any part thereof when and as requested by OWNER'S Designated Representative. CONTRACTOR is responsible for the testing of both OWNER furnished and CONTRACTOR furnished systems and equipment. CONTRACTOR shall correct all defects of the Work (refer to Article 23 of the Contract) to the satisfaction of OWNER'S Designated Representative. All testing equipment, unless otherwise

specified, shall be provided by CONTRACTOR. Test data shall be submitted to the OWNER'S Designated Representative.

- B. Testing shall specifically include but not be limited to:
1. The verification of proper operation of all lighting systems.
 2. The checking of proper phase rotation for all 3-phase AC motors and panelboards per Site.
 3. The verification throughout all electrical systems for proper voltage and adjusting transformer taps if necessary.
 4. The impedance of all grounding electrodes and the ground system as an entity. Refer to Section 16455.
 5. The functional operation of bells, buzzers, clocks, annunciators and remote security locks.
 6. Primary/secondary circuit breakers, ground fault devices.
 7. The load testing of all aspects of any engine generator(s), when requested by OWNER.
 8. Paging and music systems.
 9. D.C. high potential testing of all medium voltage shielded cables. Refer to Section 16120 for test procedures.
 10. "MEGGER" resistance testing of transformers, motors and non-shielded cable. MEGGER tests for transformers and motors shall be per the manufacturer's recommendations. Refer to Section 16120 for test procedures for non-shielded cable.
 11. The operational integrity of all control wiring and/or cabling, installed by the CONTRACTOR for building services, process control and any specialty wiring systems.
 12. Ethernet wiring installed and certified per 3M IT Specifications by qualified contractor. Ethernet wiring to be installed and tested per Section 16740 of this specification.

1.4 HAZARDOUS LOCATIONS:

- A. All equipment, materials, fittings, electric fixtures and wiring installed in areas identified on Drawings or specified herein as hazardous, shall be furnished and installed in accordance with Chapter 5 of the National Electrical Code.
- B. All materials and equipment which are fabricated with approved UL seals will not require further sealing when installed, unless seals are broken or damaged.
- C. Explosion proof unions shall be installed between field devices, enclosures and the conduit seal fittings.
- D. Seals poured in the field by CONTRACTOR shall be installed in accordance with prevailing code, regulation, or ordinance and shall be permanently identified (tag, color, etc.) in a manner acceptable to OWNER indicating which seals have been poured.
- E. Conduit seals are not required for intrinsically safe circuits in hazardous areas except where the conduits enter a purged enclosure or leave the hazardous area.

1.5 OWNER FURNISHED EQUIPMENT AND/OR OWNER'S EXISTING EQUIPMENT:

- A. CONTRACTOR shall be responsible for receiving, storing, moving, assembling, cleaning and installing unit substations, control panels, motor control center, engine generators, low voltage and/or medium voltage switchgear, power panels and similar items furnished by OWNER, or existing equipment that is to be relocated.
- B. All bus, cable or wire terminations or connections on all OWNER furnished equipment, relocated equipment or CONTRACTOR furnished equipment shall be checked by the CONTRACTOR and tightened if required.

1.6 DEMOLITION/REMOVAL HOURS

- A. Hours specified for demolition or removal do not include the disposal of removed materials. Disposal of materials is covered elsewhere in these Specifications or in the Contract.

2.0 PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All electrical equipment and materials provided shall be labeled or listed by a nationally recognized testing laboratory. Any exceptions, excluding motors, must be approved by the OWNER in writing.
- B. All CONTRACTOR furnished equipment, including its component parts, shall be the current standard products of the manufacturer in order to insure prompt and continuing service and replacement of parts.

3.0 PART 3 - EXECUTION - NOT APPLICABLE

4.0 PART 4 - RELATED DOCUMENTS

SECTION 16015

ELECTRICAL IDENTIFICATION

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install electrical identifications as shown on Drawings and/or herein specified.

2.0 PART 2 - PRODUCTS

2.1 NAME PLATES:

- A. Nameplates shall be rigid laminated, three layers, black with white core (red with white core for electrical loads connected as emergency, legally-required stand-by, or optional stand-by), unless noted otherwise, engraving grade phenolic plastic, or OWNER approved equal. Type "A" nameplates shall be used on drive starters, motors, etc., type "B" nameplates shall be used on all field devices. Types "C" and "D" shall be used for all motor control centers and panelboards.
 - 1. Type "A" shall have 3/16-inch lettering on a 3/4 x 2-1/2 inch nameplate.
 - 2. Type "B" shall have 3/16-inch lettering on a 3/8 x 1-1/4 inch nameplate.
 - 3. Type "C" shall be a 3/4-inch x 3-1/2 inch nameplate. The first line shall be the panelboard/motor control center number with 1/4 inch lettering, and the second line shall be "Fed from XXXXXX" with 3/16 inch lettering.
 - 4. Type "D" shall have 5/32 inch lettering " * Amps minimum breaker/compartment interrupting rating MO/YR" on a 3/8 x 3-1/2 inch nameplate. *Use correct ampere ratings from panelboard schedule.
- B. Nameplates shall attach with double back pressure sensitive tape.

3.0 PART 3 – EXECUTION

3.1 NAME PLATES

- A. CONTRACTOR shall provide and install coded nameplates on all motor control centers, panels, motors and devices described in the Work. Codes shall be as listed on the equipment and material procurement list under panel/device code, on "Motor and Equipment Data" sheet under motor number, or on panelboard schedules under panel number. All addenda, FCR's and Riders shall include nameplates for field devices, motors, motor control centers and/or panels added on same labels.
- B. CONTRACTOR shall install nameplates furnished by Others on existing Control Panels as indicated in the Contract Documents.

3.2 LABELS

- A. CONTRACTOR shall provide and install circuit identification numbers for all receptacles, plug mold outlets, hood power, etc. Method of marking shall be via pressure sensitive plastic tape labeling machine.
- B. CONTRACTOR shall install all intrinsically safe labels furnished by OWNER. Refer to Section 16941.
- C. CONTRACTOR shall install all Arc Flash labels furnished by OWNER.

4.0 PART 4 - NOT APPLICABLE

SECTION 16110

RACEWAYS AND SUPPORTS

3M ELECTRICAL STANDARD SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install raceways and supports for such electrical systems as lighting, power, closed circuit television, sound, security, fire alarm and telephone as shown on Drawings and herein specified.
- C. Related Work Specified Elsewhere:
 - 1. Wires, Cables and Buses: Section 16120
 - 2. Switches, Receptacles and Boxes: Section 16140
 - 3. Modular Distribution System: Section 16144
 - 4. Underground Raceways, Direct Burial Cables, Manholes, Trenching, Backfilling and Compacting: Section 16450

1.2 SUBMITTALS:

- A. Shop Drawings:
 - 1. Prepare and submit shop drawings for OWNER'S approval for all cable tray Work.
- B. Material List:
 - 1. Submit list of products to be provided, including manufacturer and catalog number.
 - 2. Submit separate list of each product, which CONTRACTOR proposes to substitute for the specified items, including manufacturer, catalog number and catalog cut for each item, for consideration by OWNER.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. All materials shall be transported, stored and handled in a manner that will avoid damage or deformation. Protect ends of conduit lengths during storage and handling to exclude dirt, moisture and foreign substances.

2.0 PART 2 - PRODUCTS

2.1 CONDUIT:

- A. All conduit that is intended for use as raceways for wire and cables in accordance with the National Electric Code (NEC) and shall be of size and number as indicated on Drawings. All conduit, unless otherwise indicated, shall be UL labeled and shall consist of the following:
 - 1. Rigid steel conduit shall be hot dipped galvanized, heavy-wall.
 - 2. Rigid steel conduit intermediate grade (IMC), hot dipped galvanized.
 - 3. Electrical metallic tubing (EMT).

4. Flexible steel conduit shall be galvanized.
 5. Liquidtight flexible metal conduit.
 6. Rigid nonmetallic electrical conduit (Schedule 40 and Schedule 80).
 7. Flexible metallic couplings for classified shall be used for difficult bends, or to allow movement or vibration of connected equipment.
 8. PVC coated conduit.
- B. Conduit for underground or exterior applications is specified elsewhere and is not a part of Work of this Section.
- C. Aluminum conduit shall not be used without approval from the OWNER.
- D. Electrical nonmetallic tubing (ENT) shall not be used without approval from the OWNER.

2.2 CONDUIT FITTINGS AND BOXES:

- A. The following conduit fittings and boxes shall be of sufficient size and proper type to accommodate wires, connections, fixtures and devices, all in accordance with the NEC and Drawings:
1. Fittings:
 - a. Fittings for rigid metallic conduit, or intermediate metal conduit (IMC) shall be threaded hub type, complete with full gasketed (where required) covers.
 - b. Fittings for EMT conduit shall be steel compression type or steel set-screw type on conduits less than 2-1/2 inches and steel set-screw type fittings on conduits 2-1/2 inches and larger.
 - 1) Die cast type fittings are not acceptable.
 - 2) Aluminum fittings or conduit bodies shall not be used without approval from the OWNER.
 - c. Split type (concrete-tight) couplings shall be used in general purpose areas, and Crouse-Hinds type UNY or UNF in classified areas where conduits are grouped together and cannot be rotated.
 - d. A kwik-couple coupling is approved for use with rigid or IMC conduits sizes 2-1/2 inches through 4 inches.
 - e. PVC fittings shall be of the same schedule, 40 or 80, as the PVC conduit being used. Fittings shall be intended to be joined together in the field by means of an approved solvent cement system.
 2. Boxes:
 - a. Use 2-1/2 inches or deeper boxes with conduit 1 inch and larger.
 - b. Aluminum boxes shall not be used without approval from OWNER.
 - c. Nonmetallic enclosures shall be UL Listed for the application.
 3. Concealed Box Outlets:
 - a. Box outlets for concealed conduit systems shall be standard 4 inch square, one piece drawn galvanized steel type, complete with plaster or tile rings as required to fit adjoining construction.
 4. Expansion Joints:
 - a. Conduit expansion joints shall be complete with ground jumper
 5. Outdoor Conduit Terminations:
 - a. Where conduits enter or leave a pull box, junction box, or any electrical equipment, a "Myers" hub, or approved equal fitting, shall be used.
 6. Conduit Seals:
 - a. Wherever conduits penetrate exterior concrete walls below grade, , conduit seals shall be provided.
 7. Purged Panels:
 - a. Where conduits enter or leave a purged panel or any electrical equipment, a "Myers" hub, or approved equal fitting, shall be used.

- b. A sealoff fitting must be installed in each conduit leaving a purged panel or any electrical equipment to prevent loss of pressure.
- 8. PVC to Metallic Conduit Adapter:
 - a. A PVC Schedule 40 or 80 female adapter shall be used when joining PVC to a metallic conduit system.
- 9. Hazardous Area Conduit Seals:
 - a. Use expanded body conduit seals or one size larger than the conduit to meet NEC wire fill requirements.
- 10. For all indoor applications that require a NEMA 12 or equal box or raceway, a "Myers" hub or equivalent shall be used.

2.3 LIGHTING OUTLETS AND HANGERS:

- A. The following lighting outlets and hangers shall be of sufficient size and type to properly accommodate all raceway components, all in accordance with the NEC and Drawings:
 - 1. Lighting Outlets:
 - a. Lighting outlet for exposed conduit systems, including supporting outlet boxes for box and pendant mounted fixtures shall be threaded hub cast steel type, complete with threaded fittings with mounting rated to support minimum 200 pounds.
 - 1) Use threaded EMT connectors where raceways between outlets or boxes are EMT.
 - b. Lighting outlets on exposed rigid conduit systems supporting chain-suspended fluorescent fixtures shall be threaded hub cast steel type, complete with threaded fittings.
 - 1) Each outlet shall be equipped with 15A, 120 VAC or 277 VAC, grounding-type twistlock receptacles. Refer to Section 16140 of this Specification for receptacle type.

2.4 SUPPORTS AND ACCESSORIES:

- A. Concrete Inserts:
 - 1. Inserts shall be galvanized malleable iron type complete with nuts sized to accommodate hanger rods
- B. Rods:
 - 1. Rods shall be minimum 3/8-inch diameter, galvanized or cadmium plated steel with threaded ends and of proper length without splices.
- C. Trapeze Hangers:
 - 1. Trapeze hangers shall be prime coated steel;
- D. Miscellaneous:
 - 1. Pipe straps, bolts, nuts, washers, screws and similar items shall be of galvanized steel.
- E. PVC Supports:
 - 1. Supports or saddles for underground duct banks shall be interlocking plastic duct spacers size and configuration to match the underground duct bank. Refer to Section 16450 of this Specification.
 - 2. PVC straps, clamps or other supporting means shall be used when PVC is run exposed.

2.5 CABLE TRAYS:

- A. Cable trays shall be trough, ladder or channel type, consisting of galvanized (hot-dipped) steel or aluminum construction, complete with coupling accessories, elbows, tees, crosses, branch and reducer sections, cable drop-out accessories, covers, drip guards, barriers, cable clamps, hangers,

anti-sway braces and all other appurtenances for a complete installation. All cable trays and their components shall be by one manufacturer

1. Furnish in lengths and widths as indicated.
2. Furnish rung spacing of 6, 9, 12, or 18 inches.

B. Do not install cable trays below steam or water pipes.

2.6 WIREWAYS:

A. All wireway that is intended for use as raceways for wire and cable in accordance with the NEC shall be the size and type as indicated on Drawings. All wireways shall be UL listed and meet NEMA standards.

1. NEMA 1 wireway shall be 2-1/2 inches x 2-1/2 inches; 4 inches x 4 inches; 6 inches x 6 inches; 8 inches x 8 inches; 10 inches x 10 inches or 12 inches x 12 inches with or without knockouts. Covers shall be the hinge type with screw or snap fasteners. Wireway covers and bodies shall be fabricated from 16 gage (2-1/2 inches x 2-1/2 inches, 4 inches x 4 inches and 6 inches x 6 inch sizes) and 14 gage (8 inches x 8 inches, 10 inches x 10 inches and 12 inches x 12 inches sizes) steel. Dividers shall be used to separate shield wires from all other wiring or as noted on Drawings.
2. JIC wireway shall be 2-1/2 inches x 2-1/2 inches; 4 inches x 4 inches; 6 inches x 6 inches; 8 inches x 8 inches; 10 inches x 10 inches or 12 inches x 12 inches and shall have no knockouts. All seams shall be continuously welded. Each cover shall have a neoprene gasket cemented in place with oil resistant adhesive. Cover shall be hinged with screw clamp fasteners. Wireways shall be designed to protect wire and cable from dust, dirt, oil and water. Dividers shall be used to separate shielded wires from all other wiring or as noted on Drawings. Hubbed conduit fittings shall be used where conduits enter or exit the wireway.

B. Do not install wireways below steam or water lines.

2.7 SURFACE METAL AND NONMETALLIC RACEWAY (PLUGMOLD):

A. All surface metal and nonmetallic raceway that is intended for use as raceways for wire and cables in accordance with NEC shall be of the size and number as indicated on Drawings. All surface metal raceway shall be UL labeled and used for interior use in dry locations only.

B. Plugmold shall be used only where noted on Drawings or with written permission from the OWNER.

3.0 PART 3 – EXECUTION

3.1 RACEWAY INSTALLATION:

A. General:

1. Provide raceways and supports as indicated on Drawings or as required for each space and condition by NEC with all components installed in accordance with manufacturer's recommendations and the NEC.
2. Do not install any raceways or electrical items on any "pressure relief" walls. If devices or raceways are to be located in this area, they must be free standing or self-supporting.
3. Do not fasten raceways, wireway or electrical equipment onto the bottom side of a "metal deck" roof. If it is imperative that equipment be fastened to the deck, written permission must first be obtained from the OWNER. All fasteners for metal deck roofs shall then be installed in accordance with 3M Standard Electrical Drawing No. 16110-3. Refer to Part 4 of this Section.

4. Raceways shall not be installed in front of motors, controllers, access panels, etc., so that equipment cannot be serviced or replaced.
 5. A bonding jumper must be used around any "oversize concentric or eccentric knockouts" in enclosures for circuits over 250V to ground run in metal raceway or metal cable.
- B. CONTRACTOR shall furnish and set sleeves/curbs for conduits and/or raceways passing through floors, walls, and roof. The CONTRACTOR using tradesmen skilled in the type of Work as stated above shall do any required patching.
1. Sleeves shall be fabricated from steel pipe, which shall be at least one nominal pipe size larger than the enclosed conduit.
 - a. Floor sleeves shall be 2 inches above finished floor line.
 - b. Roof sleeves shall be 12 inches above the roof deck.
 2. Where conduits or raceways pass through metal floors or decks, CONTRACTOR shall furnish and install a metal curb 4 inches high to prevent materials from leaking from floor to floor. Securely fasten and seal curb to floor.
- C. Where conduits or other electrical facilities pass through fire walls and floors, the open space between the conduit or other electrical facility will be closed off by using the appropriate 3M Brand "Fire Barrier" material.

3.2 CONDUIT INSTALLATION:

- A. General:
1. Conduit 1/2 inch in diameter shall be the smallest size used, except on prewired equipment, 3/8 inch flexible conduit may be used where approved by local authority. Run concealed conduits in a direct line with long sweep bends and offsets.
 - a. Run concealed conduits in a direct line with long sweep bends and offsets.
 - b. Run exposed conduits parallel to and at right angles to the building lines.
 - c. Conduit expansion joints shall be installed at building expansion joints and when noted on Drawings.
 - d. Install conduit to avoid steam or water pipes. A minimum separation of 3 inches shall be maintained where conduits are run parallel to or across water pipes, and a minimum separation of 6 inches shall be maintained where steam lines and conduits run parallel or cross.
 - e. Where conduits are installed in reinforced concrete floors or columns, 3/4 inches shall be the maximum size, unless otherwise specified.
 - f. Install conduits or raceways a minimum of 12 inches from smoke detectors; sprinkler heads or CO2 discharge heads.
 2. Where field conditions require that conduits indicated as concealed on Drawings be run exposed, or conduits indicated as exposed be run concealed, obtain approval of OWNER before installation.
 3. Where conduits are run above a suspended ceiling and dedicated support wires are to be used, the following shall be met:
 - a. Dedicated support wires shall be identified per local site requirements, commonly support wires will be painted red.
 - b. Only conduits 3/4 inch or smaller may be supported using approved conduit clips.
 - c. Supported conduits shall serve only branch circuits to loads mounted on/in the suspended ceiling, or communication circuits terminating within the ceiling space.
 - d. Supported conduits shall be limited to following raceway types: electrical metallic tubing, armored cable, metal clad cable, or flexible metal conduit.
 4. Electrical metallic tubing (EMT) may be used with written permission at indoors where permitted by code for the following systems:

- a. Sound Systems
 - b. Paging Systems
 - c. Fire Alarm Systems
 - d. Telephone Systems
 - e. TV and Intercom Systems
 - f. HVAC system control wiring where not subject to physical damage or in a wet location.
 - g. Lighting and Power Branch Circuits:
 - 1) Horizontal or vertical conduit over 10 feet above finished floor.
 - 2) Where conduit is concealed in the wall partitions or above suspended ceilings (regardless of height).
 - 3) In laboratories and offices where not subject to physical damage.
 - 5. EMT shall NOT be used in any of the following applications or areas:
 - a. Stems used on pendant mounted fixtures;
 - b. Systems over 600 volts;
 - c. Feeders for panels, transformers feeding panelboards, motor control centers or major electrical equipment (major electrical equipment is defined as anything requiring a 125 amp circuit or larger);
 - d. Motor connections (flexible conduit is required, refer to Section 16900 of this Specification);
 - e. Hazardous areas;
 - f. Buried in earth or embedded in concrete;
 - g. Process wiring, defined as those conduits mounted on any machine proper or connecting the machine to an overhead pullbox, nearby control panel or underfloor raceway system.
 - h. Potentially wet areas, defined as:
 - 1) Manholes and handholes
 - 2) Outdoors
 - 3) Boiler house
 - 4) Pump house (fire and fuel)
 - 5) Coolers
 - 6) Pump rooms (all)
 - 7) Truck and Railroad docks
 - 6. Aluminum conduit shall be used only where shown on Drawings or noted in the Contract Documents. Aluminum conduit shall not be embedded or placed in contact with concrete.
 - 7. Conduit embedded in concrete or installed underground shall be rigid steel type, except as noted in Section 16450 of this Specification.
 - 8. Use flexible metal conduit only where flexibility is required.
 - a. Where flexible connections are needed on an exposed raceway installation, use type U.A., liquidtight flexible metal conduit, except in Class I Division 1 areas.
 - b. Liquidtight flexible metal conduit shall be used for motor connections, process devices and connection to distribution transformers. This applies to general purpose areas only.
 - 9. Rigid nonmetallic conduit shall be used only where shown on the Drawing or as written in the "Scope of Work" and as per the NEC.
 - a. Schedule 40 in 10 foot or 20 foot lengths shall be used in underground duct banks.
 - b. Schedule 80 in 10 foot and 20 foot lengths shall be used in direct burial applications.
 - c. Schedule 80 in 10 foot lengths shall be used where rigid nonmetallic is specified to be used exposed, such as in buildings, pipe racks, etc.
- B. Installation Procedures:

1. Threaded conduits terminating at metal pullboxes, outlet boxes and cabinets with a NEMA listing greater than NEMA 1 will be terminated by using a threaded hub. NEMA 1 listed equipment will be allowed to terminate with double locknuts and insulated bushings. Conduits 2 inches or larger shall be equipped with insulated metal bushings.
 2. Conduit shall be continuous from outlet to outlet, from outlets to cabinets, pull or junction boxes and shall be secured to all boxes in such manner that each system shall be electrically continuous throughout. Open conduit ends shall have a bushing unless other terminations are shown or specified. Electrical metallic tubing box connections shall provide electrical continuity.
 3. Cut conduit ends square. Thread rigid conduit and ream to remove burrs and sharp edges. Field threads shall be of the same type and have the same effective length as factory cut threads.
 4. Make conduit joints with approved couplings and unions. Make offsets and change in direction with a hickey or power bender, standard elbows, conduit fittings, or pullboxes. Conduit runs shall be straight and true. Elbows, offsets and bends shall be uniform and symmetrical.
 5. Breather and drain fittings shall be installed in conduit system at locations where condensation may collect on devices, equipment and apparatus located in unheated spaces or outdoor.
 - a. Breather and drain fittings shall be installed at devices tapping into hazardous process lines, to prevent process fluid from entering the electrical conduit system.
 6. When rigid nonmetallic conduit is specified for use, all fittings and supports shall also be rigid nonmetallic or made of a non-corrosive material.
 7. A ground wire is required in all rigid nonmetallic conduit, unless otherwise specified.
- C. Conduit Identification:
1. Conduits, pullboxes and other raceways for circuits in excess of 600 volts, whether direct bury, above grade, or indoors, shall be color-coded using bright red paint or other means approved by OWNER. Paint shall be compatible with the environment surrounding the raceway, i.e., suitable for below grade, corrosive solvents, etc. Conduits and pull boxes located above grade or indoors shall also be stenciled HIGH VOLTAGE. Stenciling shall be white with a letter height approximately 25 percent of the circumference of the conduit to be marked, prominent and readable from the logical point of conduit access. Spacing between stencils shall not exceed 50 feet unless otherwise determined by OWNER'S Designated Representative. Exception: Where conduits traverse walls, partitions and barriers, the conduit shall be stenciled in each room or enclosed area containing conduit fittings or pullboxes.
- D. Removal Procedures:
1. All conduit that is to be abandoned shall be removed back to the point of origin, unless otherwise noted on Drawings. Disposal shall be by CONTRACTOR. Conduits abandoned in place for future use shall be marked on both ends as to the expected use and location of the opposite end.
- 3.3 OUTLET INSTALLATION:
- A. Installation Procedures:
1. Outlet boxes shall be securely fastened to ceilings, walls and columns. Boxes installed in finished ceilings, walls or columns, shall be set so that the front edge of the box is flush with the finished ceiling wall or column.
 2. Adjust mounting height in concrete masonry to avoid joints.
- B. Mounting Heights:
1. Install switch outlets 48 inches above the floor.

2. Unless otherwise noted on Drawings or specified herein, install receptacle outlets 48 inches above the floor in all locations except office spaces and lunchrooms, where they shall be installed 15 inches above the floor. Where practical, mount receptacles on exposed steel columns within column webs.
3. Set clock outlets, which are located over doors, so that when the clock is installed it will center between top of door trim and the ceiling. Where installed at other locations, clock outlets shall be set 96 inches above the floor, unless otherwise noted on Drawings.
4. Sound system volume controls shall be mounted 60 inches above floor and vertically aligned with switch outlets unless noted otherwise on Drawings.
5. Install telephone outlets 15 inches above finish floor, unless noted otherwise on Drawings.
6. Install signal system outlets as shown on Drawings and as more precisely directed in field by OWNER'S Designated Representative.
7. Install special purpose outlets at heights indicated on Drawings.

3.4 SUPPORT INSTALLATION:

A. General:

1. CONTRACTOR shall select and design supports to support the combined weight of conduit, hangers and conductors. The use of perforated steel straps for supporting conduits will not be permitted.
2. Adjustable hangers may be used to suspend 1-1/2 inch or larger conduits when separately located.
3. Where a number of conduits are to be run exposed and parallel, one with another, group them and support by trapeze hangers securely fastened to the building structure, unless otherwise approved by OWNER.
4. If adjustable trapeze hangers are used to support groups of parallel conduits, install sturdy clamps on each trapeze hanger to fasten each conduit.
5. Conduits larger than 3/4 inch may not be supported from any mechanical piping or sheet metal ducts without prior approval of the OWNER.

B. Installation Procedures:

1. Where conduits are run individually, support them by sturdy pipe straps, secured by means of toggle bolts on hollow masonry, by expansion shields and machine screws or standard preset inserts on concrete or solid masonry, and by machine screws or bolts on metal surfaces and wood construction. The use of perforated strap will not be permitted.
2. Conduits installed exposed on the surface in damp locations or in refrigerated areas shall be provided with clamp backs or other OWNER approved spacer under each conduit clamp to prevent accumulation of moisture around the conduits. Install insulating barriers in raceways between refrigerated and normal temperature areas, and where conduits go from indoors to outdoors. Barriers to be within 12 inches of the wall.
3. Fasten hanger rods to structural steel members with suitable beam clamps or to concrete inserts set flush with surface. Install a reinforced rod through the opening provided in the concrete inserts.

3.5 CABLE TRAY INSTALLATION:

- A. Cable trays shall be installed in accordance with approved shop drawings and manufacturer's Specifications.
- B. Support cable trays from building structure, so as to leave adequate access space, secure in place and brace against sway.
- C. All conduit to tray connections shall be made with connectors approved for the purpose, ensuring continuity and integrity of the ground system

- D. Refer to Section 16120 of this Specification for cable types and splices allowed.

3.6 WIREWAY INSTALLATION:

- A. Wireway shall be installed in accordance with manufacturer's instructions and OWNER approved shop drawings, if required by OWNER.
- B. Wireways run horizontally shall be supported every 5 feet and vertical runs shall be supported at intervals not exceeding 15 feet with not more than one joint between supports. Support wireway from building structure, secure in place and brace against sway.

3.7 SURFACE METAL RACEWAY INSTALLATION:

- A. Installation Procedures:
 - 1. Surface metal raceways shall be securely fastened to walls or benches.
- B. Mounting Heights:
 - 1. Unless otherwise noted on Drawings or specified herein, install surface metal raceway 15 inches above finished floor for vending machines and 48 inches above finished floor in all other locations, except when mounted on benches.
 - 2. Adjust mounting height on concrete masonry wall only as much as necessary to avoid horizontal joints.

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENTS: NOT APPLICABLE

SECTION 16120

WIRES, CABLES AND BUSES

3M ELECTRICAL STANDARD SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install wires, cables, and buses for all electrical systems as shown on Drawings and herein specified.
- C. Related Work Specified Elsewhere:
 - 1. Intrinsic Safety: Section 16941

1.2 SUBMITTALS:

- A. Material List:
 - 1. Submit list of products to be furnished, including manufacturer and catalog number.
 - 2. Submit separate list of each product, which CONTRACTOR proposes to substitute for the specified items, including manufacturer, catalog number and catalog cut for each item, for consideration by OWNER.
- B. Test Report:
 - 1. Prepare and submit primary cable testing report, as required
 - 2. Prepare and submit low voltage cable testing report, as required.

2.0 PART 2 - PRODUCTS

2.1 WIRES AND CABLES:

- A. Conductors:
 - 1. Copper conductors shall be of 98 percent minimum conductivity.
 - a. Do not use aluminum type conductors in place of copper conductors unless approval is obtained in writing from OWNER.
 - 2. Aluminum conductors shall be used only where shown or approved by OWNER and shall consist of the following:
 - a. Conductors shall be of an aluminum alloy listed or labeled by UL as a component wire stock.
 - b. Conductors shall only be permitted in sizes #4/0 AWG and larger.
 - c. Conductors shall be sized to provide the same or higher capacity as the copper conductors specified.
 - d. All raceways shall be resized to accommodate conductors accordingly.
- B. Wire and Cable (Non-Shielded):
 - 1. General:

- a. Wire and cable shall be of grade required by the National Electrical Code (NEC) for each use.
2. Minimum wire size shall consist of:
 - a. Wire size shall be of #12 AWG, except that #14 AWG may be used within lighting fixtures and for control and signal circuits.
 - b. Where indicated on Drawings, single conductor, multi-conductor or pre-bundled cables (such as Quick-Pull), #16 AWG minimum shall be permitted for control wiring. When such cables are run in the same raceway with 460V power wiring, the insulation rating shall be 600V.
3. Wiring types shall consist of:
 - a. Non-intrinsically safe control wiring shall be 600V minimum, 19 strand, THHN or THWN; neutral wire shall be white color only on 120V/208V systems and gray color on 277V/480V systems (no tags will be accepted).
 - b. Intrinsically safe (IS) non-shielded control wiring #16 minimum shall be the same as non-intrinsically safe, except it shall be light blue color. No other color shall be used without written permission from the OWNER.
 - c. Other wiring, #8 AWG and smaller shall be solid or 19 strand minimum THHN or THWN.
 - d. Other wiring larger than #8 AWG shall be 19 strand minimum THW, XHHW, THHN, or THWN.
4. Wiring to hot areas (Boiler Room, Drying Rooms, Kitchens, etc.) shall be rated for 90C service minimum.
5. Wiring to lighting fixtures shall be rated for 600VAC and 90C service minimum.
6. Wiring to chain-suspended fluorescent fixtures shall be via drop cord and receptacles.
7. Wiring installed in other areas (hot, cold, abrasive, corrosive, flexing, vibration-prone, wet, or reactive locations):
 - a. Wiring shall be of special sizes and types as shown on Drawings and as required by NEC.
8. Where portable cord is specified on Drawings, use hard service cord that is rated for damp and wet locations. These types shall be used on either general purpose or hazardous areas up to 600 volt.
9. All conductors to be abandoned shall be removed back to the point of origin, unless otherwise noted on Drawings.

2.2 WIRE CONNECTIONS AND SPLICES:

- A. Connections and splices:
 1. #18 AWG to #8 AWG, operating at 105 degrees C or less:
 - a. Electrical spring connectors shall be plated for corrosion protection. Use pre-insulated connectors and regular connectors with each combination of wires as recommended by manufacturer. Connectors shall be 3M Brand: "Scotchlok" Type Y, R, G or B; or "Performance +" O/B+, R/Y+, or B/G+; or 312, 412, 512, or 512G.
 2. #10 to #22 AWG, operating at 90 degrees C:
 - a. Electrical self-stripping tap and pigtail connectors shall be tin plated brass "U" element contact. Connectors shall be 3M Brand "Scotchlok" 557 to 567.
- B. Insulation Displacement Connectors:
 - a. 3M Brand "Insulation Displacement Connectors" 314U shall be used when performing lamp and ballast lighting retrofits.
- C. Underground Wire Splices:
 1. 600 Volt or less splices shall be 3M Brand "Scotchlok" Connector Sealing Packs, No. 3570, DBY-6 or DBR-6.

- D. Terminations and In-Line Splices:
 - 1. #26 AWG to #4 AWG splices shall be 3M Brand "Scotchlok" nylon insulated crimp terminals.
- E. Splices and Lugs (for Copper Wire):
 - 1. #6 AWG and larger shall be compression-type, solderless connectors or lugs, 3M Brand "Scotchlok" 10,000, 11,000, 30,000 or 31,000 Series.
- F. Electrical Insulating Putty:
 - 1. Putty shall be 3M Brand "Scotchfil".
- G. Insulating Tapes:
 - 1. PVC electrical tape shall be capable of operating to temperatures up to 105 degrees C. and shall be 3M "Scotch" Brand "Super 33 Plus" or "Super 88".
 - 2. Rubber tape shall be a linerless tape and shall be "Scotch" Brand 130C Linerless Rubber Tape.
 - 3. For operating temperatures higher than 105 degrees C., a glass cloth tape with a thermosetting adhesive, such as "Scotch" Brand Electrical Tape 27 or 69, shall be used.
- H. Splicing Kits for 600V Cable:
 - 1. Cold Shrink Insulators:
 - a. #2 AWG to 1000 KCMIL in-line connectors and terminal lugs on 600V cables shall be insulated with 3M Brand "PST" Connector Insulators, 8420 Series.
 - 2. Resin Kits:
 - a. In-line and wye splicing kits shall be 3M Brand "Scotchcast" 82, 82F and 90 Series.
 - b. Multimold splicing kits shall be used for irregular splice configurations, such as 3M Brand "Scotchcast" 85 Series.
 - 3. Heat Shrink:
 - a. #12 AWG to 1250 KCMIL in-line connectors on 600V cables shall be insulated with 3M Brand "ITCSN" thick wall heat shrink.
- I. Motor Lead Splicing:
 - 1. For motors less than 600 volt with motor circuit conductors of #10 AWG or smaller, a 3M Brand "Scotchlok" shall be used. For motors less than 600 volt with motor circuit conductors larger than #10 AWG a 3M Brand Series 5300 through 5314 Motor Lead Splice shall be used.
 - 2. For all motors 600V through 5000V, a 3M Brand Series 5316 through 5334 Motor Lead Splice shall be used.
- J. Signal and Control Cable Splicing:
 - 1. All splices on signal and control cable shall be made using the "Scotchcast" Brand Signal and Control Cable Splices 72-N Series or 78-R Series.
- K. Splices in Cable Trays:
 - 1. Splices for cables rated over 600 volts shall be 3M Brand 5500 Series kits.
 - 2. Splices for wires and cables rated 600 volts or less shall be 3M Brand "Scotchlok Nylon Insulated Crimp Terminals".
- L. Fireproofing:
 - 1. Where required on drawings, 5 KV and above cables in manholes, trenches, cable trays and common areas within equipment shall be arc and fireproofed with 1-1/2" minimum overlapped layer of 3M "Scotch" Brand 77 Fire and Electric Arcproofing Tape. Tape shall be installed per manufacturer's recommendations and fastened in place with 3M "Scotch" Brand 69 Glass Cloth Tape.

- M. High Voltage Wire Caps:
 - 1. To cap off the ends of high voltage cable, 3M Series ICEC-200 Series Heat Shrink Cable End Caps shall be used.
- N. Tying and Lacing Wires and Cables:
 - 1. Tying and lacing materials for field installed cables shall be non-releasable nylon cable ties with an "I" beam construction and reinforced sides to give strength and flexibility. Ties shall have rounded edges and bent-tip construction for easy handling and conformability. Weather-resistant, black nylon shall be used for outdoor or weather-exposed applications. 3M Brand Cable Ties shall be used.

2.3 ALUMINUM CONNECTORS (FOR ALUMINUM WIRE):

- A. Aluminum body in-line compression connector, tin-plated, with oxide film contact aid shall be 3M Brand "Scotchlok" 20000 Series.
- B. Aluminum body compression lug, tin-plated, with oxide film contact aid shall be 3M Brand "Scotchlok" 40000 Series.
- C. Not permitted:
 - 1. Connectors and lugs with set screws.
 - 2. Connectors and lugs made of copper or brass.

2.4 SHIELDED CABLE:

- A. Shielded cable for instrumentation devices shall consist of a tinned copper wire with aluminum and polyester shield around conductors, stranded tinned copper ground wire, PLTC or TC insulation.
 - 1. For non-intrinsically safe circuits use:
 - a. Two conductor shielded cable shall be No. 9318 by Belden (for 2/c, #18 AWG shielded) or OWNER approved equal.
 - b. Three conductor shielded cable shall be No. 9365 by Belden (for 3/c, #18 AWG shielded) or OWNER approved equal.
 - c. Four conductor shielded cable shall be No. 9552 by Belden (for 4/c, #18 AWG shielded) or OWNER approved equal.
 - 2. For intrinsically safe circuits use see Section 16941 of this Specification:
 - 3. All cables that are to be abandoned shall be removed back to the point of origin, unless otherwise noted on Drawings.
- B. Shielded cable for motors controlled by a variable frequency drive shall be 1000V insulation 4/C shielded cable, 3/C shielded cable with three individual ground conductors with all conductors being copper or tinned copper or as specified on the drawings and manufactured by Belden, Lutze, Americable, LAPP or 3M approved equal.

2.5 THERMOCOUPLE WIRE:

- A. Thermocouple wire shall be the type specified on the Drawings and listed in the "Material and Equipment Procurement List".

2.6 MEDIUM VOLTAGE CABLE:

- A. Power Cable (Conventional with Non-Metallic Sheath):
1. All cables shall be manufactured per AEIC CS8-00, ICEA S-93-639, or ICES S-97-682 specifications and the following paragraphs. A one year guarantee and certified test reports shall be provided for all cables.
 2. Medium voltage power cable shall be a single conductor shielded type 133 percent insulation level unless otherwise approved by OWNER.
 3. Conductors:
 - a. Individual copper wires shall be annealed copper. The completed conductors shall be a Class B or C compact stranded copper conductor conforming to ASTM B496.
 - b. Aluminum conductors shall be of an aluminum alloy listed or labeled by UL. The conductor shall be a Class B or C compact stranded conductor conforming to ASTM B400.
 4. Conductors shall have an extruded, compatible, semi-conducting compound applied directly over the stranded conductors.
 5. Conductors shall be insulated with a high quality non-aging, heat-, moisture-, ozone and corona-resistant high-dielectric strength EPR insulation compound. Insulation shall be suitable for use in wet or dry locations at a conductor design temperature of 90 degrees Celsius. Insulation shall be capable of passing a direct current high potential or megohmmeter field test as indicated under Article entitled "Medium Voltage Cable Testing" of this Section.
 6. All conductors, except motor lead wire, shall have an insulation shield consisting of a non-metallic layer of an extruded semi-conducting compound directly over the insulation and conforming to ICEA NEMA Standard S-93-639 or S-97-682. This layer shall be free-stripping, leaving no conducting particles or other residue on the surface of the insulation and shall be legibly identified as being semi-conducting. Over this semi-conducting layer shall be a shield of 0.0025 inch minimum thickness copper shielding tape. Other methods of attaining the insulation shield, such as copper drain wires and corrugated copper are equally acceptable insofar as they meet or exceed the requirements specified above. The applicable portions of this insulation shield Specification shall apply to URD direct burial cable as well.
 7. The outer jackets for conventional cable with a non-metallic sheath and motor lead wire shall be polyvinyl chloride or chlorinated polyethylene. The jacket for interlocked armor cable shall be as specified below. The jacket for URD direct burial cable shall be as specified for power cable above and rated for use in abusive environments.
 8. All cables that are to be abandoned shall be removed back to the point of origin, unless otherwise noted on Drawings.
- B. Metal Jacketed Cable (Interlocked Armor):
1. Medium voltage metal jacketed cable shall be a three conductor shielded cable KV rated as shown on Drawings with 133 percent insulation level. Conductors shall be interwound with a stranded copper ground wire(s) and the assembly bound together with tape, or other material of equal performance, beneath an outer metal jacket of galvanized steel, aluminum or bronze interlocked armor. Over the armor, there shall be an overall PVC jacket impervious to ultraviolet degradation. The outer jacket shall be yellow for 5KV and red or orange for 15KV.
- C. Motor Connection Cable. For 2.3KV and 4KV motors, use 5KV non-shielded cable unless noted otherwise on Drawings.
- D. All cables that are to be abandoned shall be removed back to the nearest control panel, panelboard or substation, unless otherwise noted on Drawings.

2.7 ARMORED CABLE, 600V CLASS:

- A. Interlocked armored cable shall consist of three or four conductor type, of sizes as shown on Drawings, rated 600V and 90C conductor temperature. Conductors shall be stranded bare copper with crosslinked polyethylene insulation. Conductor jacket shall bear positive phase identification, either numbered or color coded. Conductors and ground wires shall be wrapped overall with a non-metallic binder tape. Overall armor shall be single strip, positively locked galvanized steel or welded corrugated aluminum at least 0.025 inch thick.
- B. All cables that are to be abandoned shall be removed back to the point of origin, unless otherwise noted on Drawings.

2.8 BUS DUCTS:

- A. Bus ducts shall be of size and type as indicated on Drawings, fabricated from 98 percent conductivity copper, silver plated at all joints. The assembly, including enclosures, insulation and supports, shall be in modular units of rigid construction.
 - 1. Plug-In Openings:
 - a. Openings shall be 12 inches on centers on alternate sides, 10-openings per 10 foot standard section.
 - 2. Covers:
 - a. Provide covers for all openings without devices plugged in.
 - 3. Plug-In Devices:
 - a. Devices shall be circuit breaker type in quantities and ratings as shown on Drawings.

2.9 FIBER OPTIC CABLE:

- A. Fiber optic cable shall be of the type specified on the Drawings and listed in the "Material and Equipment Procurement List".

3.0 PART 3 - EXECUTION

3.1 ALUMINUM CONNECTORS:

- A. Where aluminum conductors are permitted, all aluminum conductors shall be terminated with an aluminum body compression lug. No set screw terminations on aluminum conductors are permitted.
- B. Wire brush aluminum conductors immediately before installing a lug or connector.
- C. Use only the manufacturer's recommended lug, compression tool and dies that match the conductor.
- D. Use a "Belleville" washer on all bolted connections.

3.2 WIRE CONNECTIONS, SPLICES AND TERMINATIONS:

- A. All wires or cables that are shown on Drawings for panels, field devices, motors, controllers, etc. shall be terminated by the CONTRACTOR unless specifically noted "Terminations to be done by others".
- B. All bolt-torque values for electrical connections shall follow manufactures specifications. If not specified by manufacture, CONTRACTOR shall follow NETA (InterNational Electrical Testing Association) Standards.

- C. Provide same color wire on both sides of in-line splices.
- D. Feeder connections, taps and splices on wires larger than #6 AWG with irregular-shaped connectors:
 - 1. First, build up with 3M "Scotchfil" electrical insulating putty to eliminate both sharp corners and voids. Use enough insulating putty until good, over-all padding is provided. Compress putty to fill all voids and generally smooth-up before applying electrical splice protection.
- E. Insulate indoor wire and cable splices by taping with 3M "Scotch" 33 Plus vinyl plastic electrical tape. Apply tape to the wire splices with the same tension that it has when it comes from the roll. The tape shall provide a uniform covering of at least 4 layers, half-lapped in two directions.
- F. Where connections are exposed to vibration, use at least 6 layers of 3M Brand "Scotch" 33 Plus vinyl plastic tape, half-lapped in 3 directions. Make-up all wire and cable splices neatly and carefully, exercising extreme skill to assure neat workmanship and proper insulation over the conductor joints. When requested, several splices shall be opened for the OWNER'S inspection.
- G. All 600V in-line direct buried splices or splices exposed to moisture shall be insulated using 3M Brand cold shrink connector insulators, in-line splicing kits, or Multimold splicing kits.
- H. For electrical splices requiring tape with resistance to solvents and oils, or temperatures between 80C and 105C, protect with 6 layers of half-lap in three directions, using 3M Brand "Scotch" 33 Plus.
- I. Use 3M Brand "Scotch" 27 or 69 electrical tape on splices involving heat-resistant or asbestos wires rated at or above 105 degrees C. Make splices with uninsulated 3M Brand "Scotchlok" connectors, protected by 6 layers, half-lapped in three directions. Apply tape at the joint with the same tension as it has when it comes from the roll. When requested, several splices shall be opened for the OWNER'S inspection.
- J. Terminations having lugs shall be used to connect motor leads and device leads to circuit wires, one lug on motor lead or device lead and one lug on circuit wires. Bolt the lugs together to complete the circuit. Use 3M Brand terminals and lugs only. Insulate and seal the motor leads using 3M Brand Motor Lead Kits 5300 Series.
- K. Terminal lugs shall be installed on wires that connect to terminal strips, as appropriate to installation, i.e. spade type, ring tongue. All lugs shall be 3M Brand "Scotchlok" Terminals only.
- L. All spare wires shall be terminated at terminal strips. If existing terminal strips have no spare terminals, the CONTRACTOR shall furnish terminal strips as required. Spare wires shall be tagged as to destination.
- M. All terminations using solderless terminals shall be double crimped (Electrical and Mechanical crimp) at the point of connection to the terminal.
- N. On installations of outdoor low voltage connections, spray 3M Brand 4-way spray #1605 or 5-way spray #4608 on all connections prior to closing junction boxes.
- O. Signal and control cable shall be installed without splices, except as provided herein. Splices in remote apparatus and in wiring between apparatus shall be allowed only where shown on the drawing and/or applicable wiring plan. Splices shall be made using "Scotchcast" Brand Signal and Control Splices 72-N Series or 78-R Series.

3.3 SHIELDED CABLE INSTALLATION (600 VOLTS AND BELOW):

- A. Shielded cables for instrumentation devices shall be installed in separate steel conduits and shall not occupy the same enclosure with 120V or higher unshielded conductors. Shielded conductors may be grouped together, except that intrinsically safe wires shall not be run with any non-intrinsically safe wiring.

- B. Where shielded cables for instrumentation devices enter a panel or enclosure, and where power wiring exists, provision shall be made to provide physical isolation of signal and power conductors. Install sleeve on shield grounds in panels. Conduit connections shall be made to assure minimum interaction between power and signal circuits.
- C. For shielded cable connections (3-wire), the black wire is negative, the red wire is positive, and the clear wire is signal. Mark the polarity on the wire along with the identification number.
- D. On tach generator connections, polarity shall be marked on wires along with identification number.
- E. For Intrinsically Safe wiring see Section 16941.
- F. Shielded cables for motors controlled by variable frequency drives shall have the shield, ground(s) and drain wire terminated at the motor junction box and drive end. The shield, ground(s) and drain wire shall be passed through any field disconnect via a neutral bar kit or lugs/tape/heat shrink tubing.
- G. Shielded cables shall be installed on motors 60HP and smaller or as directed on the drawings.

3.4 THERMOCOUPLE WIRE INSTALLATION:

- A. CONTRACTOR shall obtain and follow the manufacturer's recommendations on the installation of thermocouple wire.

3.5 ARC-PROOFING:

- A. Individually arc-proof all cables over 600V in manholes, handholes, vaults, cable trays and locations not protected with conduit.
- B. All high-energy cable, important (as noted on Drawings) communication and control cables in manholes, vaults, pullboxes, on open cable trays or other exposed locations where threat of fire exists, or communicated fault can occur, shall be arc and fireproofed with one half-lapped layer of "Scotch" Brand 77 Electric Arc and Fireproofing Tape. Tape shall be secured with a 2-layer band of "Scotch" Brand 69 Glass Electrical Tape over the last wrap. Each circuit shall be individually arc-proofed.

3.6 600 VOLT AND BELOW CABLE INSTALLATION:

- A. Exercise care when installing cable so as not to injure cable. Handle cable according to manufacturer's recommendations.
- B. Do not bend to a radius smaller than manufacturer's recommendations.
- C. A pulling tension meter must be used so as not to exceed manufacturer's recommendations for pulling tensions.
- D. 3M Brand "WL" wire pulling lubricant shall be used when pulling in any conductors except fiber optic cable. All cables should be cleaned, and be kept free of all foreign objects or contaminants throughout construction.

3.7 MEDIUM VOLTAGE CABLE INSTALLATION:

- A. Install cable in the presence of OWNER'S Designated Representative.
- B. Cable reels shall be stored upright on rims until needed.

- C. Exercise care when installing cable so as not to injure cable. Handle cable according to manufacturer's recommendations. Do not bend to a radius smaller than specified or recommended. A pull tension meter must be used for all M.V. cable installations; do not exceed cable manufacturer's requirements for pulling tensions nor sidewall pressures (i.e., one large wheel shall be used in lieu of several small ones on pulling sheaves).
- D. Except where more stringent requirements are set by the manufacturer, minimum bending radii shall be as follows:
 - 1. Rubber and thermoplastic covered cables:
 - a. Shielded: 12 x overall cable diameter.
 - b. Nonshielded: 8 x overall cable diameter.
 - 2. Interlocked armored cable:
 - a. 8 x overall cable diameter.
- E. Where it is necessary to pull cable around a sheave, the sheave shall be one specifically designed for the purpose.
- F. 3M Brand "WL" wire pulling lubricant shall be used when pulling in any conductors except fiber optic cable. All cables should be cleaned, and be kept free of all foreign objects or contaminants throughout construction.
- G. The shield shall be grounded at all terminations of shielded cable.
- H. Provide cable support at all terminations and in manholes, etc.
- I. Terminating of all single conductor weather protected cables operating over 600V (except motors) shall be by means of 3M Brand Quick Term III 7620T Terminating Kits. Installation shall be in accordance with manufacturer's instructions. Additional accessories required shall be furnished by CONTRACTOR.
- J. Provide fully insulated cable connections at 5/15KV metal-clad switchgear, oil switch, or vacuum switch equipment. This is taping in addition to the termination to maintain a totally insulated bus system. Procedure: Apply one half-lap of 3M Super 33+ tape over bolted connection. Apply four half-laps of 3M 130C tape. Apply two half-laps of 3M 70 tape. EXCEPTION: If insulating boots are specifically noted as being furnished with the equipment. Note: It is not required to tape the connection where the bus is not insulated and bar spacing meets the requirements of NEC table 490-24.
- K. If equipment supplied by OWNER is equipped with 600 AMP apparatus bushing, cable terminations, CONTRACTOR shall furnish 3M Brand 5815E with cable adapters.
- L. In potentially wet indoor areas or outdoors, use 3M Brand Quick Term III 7690S Termination Kits. Installation shall be in accordance with manufacturer's instructions. Additional accessories required shall be furnished by CONTRACTOR.
- M. Neither color coding tape nor PVC tape of any kind shall be applied on the termination side of ground connections at premolded terminations. Color coding tape shall be on the cable rather than on the termination.
- N. Ends of cables shall be kept sealed at all times by 3M Brand "Scotchcast" Multi-Mold 85-10, 12, or 14 Splicing Kits or 3M Brand "ICEC" Series heat shrink end seals, except when a termination or splice is in the process of being made. In no case shall Work be stopped on an open cable until the termination or splice is completed.
- O. No splices shall be installed in non-shielded cables operating above 600 Volts.
- P. Splices and terminations shall be made by experienced cable splicers whose qualifications shall be subject to approval of OWNER'S Designated Representative.
- Q. Electrical terminations of cable for 2 and 4 kV motors shall be insulated using the 3M Brand Motor Lead Kits of the series as specified in Part 2 of this Specification.

1. Prepare cable and install terminations as noted in instructions that come with termination kit.
- R. Splices in 15 KV shielded power cables shall be made in manholes, cable pits or pull boxes.
 1. In-line splices where future disconnection is not required shall be pre-molded, factory tested, 3M Brand 5500, 5515 or 5516 Series "Quick-Splice" QS II or QS III In-line Splicing Kits.
 2. In-line splices where future disconnection is required, or Tee or Wye splices shall be fully shielded, premolded, factory tested splices, elbows and bushings, 3M 5815 Series Kit with cable adapters.
- S. CONTRACTOR, when installing the high voltage terminators to the switchgear terminating post, shall tighten to the foot LB's as listed:

<u>Bolt Material</u>	<u>Bolt Diameter</u>	<u>Torque Foot Pounds</u>
Heat Treated Steel	1/4"	5
	5/16"	12
	3/8"	20
	1/2"	50
	5/8"	95
Silicon Bronze	1/4"	5
	5/16"	10
	3/8"	15
	1/2"	40
	5/8"	55

- T. Fireproofing:
 1. All cables 5000V and above shall be fireproofed where they occupy an enclosure, such as a pull box, manhole, or "Tray-A-Duct" transition box. All control cables shall be fireproofed where they share a common enclosure with cable rated 5000V and above. Cable identification shall be located over the fireproofing tape. Fireproofing shall be done using the material specified in Part 2 of this Specification following manufacturer's installation instructions.

3.8 MEDIUM VOLTAGE CABLE TESTING:

- A. Test cable over 600V in the presence of OWNER'S Designated Representative.
- B. Each conventional non-metallic sheathed, URD direct burial and metal jacketed power cable over 600V shall be given a meggar test before installation and a direct current high potential test after installation and terminations have been made, but before connections have been made to busses or apparatus. All single conductor cables shall be tested between conductors and ground with metallic shield and the other two conductors grounded to the same ground. Each conductor shall be successively tested in the same manner. Direct current voltages shall be applied with negative polarity to the cable conductor.
- C. Record acceptance test upon instruction from the OWNER'S Designated Representative.
- D. Final acceptance of the cable will depend upon satisfactory results of the high potential test. If a second test is necessary it shall similarly withstand a reduced voltage (60 percent to 75 percent of the first field test voltage). Test only upon instruction from the OWNER'S Designated Representative.
- E. No cable shall be permanently energized until the master copy of its test record is approved by OWNER. Three copies of the test report shall be furnished to OWNER.

- F. The CONTRACTOR shall provide all required electrical power to operate any test equipment. The power can be obtained from an existing power source or by use of a portable generator provided by the CONTRACTOR.
- G. Preparatory Steps:
1. Adequate safety precautions shall be taken so personnel and equipment will not come in contact with the cable ends while testing.
 2. Disconnect both ends of the cable and make free of all equipment.
 3. Each cable shall be given a continuity test and shall be identified with a phase designation.
 4. When necessary, seal cables to prevent corona from forming at both ends of the cable being tested. Seal cables as follows:
 - a. On the free end of cable that is to be tested, wrap all metal parts of terminator with 130 tape 1/2 lapped, a total of 4 complete wraps. Cover with a clear plastic bag and tape off bag end.
 - b. On the testing end of cable, connect the high connector to cable termination. Wrap all metal parts of terminator, including high pot connection, with 130 tape 1/2 lapped, a total of 4 complete wraps. Cover with a clear plastic bag and tape off bag end.
 5. On shielded cables, ground all shields to the same point.
 6. Cables not being tested shall be grounded to the same point as the shields.
 7. Verify adequate clearance between circuit ends under test and ground or other equipment to prevent flashovers.
 8. Set up and connect the "Hi-Pot" tester as recommended by the manufacturer.
 9. Make final safety and grounding test.
- H. Testing Procedures:
1. All acceptance testing for 5KV and above cables shall be completed per manufacturer specification and completed reports turned over to Owner
- I. Megohmmeter Test:
1. Each non-shielded motor and connecting lead wire over 600V thru 5000V shall be given a continuity and a direct current insulation resistance test after installation and after terminations have been made, but before connections have been made to busses or apparatus. All single conductor cables shall be tested between conductors and ground with the other 2 conductors grounded to the same ground. Each conductor shall be successively tested in the same manner. Direct current voltages shall be applied with negative polarity to the cable conductor.
 2. Final acceptance of the cable will depend upon satisfactory results of the test being witnessed and approved in writing by OWNER'S Designated Representative. No other reports for this test will be required by OWNER.
 3. No cable shall be permanently energized without express written approval of OWNER'S Designated Representative.
 4. Adequate safety precautions shall be taken so personnel and equipment will not come in contact with the cable ends while testing.
 5. Disconnect both ends of the cable and make free of all equipment.
 6. Each cable shall be given a continuity test and shall be identified with a phase designation.
 7. Cables not being tested shall be grounded to the same point.
 8. Verify adequate clearance between the circuit ends under test and ground or other equipment to prevent flashovers.
 9. Set up and connect the megohmmeter tester as recommended by the manufacturer.
 10. Make final safety and grounding test.
 11. Testing procedures:
 - a. Test voltages for 5KV cable shall have a rated voltage plus 1KV = 6KV.

- b. Apply voltage in gradual increments as recommended by the manufacturer until test voltage is attained. Follow megohmmeter manufacturer's recommendations to determine if there is a ground or short on the conductor being tested.
- c. Maintain test voltage for 1 minute.
- d. Read megohms as indicated on the megohm scale. Recommended minimum insulation resistance is 50 megohm. If cable resistance test falls below 50 megohm, all conductors shall be replaced unless approved by OWNER.
- e. Reduce and remove test voltage from the cable. Ground the cable and remove the HV test lead. Note: Do not ground the cable until the voltage has been reduced to less than 3000V.
- f. Repeat the procedure for the other cables.

3.9 LOW VOLTAGE CABLE TESTING (600V)

- A. Where required, test 600V cable in the presence of the OWNER'S Designated Representative.
- B. Each 600V cable larger than #4/0 AWG shall be given a direct current insulation resistance test ("MEGGER") after installation and after terminations have been made, but before connections have been made to electrical busses or apparatus. All single conductor cables shall be tested between conductors and ground with the other two conductors grounded to the same ground. Each conductor shall be successively tested in the same manner. Direct current voltages shall be applied with the negative polarity to the cable conductor.
- C. Final acceptance of the cable will depend upon satisfactory results of the test being witnessed and approved in wiring by OWNER'S Designated Representative with approved contractor form.
- D. Testing Procedures:
 1. Test voltage for 600V cable shall be 1,000 Volts. Recommended minimum insulation resistance is 50 megohm. If cable resistance test falls below 50 megohm, all conductors shall be replaced unless approved by OWNER.
 2. Maintain test voltage for 1 minute minimum.

3.10 PHASING AND IDENTIFICATION OF CONDUCTORS:

- A. General:
 1. Phases shall be established at all transformers, switch gear, motor control centers, feeders, switches and panelboards and marked in an approved manner, namely A, B, C as follows: Front to back, top to bottom, or left to right when facing the front of the equipment.
 2. Branch circuits conductor sizes #12 through #10, the color coding shall be as follows and/or as appropriate per local code:

<u>CONDUCTORS</u>	<u>120/208 VOLTS</u>	<u>277/480 VOLTS</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

For wire sizes #8 and larger, 3M Brand "Scotch" Series 35 color coding tape shall be used for color coding the conductors at all terminations and splices. All colors shall be consistent throughout each wiring system.

3. All neutral wires shall be identified by marking the panel circuit pole number on the neutral conductor at the neutral bar.

- B. Feeders:

1. Unless noted otherwise, wires and cables shall be identified according to National Electric Code Requirements.
 2. For identification purposes, 3M Brand "Scotch" 35 vinyl plastic color coding tape shall be used for all PVC and polyethylene jacketed cable.
- C. Control/Power Wiring:
1. Control identification shall agree with the identification system shown on Drawings, Specifications and wiring diagrams. Color coding may be used as a supplemental identification as directed or required in individual cases. Neutral wire shall be white color only on 120V/208V systems and gray color on 277V/480V systems (no tags accepted in lieu of colors as indicated).
 2. All wires that terminate in panels which are for lighting and building services power and control shall be marked with 3M Brand wire markers or OWNER approved equal. These shall be mechanically printed with a permanent ink and must be installed and heated according to the manufacturer's specification.
 3. All wires and cables that terminate in control panels, MCC's, field devices, junction boxes, or wireways that are for process or maker wiring shall be marked with 3M Brand wire markers or OWNER approved equal. These shall be mechanically printed with a permanent ink and must be installed and heated according to the manufacturer's specification.
- 3.11 FIBER-OPTIC CABLE INSTALLATION:
- A. CONTRACTOR shall obtain and follow the manufacturer's recommendations on installation of fiber cable.
- 3.12 INSTALLATION OF BUS DUCTS:
- A. Support bus ducts from building structure and brace against swaying.
- B. Where required, shields shall be provided to protect bus ducts from dripping water, condensation and / or other falling material.
- C. Bus ducts shall be installed away from and not below water, sewer, steam or process piping.
- 4.0 PART 4 - RELATED DOCUMENTS
- 4.1 ATTACHMENTS: NOT APPLICABLE

SECTION 16140

SWITCHES, RECEPTACLES AND BOXES

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install switches, receptacles and boxes as shown on Drawings and herein specified.
- C. Related Work Specified Elsewhere:
 - 1. Raceways and Supports: Section 16110
 - 2. Wires, Cables and Buses: Section 16120

1.2 SUBMITTALS:

- A. Shop Drawings:
 - 1. Prepare and submit shop drawings for OWNER'S review. Shop drawings shall consist of detailed Drawings or catalog cuts of each size of pull and junction box.
- B. Material List:
 - 1. Submit list of products to be provided, including manufacturer and catalog number.
 - 2. Submit separate list of each product which CONTRACTOR proposes to substitute for the specified items, including manufacturer, catalog number and catalog cut for each item, for consideration by OWNER.

2.0 PART 2 - PRODUCTS

2.1 SWITCHES AND PILOT LIGHTS:

- A. Switches:
 - 1. Switches shall be flush tumbler type, 120/277 VAC, 20 amp:
 - a. Single pole switches shall be "No. 1221I " by Hubbell, 1221-SI by Leviton, or OWNER approved equal.
 - b. Three-way switches shall be "No. 1223I" by Hubbell, 1223-SI by Leviton, or OWNER approved equal.
 - c. Four-way switches shall be "No. 1224I" by Hubbell, 1224-SI by Leviton, or OWNER approved equal.
 - d. Lighted handle single pole switch No. HBL1221ILC by Hubbell, or OWNER approved equal.
- B. Explosionproof Switches:
 - 1. Switches shall be 120/277 VAC, 20 amp.
 - 2. Single pole switches shall be number EDS150-F1 by Appleton, or OWNER approved equal.

3. Three-way switches shall be number EDS150-F3W by Appleton, or OWNER approved equal.
4. Four-way switches shall be number EDS150-F4W by Appleton, or OWNER approved equal.
- C. Outdoor and Wet Location:
 1. Provide the equivalent of the switches and lights specified above, but with gasketed weatherproof plates and switch covers.
 2. Weatherproof cover shall be #HBL1795 by Hubbell, COVER-S by Leviton, or OWNER approved equal.
- D. Plates and Covers:
 1. Plates and covers for switches on exposed conduit systems shall be of cadmium plated steel.
 2. Plates for flush switches shall be smooth- Nylon ivory color plates. Plates for all other types of flush receptacles shall be satin finished stainless steel.

2.2 RECEPTACLES:

- A. Duplex Receptacles:
 1. AA1 20A, 125VAC, 2 pole, 3 wire, grounding type, NEMA Code 5-20R.
 2. AA2 20A, 125VAC, 2 poles, 3 wire, ground fault circuit interrupter receptacle with 5 mA trip lever protecting downstream outlets, NEMA Standard WD 1-1.10 GF5352-I
- B. Single Receptacles:
 1. AA3 20A, 125VAC, 2 pole, 3 wire, grounding type, NEMA Code 5-20R.
- C. Outdoor and Wet Locations:
 1. Provide the equivalent of the receptacles specified above, but with an enclosure that is weatherproof whether or not the attachment plug cap is inserted. The outlet box hood listed for this purpose shall be listed and identified as "extra duty".
- D. Plates and Covers:
 1. Plates and covers for receptacles on exposed conduit systems shall be of cadmium plated steel.
 2. Plates for flush receptacles Type AA1, AA2 or AA3 shall be smooth-faced, nylon ivory color plates.
 3. Plates for all other types of flush receptacles shall be satin finished stainless steel.
 4. GFCI hoods in damp or wet locations shall be rated NEMA 3R

2.3 SPECIAL RECEPTACLES, CLASS A:

- A. Straight Blade Receptacles (Single Phase, 120VAC):
 1. A1 30A, 125VAC, 2 pole, 3 wire, grounding type, NEMA Code 5-30R.
 2. A2 50A, 125VAC, rigidly mounted on wall or machine, not cord connected: 2 pole, 3 wire, grounding type, NEMA Code 5-50R
 3. A3 20A, 125/250VAC duplex grounding type, consisting of one NEMA Code 5-20R and one NEMA Code 6-20R.
- B. Twistlock Receptacles (Single Phase):
 1. A4 15A, 125VAC, grounding type, NEMA Code L5-15R.
 2. A5 15A, 125VAC, duplex, 2 pole, 3 wire, grounding type, NEMA Code L5-15R.
 3. A6 20A, 125VAC, 2 pole, 3 wire, grounding type, NEMA Code L5-20R..
 4. A7 30A, 125VAC, 2 pole, 3 wire, grounding type, NEMA Code L5-30R.
- C. Isolated Grounding Type:
 1. AA5 20A, 125VAC, 2 pole, 3 wire, isolated grounding type, NEMA Code 5-20R.

2.4 SPECIAL RECEPTACLES, CLASS B:

- A. Straight Blade Receptacles (Single Phase 208/230 VAC-120/208VAC):
 - 1. B1 20A, 250VAC, duplex, 2 pole, 3 wire, grounding type, NEMA Code 6-20R.
 - 2. B2 30A, 250VAC, mating 30A ac unit plug: 2 pole, 3 wire, grounding type, NEMA Code 6-30R.
 - 3. B3 50A, 250VAC, 2 pole, 3 wire, grounding type, NEMA Code 6-50R.
 - 4. B7 15A, 230VAC, 50 Hz, 2 pole, 3 wire grounding type, NEMA Code 6-15R,
- B. Twistlock Receptacles (Single Phase 208/230VAC-120/208VAC):
 - 1. B4 20A, 250VAC, 2 pole, 3 wire, grounding type, NEMA Code L6-20R.
 - 2. B5 30A, 250VAC, 2 pole, 3 wire, grounding type, NEMA Code L6-30R.
 - 3. B6 30A, 125/250VAC, 3 pole, 4 wire, grounding type, NEMA Code L14-30R
 - 4. B8 15A, 230VAC, 50 Hz, 2 pole, 3 wire, grounding type, NEMA Code 6-15R.

2.5 SPECIAL RECEPTACLES, CLASS C:

- A. Twistlock Receptacles (Single Phase-277VAC):
 - 1. C1 15A, 277VAC, 2 pole, 3 wire, grounding type, NEMA Code L7-15R.
 - 2. C2 20A, 277VAC, 2 pole, 3 wire, grounding type, NEMA Code L7-20R.
 - 3. C3 30A, 277VAC, 2 pole, 3 wire, grounding type, NEMA Code L7-30R.

2.6 SPECIAL RECEPTACLES, CLASS D:

- A. Twistlock Receptacles (3 Phase 208/230VAC):
 - 1. D1 30A, 250VAC, 3 pole, 4 wire, grounding type, NEMA Code L15-30R
- B. Weatherproof Receptacles (3 Phase 208/230VAC):
 - 1. D2 30A, 600VAC, weatherproof: 4 pole, 3 wire, grounded through shell and extra pole, Style 2, threaded cap, 3/4 inch hub.
 - 2. D3 60A, 600VAC, 4 pole, 3 wire, grounded through shell and extra pole, Style 2, threaded cap, 1-1/4 inch hub.
 - 3. D4 20A, 250VAC, 3 pole, 4 wire, grounding type, NEMA Code L15-20R.

2.7 SPECIAL RECEPTACLES, CLASS E:

- A. Twistlock Receptacles (3 Phase 120/208VAC):
 - 1. E1 30A, 120/208VAC, twistlock: 4 pole, 5 wire grounding type, NEMA Code L21-30R.
- B. Weatherproof Receptacles (3 Phase 120/208VAC):
 - 1. E2 30A, 600VAC, 4 pole, 4 wire, grounded through shell, Style 1, threaded cap, 3/4 inch hub.
 - 2. E3 60A, 600VAC, 5 pole, 4 wire, grounded through shell and extra pole, Style 2, threaded cap, 1-1/4 inch hub.
 - 3. E4 100A, 600VAC, 4 pole, 4 wire, grounded through shell, Style 1, threaded cap, 1-1/2 inch hub.
 - 4. E5 20A, 120/208VAC, twistlock, 4 pole, 5 wire, grounding type, NEMA L-21-20R.

2.8 SPECIAL RECEPTACLES, CLASS F:

- A. Twistlock Receptacles (3 Phase, 480VAC):
 - 1. F1 30A, 480VAC, twistlock: 3 pole, 4 wire grounding type, NEMA Code L16-30R.
- B. Weatherproof Receptacles (3 Phase, 480VAC):
 - 1. F2 30A, 600VAC, 3 pole, 3 wire, grounded through shell, Style 1, threaded cap, 3/4 inch hub.

2. F3 60A, 600VAC, 3 pole, 3 wire, grounded through shell, Style 1, threaded cap, 1 inch hub.
3. F4 100A, 600VAC, 3 pole, 3 wire, grounded through shell, Style 1, threaded cap, 1-1/4 inch hub.
4. F7 20A, 480V twistlock, 3 pole, 4 wire grounding type, NEMA L16-20R.

2.9 SPECIAL RECEPTACLES, CLASS K:

A. Single Gang Assembly Through Feed Receptacles (Single Phase 120VAC):

1. K1 20A, 125/250VAC, 2 wire, 3 pole, hazardous area, Class I, Groups C and D, factory sealed, CPS152-211 with CPP516 plug by Crouse-Hinds, or OWNER approved equal.
2. K2 20A, 125VAC, 2 wire, 3 pole, hazardous area, Class I, Groups B, C and D. Add external seal for Group B, Groups C and D are factory sealed. Class 2 Division I and II, Groups F and G EFSC175-2023 with ECP-1523 plug (15A, NEMA 5-15P) or ECP-2023 plug (20A, NEMA 5-20P) by Appleton, or OWNER approved equal
3. K3 20A, 125VAC, 2 wire, 3 pole, hazardous area, Class 1 Division I, Groups B, C and D, Class 2 Division I and II, Groups F and G, Arc Guard ENR-21201 with EDS back box and 20A plug ENP-5201 (NEMA 5-20P) by Crouse-Hinds, or OWNER approved equal.

2.10 SPECIAL RECEPTACLES, CLASS M:

A. Grounded, Delayed Action Circuit Breaking Receptacles (3 Phase, 208VAC):

1. M1 30A, 240VAC, 3 wire, 4 pole, hazardous area, Class I, Groups C and D, 3/4 inch feed through hubs. Group D is factory sealed. Group C requires external seal. Spring door. CESD 2214 with CPH7714 plug by Crouse-Hinds, or OWNER approved equal.
2. M2 60A, 240VAC, 3 wire, 4 pole, hazardous area, Class I, Groups C and D, 1-1/4 inch feed through hub. Group D is factory sealed. Group C requires external seal. Spring door. CESD 4234 with CPH7934 plug by Crouse-Hinds, or OWNER approved equal.

2.11 SPECIAL RECEPTACLES, CLASS N:

A. Grounded, Quick Make-Quick Break Receptacles (3 Phase 480VAC):

1. N1 30A, 480VAC, 3 wire, 4 pole, hazardous area, Class I, Group D, requires external seal, 1-1/4 inch through feed hubs, threaded cap. Crouse-Hinds SRD3484D with SP3483D plug, or OWNER approved equal.
2. N2 60A, 480VAC, 3 wire, 4 pole, hazardous area, Class I, Group D, requires external seal, 1-1/2 inch through feed hubs, threaded cap. Crouse-Hinds SRD6484D with SP6485D plug, or OWNER approved equal.
3. N3 20A, 480VAC, 4 wire, 3 pole, hazardous area, Class I, Group D, requires external seal, 3/4" hub. Vantage Technology YXA-23032-G with PXD-53042-G plug.

2.12 PULL AND JUNCTION BOXES:

A. Junction and Pull Boxes:

1. Junction and pull boxes shall be of size that provides ample pulling and splicing space, with insulated cross-brackets to support feeder cables and circuit connectors. Fabricate boxes and covers of galvanized steel in gages conforming to NEC and local codes.
2. In junction and pull boxes where power and shielded cables enter, suitable dividers shall be required.

B. Cable Supports:

1. Cable supports for 600VAC or less shall be double wedge type, sized to fit conduits and cables in riser feeders by Kellems or OWNER approved equal.

2. Cable supports over 600VAC shall consist of a wire mesh holding device type by Kellems or OWNER approved equal.

2.13 CABLE TIES:

- A. Cable ties shall be "3M Brand Cable Ties".

3.0 PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install switches, receptacles and boxes and fasten them to the building structure independently of the conduits and wire which enter them. Provide bolts, rod hangers, brackets, or other methods that provide fixed, non-vibrating support.
- B. Support at each level all conduit entering cable support boxes so that no strain is added to the cable support boxes.
- C. Bind groups of conductors together with cable ties.
- D. Receptacles shall be furnished where shown on Drawings. In wet or outdoor locations, CONTRACTOR shall use the weathertight model of the units specified.
- E. For underfloor duct receptacles, refer to Drawings and floor duct manufacturer's specifications.
- F. All 3 phase, 3 wire and 3 phase, 4 wire, 60 Hz receptacles shall be wired for ABC clockwise phase rotation. A phase sequence indicator shall be used for checking phase rotation.

4.0 PART 4 - RELATED DOCUMENTS - NOT APPLICABLE

SECTION 16170

DISCONNECTS, TRANSFORMERS, PANELBOARDS AND BREAKERS

3M ELECTRICAL STANDARD SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install all disconnects, transformers, panelboards and breakers as shown on Drawings and herein specified.
- C. Related Work Specified Elsewhere:
 - 1. Raceways and Supports: Section 16110
 - 2. Wires, Cables and Buses: Section 16120

1.2 SUBMITTALS:

- A. Shop Drawings:
 - 1. Prepare and submit shop drawings for OWNER'S approval.
 - a. Shop drawings for panelboards shall indicate cabinet dimensions, flush and surface mounting, main bus, terminal ratings and rating type of circuit breakers, finish, locks, number of breakers and spare circuits and details of construction.
 - b. Shop drawings for transformers shall indicate approximate dimensions, circuit arrangement, weight and all other pertinent information. Provide design data sheet indicating losses at no-load and full-load conditions.
- B. Material List:
 - 1. Submit list of products to be provided, including manufacturer and catalog number.
 - 2. Submit separate list of each product which the CONTRACTOR proposes to substitute for the specified items, including manufacturer, catalog number and catalog cut for each item, for consideration by OWNER.

2.0 PART 2 - PRODUCTS

2.1 DISCONNECT SAFETY SWITCHES:

- A. All disconnect safety switches shall be heavy duty, quick make-quick break type, complete with covers rated for the appropriate environment. Disconnect Switch Requirements:
 - 1. Non-fused safety switches, except where fused types are shown on Drawings.
 - 2. Covers shall be safety interlocked type enclosures conforming to NEMA requirements; capable of being locked open.
 - 3. Two normally open auxiliary contacts shall be provided on switches unless otherwise specified on the "Equipment and Material Procurement List".
 - 4. Fuses as specified on the "Equipment and Material Procurement List".

2.2 TRANSFORMERS:

- A. Transformers shall be dry type with a temperature rise selected according to the following table:

Less than 75 kVA	150°C Rise
75 kVA through 150 kVA	115°C Rise
225 kVA and greater	80°C Rise

They shall be arranged for floor or wall mounting. Single phase units shall have taps as specified by OWNER.

1. Three phase units rated for 15 KVA or less shall be furnished with a minimum of two 5 percent full capacity taps to adjust the secondary voltage.
2. Three phase units rated for 30 KVA or above shall be furnished with a minimum of six 2-1/2 percent full capacity taps (2-FCAN and 4-FCBN) to adjust the secondary voltage.
3. Transformers 15kVA and larger, single phase and three phase, low voltage general purpose shall meet Energy Code NEMA TP-1.
4. Drive isolation and K-rated transformers as specified by OWNER.

2.3 PANELBOARDS:

- A. Panelboards shall be as specified on the "Equipment and Material Procurement List". Panelboards shall consist of the following:

1. LP and ELP, SLP lighting and power panels for 120/208 Vac circuits, 3 phase, 4 wire shall be equal to Eaton Electrical Type Pow-R-Line 1.
2. L and EL lighting panels for 277/480 Vac circuits, 3 phase, 4 wire shall be equal to Eaton Electrical Type Pow-R-Line 3a.
3. P, SP, PD, SPD and LPD power distribution panels for 480 Vac circuits, 3 phase, 3 or 4 wire shall be equal to Eaton Electrical Type Pow-R-Line 4B.
4. All panels rated 400 amps or larger shall have a box width of 28 inches minimum.

- B. Panelboards shall consist of the following components:

1. Cabinet and Trim:
 - a. Door-in-door construction, galvanized sheet steel, factory enameled, with card, plastic, cover and holder inside door. Provide in-wall cabinets with flush trim where there is sufficient wall thickness. Surface mounted cabinets and trims shall be used elsewhere or where shown. Refer to Part 4 of this Section.
2. Locks:
 - a. Provide flush combination lock and catch at inner doors. Furnish 2 keys for each lock, all locks for all panels keyed alike.
3. Nameplate:
 - a. Provide Type "C" nameplate (as defined by Section 16015 of this Specification) for OWNER'S panel number identification. Nameplates shall be adhered to outside of door.
4. Future Circuit Breakers:
 - a. SPARE - provide circuit breaker and mounting hardware of the designated frame size, poles and ampacity.
 - b. PROVISION - provide and install double branch mounting hardware of the designated frame size and poles necessary to install a future circuit breaker. Also, provide a blank cover.
 - c. SPACE - has the same meaning as Item b. - PROVISION above without required breaker mounting hardware (as required by some manufacturers).
5. Panelboards shall be complete with solid copper main, neutral (where specified) and ground buses, pressure type lugs, and all other specified accessories.

2.4 CIRCUIT BREAKERS:

- A. Circuit breakers shall be as specified on the "Equipment and Material Procurement List".

3.0 PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Locate and install disconnects at convenient work heights, with disconnect handle no more than 78 inches off floor.
- B. Locate and install panelboards per Drawings and approval of OWNER'S Designated Representative.
- C. Verify the circuit breaker types and capacities required for installation in existing panelboards. Provide new circuit breakers at existing panels where circuits are modified, provide breaker mounting hardware as required.
- D. When requested within the Contract Documents, provide circuit breaker lockable handles (removable when not locked) for identified circuit breakers.
- E. Provide a typewritten directory on the inside of each panelboard giving circuit or line number and a complete description of each circuit or line controlled by each breaker.
- F. Transformers shall be mounted to support their own weight. Refer to drawings for special mountings.
 - 1. The neutral wire and frame of all transformers shall be bonded to the system ground.
 - 2. Adequate clearance shall be maintained to provide proper ventilation per manufacturer's recommendation.

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENTS: NOT APPLICABLE

SECTION 16450

UNDERGROUND RACEWAYS, DIRECT BURIAL CABLES, MANHOLES, TRENCHING, BACKFILLING, AND COMPACTING

3M ELECTRICAL STANDARD SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Perform all trenching, backfilling and compacting for underground utilities as shown on Drawings and as herein specified.
- C. Furnish and install all underground systems as shown on Drawings and herein specified, including the following systems:
 - 1. Underground duct banks - power and communications.
 - 2. All manholes and handholes.
 - 3. Underground conduits.
 - 4. Direct burial cables.
- D. Related Work Specified Elsewhere:
 - 1. Wires, Cables, Buses: Section 16120
 - 2. Lighting: Section 16500

1.2 QUALITY ASSURANCE

- A. Inspection and Testing:
 - 1. Inspection and testing by OWNER'S Designated Representative and/or a Soils Technician, hired and paid for by OWNER, will be conducted as required during the trenching and backfilling operations to assure compliance with this Specification.
 - a. Refer to Section 01712 of this Specification for the basis of payment for retesting.
- B. Requirements of Regulatory Agencies:
 - 1. It shall be CONTRACTOR'S responsibility and duty to be familiar with local, state and federal rules and regulations relating to this type of Work and they shall assume the responsibility for compliance therewith.
 - 2. A permit for crossing a railroad or road will be obtained by OWNER from the agency operating the railroad or road, and CONTRACTOR shall comply with all requirements governing the issuance of such permit as to time limits, safety precautions, type of materials, method of construction and performance security, at no extra cost to OWNER.
 - 3. All other permits required shall be obtained and paid for by CONTRACTOR.
 - 4. Warning Lights and Barricades:
 - a. CONTRACTOR shall provide, as directed by OWNER'S Designated Representative, warning lights or barricades for open trenches or excavations, and whenever required by OSHA.

2.0 PART 2 - PRODUCTS

2.1 UNDERGROUND SYSTEMS:

- A. All underground concrete encased duct banks shall use Schedule 40 PVC conduit, and convert to rigid steel conduit when entering buildings or ending at terminal poles.
- B. Underground communication ducts may be of the precast type when approved by OWNER.
- C. Manholes shall be precast unless approved by OWNER. Manhole size (length, width, and height) shall be as shown on Drawings.
 - 1. CONTRACTOR shall submit product data and/or shop drawings for OWNER approval before installation may begin.
 - 2. Manholes shall be structurally rated for the location where the manhole is to be located.
 - a. Manholes shall meet American Association State Highway Officials requirements for H-20 loading.
 - b. Concrete used for construction of manhole shall have a 28-day strength of 4000-pound psi.
 - 3. Manhole access openings shall be 30 inches clear in diameter minimum.
 - a. Where top of manhole is to be exposed above finished grade, the manhole cover shall be flush with the top of the manhole.
 - b. Where top of manhole is to be below finished grade, the manhole cover shall be made flush with top of finished grade.
 - c. Manhole covers shall be marked for the electrical service intended for the manhole, i.e. marked "Telephone" for manholes used for telephone cables and "Electric" for manholes used for electrical power cables
 - d. Pulling irons shall be opposite each window and in the center of the floor.
 - e. CONTRACTOR shall install hooked type insulator for the racks where required for proper cable support.
 - 4. Manholes shall have required openings in base of manhole for ground rods and drainage sump as referred to be Article 3 of this Section.
- D. Handhole size (length, width, and height) shall be as shown on Drawings.
 - 1. Handhole shall be of sufficient structural strength for location in which the manhole is to be located.
 - 2. Handhole covers shall be bolt down unless approved by OWNER.
 - a. Covers shall not require the use of specialized tools to open.
 - b. Covers shall be marked for the electrical service intended for the handhole, i.e. "Electric" used for distribution power wiring, "Lighting" used for lighting circuits, "Telephone" used for telephone circuits.

2.2 DIRECT BURIAL SYSTEMS:

- A. All direct burial conduit shall be rigid nonmetallic Schedule 80 or rigid steel, sizes and numbers as shown on Drawings. Rigid nonmetallic Schedule 40 may be used for systems 600 volts or less where approved by OWNER.

2.3 SOIL MATERIALS:

- A. Topsoil shall be defined as follows:
 - 1. The top layer of variable depth of soil consisting of vegetable matter, organic and inorganic soil.

- B. Unsuitable Material shall be defined as follows:
1. All saturated and unsaturated mixtures of soil, including organic and/or inorganic matter such as humus, spongy matter, roots, stumps, muck, peat, rubbish and other objectionable materials, designated by OWNER not suitable for foundation material, regardless of moisture content. Foundation material is defined as material either in place or in embankment areas that will have some type of loading superimposed upon it under this Contract or in the future as shown on Drawings.
- C. Suitable Material shall be defined as follows:
1. All earth materials except topsoil, rock and unsuitable materials.
- D. Rock shall be defined as follows:
1. All boulders and rocks, measuring 1 cubic yard or more.
 2. Dolomite, granite, trap, quartzite, limestone, hard sandstone, slate or other hard material, in natural ledges 6 inches or more in thickness, or displaced masses which, in the opinion of OWNER, are not practical to excavate and remove by the use of:
 - a. Dozer or dozer ripper equipped with at least 200 engine horsepower.
 - b. Backhoe or shovel with bucket capacity of not less than 1-1/2 cubic yards.
 - c. Non-power operated hand tools (but does require line drilling, blasting, presplitting, rock wedging, jack hammering and/or the use of other power tools).
 3. A rock ledge shall be considered to be a continuous deposit of any one of the above materials which may or may not include interbedded seams of soft material that can be measured for thickness, either horizontally or vertically. If the vertical thickness of soft material between layers is less than 12 inches, then this material shall be included and measured as rock excavation. If the horizontal thickness of soft material between pinnacles measures less than 30 inches, then this material shall be included and measured as rock excavation.
- E. Granular Material (fill around conduit, cable or concrete duct):
1. Granular material shall conform to the following:
- | <u>SIEVE SIZE</u> | <u>TOTAL PERCENT PASSING</u> |
|-------------------|------------------------------|
| No. 4 | 100 |
| No. 40 | 5 - 50 |
| No. 200 | 0 - 10 |
- * The fraction passing the No. 200 sieve shall not be more than 30 percent of the fraction passing the No. 40 sieve. The plasticity index shall be less than 5.
- F. Crushed Rock (conduit or concrete duct foundation material):
1. Crushed rock for conduit or concrete duct foundation material shall conform to ASTM C33 gradation 67 (3/4 inch to number 4).

3.0 PART 3 - EXECUTION

3.1 UNDERGROUND ELECTRICAL DUCT SYSTEMS:

- A. Underground Work:
1. CONTRACTOR shall do all excavating, concrete Work and backfilling, unless otherwise noted. Trenching, backfilling, shoring and compacting shall be in accordance with this Section. CONTRACTOR shall furnish and install all manholes, handholes, cable pits, conduit, fittings, manhole hardware, cable racks and grounding, unless otherwise noted.
- B. Conduit:
1. Conduit shall be rigid nonmetallic Schedule 40 of the sizes and number as indicated on Drawings. Exception: Where rigid steel is called out on Drawings or herein specified for structural strength of duct system, such as under roadways.

2. Use rigid steel conduit when pushing conduits.
 3. Aluminum conduit shall not be used.
 4. Adapters shall be provided where the conduit run changes from rigid nonmetallic to rigid steel conduit.
 5. Where conduits exit buildings in concrete duct banks, the first five feet minimum shall be rigid steel. Also, if CONTRACTOR elects to use field-erected manholes instead of precast manholes, then use rigid steel conduit as per above statement.
 6. When a duct bank terminates at a terminal pole, the last five feet (minimum) of duct shall be rigid steel, including all conduits on the pole.
 7. Conduit shall be arranged in tiers, as indicated on the duct bank cross-sectional Drawings. The conduit shall be so placed in the desired formation that the vertical and horizontal separation will be not less than 1-1/2 inches between the outside surfaces of adjacent conduits. This separation shall be obtained by using plastic separators installed at 60-inch intervals and then tying the individual conduits together with heavy twine to form a rigid skeleton conduit structure.
 8. Conduits shall be installed 7-1/2 inches minimum on center, horizontally and vertically as per NEC.
 9. In laying the conduit, all joints shall be staggered at least 6 inches both vertically and horizontally, and all joints/fittings shall be joined together by means of an approved solvent cement system.
 10. All conduit shall be equipped with end bells where they terminate in walls of buildings, cable pits, manholes and handholes.
 11. A 200-pound poly rope shall be installed and left in all spare conduits not containing wire or cable.
 12. All conduits shall be swabbed clean before cable or poly rope installation and kept clean and free of contaminants throughout construction.
 13. To prevent water from leaking into the building from underground conduits, CONTRACTOR shall furnish and install "OZ" compression type "CSM" sealing bushings when conduit entrance is below exterior grade.
 14. When more than 4 ducts in a duct bank are required, de-rating factors must be considered.
 15. All duct-conduit runs shall slope toward manholes at a 1 to 2 percent slope to permit duct drainage.
- C. Concrete Envelope:
1. Conduit and ducts shall be laid with a minimum protective covering of 3 inches of 3000 pound PSI concrete on all sides.
 2. The concrete envelope shall be reinforced the entire length of the duct bank, or as noted on Drawings, but shall always be reinforced where the envelope crosses roadways, fill or loose soil, or other utility mains. Reinforcement shall consist of #4 steel reinforcing rods with #3 steel ties 36 inches on center or as indicated on the duct cross-sectional Drawings. Reinforcing shall extend 4 feet beyond areas requiring additional protection. Top of the concrete envelope shall be a minimum of 30 inches below the finished grade.
 3. All concrete shall be protected from freezing throughout the curing.
 4. Duct Bank shall be colored red unless directed by OWNER.
- D. Manholes, Handholes and Cable Pits:
1. CONTRACTOR shall install two 3/4 inch by 120 inch copper clad ground rods in each manhole. They shall be driven not closer than 72 inches from one another. Ground rods shall protrude 6 inches above the manhole floor and shall be connected by a length of exposed #6 AWG, copper conductor secured to the side walls. Each ground wire shall be secured with a suitable exothermic or irreversible crimp type ground rod connection as directed by OWNER. CONTRACTOR shall bond all metal parts together, such as conduits, cable racks, pulling irons, etc. CONTRACTOR shall provide and install a 1/4-inch x 1 inch x 12 inches copper ground bus in each manhole.

2. Manhole "Drywell Pit" shall consist of 36 inches of coarse gravel under the floor opening. The floor opening shall be 12 by 12 inches. The "drywell" may be deleted in areas with a high water table - verify with OWNER'S Designated Representative.
3. CONTRACTOR shall furnish and install racks in all manholes where indicated on Drawings.
 - a. Cables shall be routed around periphery of manhole. Secure cables with 3M Brand Cable Ties and rope.
4. The maximum distance between manholes shall be 600 feet.
5. CONTRACTOR shall construct manholes, handholes and cable pits in accordance with the details shown on Drawings and as hereinafter specified. Concrete used for the construction of manholes shall have a 28-day strength of 4000-pound PSI and reinforcing bars shall be in accordance with the details shown on Drawings. All unused window openings shall be filled with brick and mortar unless noted otherwise. Manhole throats shall be constructed of brick and the soil side of the throat shall be covered with a 2-inch layer of mortar. Outside walls shall be dampproofed. Precast manholes, handholes and cable pits may be used as per Article 2.1 of this Section.
 - a. All concrete shall be protected from freezing throughout the curing.

3.2 UNDERGROUND DIRECT BURIAL SYSTEMS:

A. Underground Conduit Systems:

1. Conduit shall be rigid steel or PVC conduit Schedule 80, sized as shown on Drawings. Schedule 40 PVC may be used for systems 600 volts or less.
2. Where underground conduit is indicated on Drawings, conduits shall have a soil top cover of not less than 24 inches for under 600VAC and not less than 30 inches for over 600VAC.
3. Rigid steel conduit shall be installed where conductors cross roads, drives or walks. Conductor shall enter manholes, handholes, cable pits, walls, foundations or terminal points through a protective galvanized steel conduit sleeve or elbow of appropriate size. Open end of sleeve or elbow shall be provided with bushing and a moisture seal after conductor is installed. Seal shall be of a type approved for the system voltage and conductor insulation.

B. Direct Burial Cable Systems:

1. Underground wire and cable shall be sized as per Drawings and as specified under Section 16120.
2. Where direct burial circuits are indicated on Drawings, conductors shall have a soil top cover of not less than 24 inches for under 600VAC and not less than 30 inches for over 600VAC. Conductors shall rest on and be covered with a 3-inch layer of sand to prevent conductor damage from rocks or sharp objects in the fill. Additional protection at points indicated on Drawings or specified herein shall be provided by installing treated planks between cable sand and trench fill.
3. Rigid steel conduit shall be installed where conductors cross roads, drives or walks. Conductor shall enter manholes, handholes, cable pits, walls, foundations or terminal points through a protective galvanized steel conduit sleeve or elbow of appropriate size. Open end of sleeve or elbow shall be provided with bushing and a moisture seal after conductor is installed. Seal shall be of a type approved for the system voltage and conductor insulation.

3.3 TRENCHING:

A. General Excavation:

1. Excavation shall be made to the alignment and depth shown on Drawings and limited to not more than 100 feet in advance of conduit, cable or concrete duct laying, unless

otherwise authorized by OWNER'S Designated Representative. All excavations shall be made by open cut, unless otherwise approved by OWNER or shown on Drawings. The banks of trenches shall be so cut to meet the requirements of federal, state and local codes and regulations.

2. Where the conduit, cable or concrete duct is to be within a controlled fill area, that portion of the controlled fill up to 24 inches above the conduit, cable or concrete duct shall be in place before trenching is begun.

B. Rock Excavation:

1. Rock occurring in excavation shall be uncovered by CONTRACTOR and measured by OWNER before its removal by CONTRACTOR. Any rock removed before OWNER'S inspection and measurements shall be construed as general excavation and CONTRACTOR cannot obtain additional compensation for its removal. Rock occurring in excavation for conduit, cable and concrete duct Work shall be measured at its actual width but not more than 24 inches greater than the outside diameter of the conduit, cable and concrete duct. Rock occurring in excavation for manholes and other construction shall be measured to include 12-inch clearance from outside face of the structure. The bottom of the rock excavation shall be 6 inches below the bottom of the conduit, cable and concrete duct. The volume in cubic yards will be computed by the method of average end areas.
2. All Work with explosives shall have prior OWNER approval in writing and shall be done by competent personnel in such a manner as not to endanger life or property. All storage places for explosives and inflammable materials shall be clearly marked DANGEROUS. The method of storing and handling explosives, including inflammable materials, shall conform to all federal, state and local laws, by-laws and regulations.

C. Trench Width:

1. The minimum width of unsheeted trench shall be 18 inches, and for conduit 6 inches or larger, at least 12 inches greater than the nominal diameter of the conduit. The maximum clear width of trench at the top of the conduit, cable or concrete duct shall be not more than 24 inches greater than the outside diameter of the conduit, cable or concrete duct.
2. Pavements of all types shall be cut with a saw or other equipment in order to provide a straight edge for replacement.
3. Excavation for manholes and similar items shall be sufficient to permit the carrying out of the construction as required.

D. Correcting Faulty Grade:

1. Wherever the excavation is carried below the plan grade and the bottom is considered to be in good soil as determined by OWNER'S Designated Representative, CONTRACTOR shall, at their own expense, refill all over excavated space with suitable material and compact as hereinafter specified in Article 3.7 of this Section.

E. Dewatering:

1. CONTRACTOR shall form all dams or perform other Work necessary for keeping the excavation clear of water during the progress of the Work and, at their own expense, pump or otherwise remove all surface and perched water which accumulates in the trenches. Perched water that cannot be dewatered in 48 hours of continuous pumping at a minimum rate of 60 gallons per minute (GPM) in dry weather shall be considered ground water. Water weeping out of permeable soil lenses after the initial removal of water from the trench in 48 hours or less is considered to be perched water. All openings along the line of conduit or concrete duct shall be securely closed with suitable stoppers to prevent earth or other substances from entering the conduit or concrete duct at any time.
2. Dewatering to lower the static level of ground water will be paid for by OWNER on a unit price basis, or if no unit price has been requested, extra compensation shall be allowed as described in the Contract.

F. Disposal of Waste Materials:

1. Any material found in the excavation as determined by OWNER'S Designated Representative to be unsuitable for backfill shall be separated from the suitable material.
2. Unsuitable and excess suitable materials shall be removed from the Worksite and disposed by CONTRACTOR, unless disposal on the Worksite is directed by OWNER'S Designated Representative.

3.4 SHORING AND SHEETING:

- A. Shoring, sheeting, bracing and similar items as may be required to support the side of the excavation and to prevent any movement which may in any way endanger personnel or injure or delay the Work or endanger adjacent buildings or other structures shall be put in place and maintained by CONTRACTOR at their own expense. Where sheeting and bracing are used, the trench width shall be of such width to allow proper placement of the conduit, cable or concrete duct and backfill. Bedding requirements shall be increased when the maximum trench width is exceeded as previously specified under Article 3.3 of this Section (refer to paragraph entitled "Trench Width"). Trench sheeting shall remain in place until conduit, cable or concrete duct has been laid, tested for defects, and repaired if necessary, and the earth around it compacted to a depth of 12 inches over the top of the conduit, cable or concrete duct. Steel sheeting and bracing shall be removed in such manner as not to endanger the constructed conduit, cable, concrete duct, structures, utilities or property, whether public or private.
- B. Where wood sheeting or wood skeleton sheeting is driven along side the conduit, cable or concrete duct, it shall be cut off and left in place to an elevation 18 inches above the top of the conduit or concrete duct.
- C. If removal of the skeleton sheeting might cause a collapse of the trench wall and/or a widening of the trench at the top of the conduit, cable or concrete duct, the skeleton sheeting system may be left in place.
- D. A trench shield or trench box made of steel or wood and adequately braced may be used. This shield shall be pulled along in the trench and the conduit or concrete duct bedded and jointed inside the box. Care shall be exercised in moving the shield so that the previously laid conduits or concrete duct and backfill are not disturbed.

3.5 CONDUIT, CABLE OR CONCRETE DUCT FOUNDATION:

A. In Good Soil:

1. The trench shall have a bottom conforming to the grade to which the conduit, cable or concrete duct is to be laid. Machine excavation shall be halted above the invert grade and final excavation shall be done by hand. The bottom of the excavation shall have a cradle shaped to the outside of the conduit, cable or concrete duct with minimum width equal to 1/2 the outside diameter of the conduit, cable or concrete duct. The conduit shall be laid upon sound soil cut true and even, including excavation for joints, so that the barrel of the conduit or concrete duct will have a bearing for its full length.
2. Where conduit is thermoplastic, the trench shall be excavated 4 inches below invert grade and backfilled with granular material as previously specified under Article 2.3 of this Section and compacted to a density not less than 85 percent of maximum dry density as defined by ASTM D1557 (Modified Proctor).

B. In Poor Soil:

1. If wet, soft or unstable soil, incapable of properly supporting the conduit, cable, concrete duct or structures, is encountered in the trench as determined by OWNER'S Designated Representative, CONTRACTOR shall excavate to a depth set by OWNER below the conduit, cable, concrete duct or structure bottom to remove these unsuitable materials.

2. CONTRACTOR shall then backfill in 8-inch layers with crushed rock to the elevation allowed for machine excavation. The backfill shall be compacted to a density not less than 95 percent of maximum dry density as defined by ASTM D1557 (Modified Proctor). The conduit, cable or concrete duct shall then be bedded as previously specified in paragraph A above. Such Work will be paid for by OWNER on a unit price basis, or if no unit price has been requested, extra compensation shall be allowed as described in the Contract.
- C. In Rock or Other Incompressible Materials:
1. Rock, boulders, hard pan and larger stones shall be removed to provide a clearance of at least 6 inches below the outside barrel of the conduit fittings and to a clear width of 6 inches on each side of all conduit, cable, concrete duct and appurtenances for conduit, cable or concrete duct 15 inches or less in diameter. Provide a clear width of 9 inches on each side of all conduit, cable, concrete duct and appurtenances for conduit, cable or concrete duct larger than 15 inches in diameter. Adequate clearance for properly jointing conduit, cable or concrete duct laid in rock trenches shall be provided. The space between the rock at the bottom of the trench and the bottom of the conduit or concrete duct barrel and joint shall be filled with granular material and thoroughly compacted.
 2. That part of the trench extended to a point 12 inches above the top of the conduit, cable or concrete duct shall be backfilled with granular material, free of deleterious matter carefully placed and tamped.
 3. The providing of granular material is considered incidental and no additional compensation will be made by OWNER for this incidental Work.

3.6 TUNNELING:

- A. Wherever excavation by open cut is impractical, such as in crossing pavement or railroad tracks, the conduit, cable or concrete duct shall be placed by tunneling, jacking or auguring as shown on Drawings.
- B. The method of tunneling used shall be such as to insure proper alignment and grade of the conduit, cable or concrete duct in final position. If open tunneling is feasible, the space between the conduit, cable or concrete duct and undisturbed earth shall be completely filled with a suitable material and thoroughly compacted. If it is required that the conduit, cable or concrete duct be placed inside of a carrier type unit, the space between the two units (conduit cable duct and/or carrier) shall be filled to a point above the center line of the inside unit to bed the inside conduit, cable or concrete duct firmly and prevent future movement. The material used for this bedding shall be concrete sand. The ends of the carrier type unit shall be blocked with a masonry or concrete end wall.
- C. In the event that CONTRACTOR desires to employ tunneling in locations other than as shown on Drawings in order to avoid replacement of sidewalks and similar items, they shall do so only upon receipt of written permission from OWNER. Tunneling of this nature shall be considered incidental with no additional cost to OWNER.

3.7 BACKFILLING AND COMPACTING:

- A. Backfill at Conduit, Cable and Concrete Duct Zone:
1. Unless otherwise indicated on Drawings, selected suitable material backfill free from rock, frozen material, large clods of earth, broken concrete, boulders, chunks of wood and similar items, shall be deposited on both sides of the conduit, cable and concrete duct simultaneously by hand and to the full width of the trench. The backfill material shall be moistened if necessary, tamped in 4 inch layers either by hand or with mechanical tampers under and on each side of the conduit, cable and concrete duct to an elevation of at least 12 inches above the top of the barrels of the conduit, cable or concrete duct to a

density not less than 85 percent of maximum dry density as defined by ASTM D1557 (Modified Proctor).

2. Where conduit is thermoplastic, backfill material shall be granular type as previously specified under Article 2.1 of this Section, tamped in 4 inch layers by hand to at least 24 inches above the top of the barrel of the conduit.

B. Backfill above Conduit, Cable and Concrete Duct Zone:

1. General Area:

- a. After the conduit, cable and concrete duct has been properly embedded, the remainder of the backfill shall be done in lifts of uniform layers not to exceed the depth shown in the compaction chart (refer to clause f hereinafter) and each lift shall be completely compacted over the full width of the excavated area.
- b. Furnish and install approximately 6 inches below the finish grade and directly above conduits, cable or duct banks a 6 inch wide, long-lasting plastic tape with bright, fade resistant color.. Wording and color of tape shall be industry standard. Tape to be installed the entire length of trench.
- c. The backfill material shall be suitable material free from pieces of rock, concrete or clay lumps more than 1 cubic foot in volume, roots, stumps, rubbish, frozen material and other similar articles whose presence in the backfill would cause excessive settlement. The material shall be compacted to a density at least equal to that of the surrounding soil.
- d. Special compaction shall be done around all manholes, other structures and utilities using pneumatic tampers, plate tampers, or plate vibrators with lifts not to exceed that shown in the compaction chart.
- e. If CONTRACTOR elects to backfill the entire trench with granular material when the native soil is heavy clay, or other hard-to-work soil materials, the granular backfill shall terminate 24 inches from the final grade and then the top 24 inches backfilled with the native soil to create a seal on the trench. The seal shall be eliminated when the trench crosses roadways, parking lots, rail spurs or other areas to be structurally loaded. For these areas, the granular backfill shall be placed full depth and compacted as hereinafter specified in subparagraph 2 of this paragraph.
- f. Compaction Chart:

<u>Compactor Type</u>	<u>Maximum Loose</u>	<u>Soil Lift Height Feet</u>
	<u>Sands</u>	<u>Plastic Soil</u>
Vibratory Roller (Virbo-Plus CK-10) or equal:	4.0	Not Allowed
Sheepsfoot (150psi Minimum)	Not Allowed	2.0
Vibratory Sheepsfoot (Essick VF-54T) or equal:	2.0	2.0
Button Head Pneumatic	0.5	0.5
Plate Tamper	1.0	1.0
Plate Vibrator	1.0	Not Allowed

2. Surfaced Areas:

- a. Any open trenches under or across roadways, parking lots, truck dock areas or other areas to be paved shall be backfilled as previously specified in Paragraph B above, except that the entire depth of trench shall be backfilled in 8 inch layers. The backfill shall be compacted to a density of not less than 90 percent of the maximum dry density as defined by ASTM 1557 except that the upper 36 inches shall be compacted to a density of not less than 95 percent of maximum

dry density. This shall be done in such a manner as to permit the rolling and compaction of the filled trench together with the adjoining soil to provide the required bearing value so that paving or surfacing of the area can proceed shortly after backfilling is completed.

- C. Moisture Content:
 - 1. CONTRACTOR shall either dry the material or add water to the backfill material so that the densities required can be attained.
 - 2. Settling of backfill by means of water flooding will not be permitted.
- D. Improper Backfilling:
 - 1. Where there is evidence of improper backfilling, trenches shall be reopened to the depth required for proper compaction and backfilled as specified herein.

3.8 PROTECTION OF EXISTING UTILITIES:

- A. All existing utilities and structures shall be protected from damage during excavation and backfilling of trenches. If any of the existing utilities are damaged during construction, the damage shall be properly repaired by CONTRACTOR at their expense.
- B. Before any digging, trenching, or excavation, CONTRACTOR shall notify the local utility company (gas, telephone, electric) and have them locate and identify any existing underground utilities.

3.9 RESTORATION OF SURFACE:

- A. Unless otherwise noted on Drawings, CONTRACTOR shall restore to original condition all surfaces disturbed from site drainage and/or utility construction under this Contract.

4.0 PART 4 - RELATED DOCUMENTS - NOT APPLICABLE

SECTION 16455

GROUNDING

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install all grounding Work as shown on Drawings and herein specified.
- C. Related Work Specified Elsewhere:
 - 1. Raceways and Supports: Section 16110
 - 2. Overhead Distribution System: Section 16400
 - 3. Underground Raceways, Direct Burial Cables, Manholes, Trenching, Backfilling and Compaction: Section 16450
 - 4. Lightning Protection System: Section 16610

1.2 SUBMITTALS:

- A. Test Report:
 - 1. Prepare and submit grounding system test report.

2.0 PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All construction material shall meet the requirements of this Section and of the following Sections:
 - 1. Raceway and Supports: Section 16110
 - 2. Wires, Cables and Buses: Section 16120
- B. Each ground rod shall be 3/4 inches in diameter by 120 inches long, solid steel, with a uniform, heavy, non-porous copper coating, except as otherwise indicated on Drawings. Alternate grounding electrodes may be chemical rods, concrete encased electrodes, or other as specified on the Drawings.
- C. Bus bars, installed for grounding connections, shall be no smaller than 1/4 inch x 2 inches x 12 inches solid copper unless otherwise noted on Drawings.

2.2 GROUNDING:

- A. System Grounding:
 - 1. All grounding electrode conductors shall be sized no smaller than shown in NEC Table for "Grounding Electrode Conductor for AC Systems".
 - 2. Except as noted otherwise in this Specification, when ground rods are used, the system shall comprise of one or more ground rods. All rods shall be interconnected with bare stranded copper cable to the top of each rod as shown on Drawings.
- B. Equipment Grounding:

1. All Equipment Grounding Conductors shall be sized no smaller than shown in NEC Table for "Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment". See Drawings for actual size.
2. On general purpose motors, liquidtight flexible conduit (LFC) not less than 18 inches but not exceeding 6 feet shall be used. An internal or external ground wire shall be installed. If an external ground wire is installed, it shall be secured to the LFC by using 3M Brand "Cable Ties." A UL Listed grounding type liquidtight flexible metallic conduit fitting shall be used on each end of the LFC. For LFC connections to motors, which are 1-1/2 inch and larger, a ground wire shall be installed inside the LFC.
 - a. Except where the LFC is UL Listed as an Equipment Grounding Conductor AND the OWNER'S Designated Representative approves.
 - b. Except as directed on Drawings.
3. On explosion proof motors not less than 18 inches of explosion proof flex shall be used. No additional ground wire is required.

3.0 PART 3 – EXECUTION

3.1 INSTALLATION:

- A. The electrical system and equipment shall be grounded in accordance with the latest issue of the NEC.
- B. All contact surfaces shall be thoroughly cleaned before connections are made to ensure good metal contact.
- C. System Grounding:
 1. Where ground system is shown connected to building foundation reinforcing steel, CONTRACTOR shall coordinate their Work with the other trades to ensure a smooth and orderly installation. Other contractors will connect reinforcing steel for building ground. CONTRACTOR shall furnish the base stranded cooper conductor grounding system shown on Drawings and then exothermic weld or irreversible crimp as directed by OWNER to the reinforcing steel prior to pouring of concrete.
 2. The bonding connection to building steel shall be by exothermic weld or irreversible crimp as directed by OWNER.
 - a. See Typical Grounding Detail 16455-1 (refer to Part 4 of this Section).
 3. CONTRACTOR shall furnish and install a ground test point, location as shown on Drawings and detailed on Drawing No. 16455-2 (refer to Part 4 of this Section).
 4. CONTRACTOR shall test the ground system.
- D. Equipment Grounding:
 1. Equipment grounding conductor shall be installed in conduit.
 - a. Except where otherwise indicated on Drawings.
 - b. Except for movable equipment where such equipment shall have an equipment grounding conductor as part of its flexible power cord.
 2. Grounding connections shall be exothermic weld or irreversible crimp as directed by OWNER
 3. Lighting standards shall be bonded at the base to the equipment grounding conductor and to the anchor bolt assembly or a ground rod as shown on Drawings.
 4. Additional grounding shall be installed as detailed on Drawings.
 5. As shown on Drawings, CONTRACTOR shall specifically:
 - a. Install an equipment bonding conductor from all major machine assemblies, such as winder and unwind stands, slitters, etc., to the building electrical ground system. For runs 10 feet and shorter, a #6 AWG bare copper conductor can be run exposed. For runs over 10 feet, a #6 AWG insulated copper conductor installed in nonmetallic conduit shall be used.

- b. Install a separate #10 AWG green insulated grounding conductor to each control panel and main junction/terminal box from the panel or MCC source containing the control circuit protective device.
- c. Install a separate insulated grounding conductor to each DC motor control center from the power source of the motor control center. Size according to the NEC and/or as shown on Drawings.
- 6. CONTRACTOR shall install a bonding bushing on all 2 inch and larger metal conduit.
- 7. Ground bus bars shall be installed as shown on Drawings and connected directly to building steel. If building steel is not available, connect ground bus bar to the electrical grounding system or as directed by OWNER.

3.2 GROUNDING SYSTEM TESTING GENERAL:

- A. Test the grounding system as a single entity. The grounding system maximum reading shall not exceed 3 OHMS.
 - 1. Except as approved in writing by OWNER.

3.3 TESTING PROCEDURE:

- A. A ground resistance tester shall be used with the fall of potential method.
- B. All testing procedures shall follow the meters testing guidelines.

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENTS:

- A. 3M Standard Electrical Drawings required and/or referenced within this Section are listed under the Appendix and are a part of Work of this Section.
 - 1. 16455-1 – Typical Grounding Detail
 - 2. 16455-2 – Ground Test Point
 - 3. 16455-3 – UFER Ground System, Steel Frame Building Construction
 - 4. 16455-4 – UFER Ground System, Poured Concrete Building Construction

SECTION 16500

LIGHTING

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install a complete and operating interior and exterior lighting system with equipment specified herein and shown on Drawings.
- C. Related Work Specified Elsewhere:
 - 1. Raceways and Supports: Section 16110
- D. Definitions:
 - 1. "Fixture" will include the luminaire, ballasts and lamps.
 - 2. "HID" will mean High Intensity Discharge.
 - 3. "VCP" will mean Visual Comfort Probability.

1.2 SUBMITTALS:

- A. Lighting Fixtures:
 - 1. Submit lighting fixture cut-sheets as specified on the "Fixture Schedule" in detail with the following items:
 - a. Three character code that identifies type of fixture.
 - b. Wattage of fixture.
 - c. Suspension or mounting dimensions and hardware.
 - d. Glassware, finishes and dimensions of fixture.
 - e. Stem lengths, lamps and ballast data.
- B. Ballasts (if requested by OWNER):
 - 1. Independent Testing Laboratory Data. Submit typical performance test reports for all ballasts being supplied. Test reports are to include a description of the samples tested, test method and results. The results section shall indicate:
 - a. The ballast being tested.
 - b. The number and type of lamps being operated while ballast is tested.
 - c. Measurement of reference lamp characteristics including voltage, current and wattage.
 - d. The test ballast measurements, including percent light output at various input voltages, RMS lamp current, peak lamp current, lamp current crest factor, input current, input watts, power factor, total harmonic distortion, harmonic content percent of full scale current for fundamental frequency through the seventeenth harmonic, and the ballast efficacy factor.
- C. Samples:
 - 1. If CONTRACTOR elects to substitute fixtures prior to bidding for those exact catalogue numbers specified, they shall submit samples of the specified and the substitute fixtures

for comparison, including ITL or ETL photometric reports with VCP data, independent test reports on sound criterion (HID fixtures) and any other information requested. No changes in fixtures will be permitted without the written approval of OWNER. After the bids are accepted and materials approved, no substitution will be permitted.

D. Ceiling Layout Drawings:

1. CONTRACTOR is responsible to review the architectural reflective ceiling plan to verify light fixture location. Also, verify the correct type of fixture for the ceiling that is to be installed or exists.

2.0 PART 2 - PRODUCTS

2.1 INTERIOR LIGHTING FIXTURES:

A. Fixtures:

1. All fixtures furnished by CONTRACTOR shall be shipped from the factory assembled and wired complete as far as practicable. Wire connections within fixtures shall be with approved size 3M Brand "Scotchlok" as manufactured by 3M Company.
2. Unless otherwise specified, CONTRACTOR shall provide fluorescent lighting fixtures utilizing specification grade, high efficiency reflectors.
3. Incandescent lamp fixtures shall not be used unless shown on Drawings and/or approved by OWNER.

B. Fluorescent lamp ballasts shall conform to the following:

1. Ballasts for all four foot and eight foot fluorescent lamps shall be electronic and operate the lamps at 20,000 Hz or more, shall be designed to operate one specific lamp type in one specific 1, 2, 3 or 4 lamp configuration, and shall have a lamp current crest factor of 1.7 or less. Unless otherwise specified, the ballast factor shall be .85 or greater for four foot lamps and .81 or greater for eight foot lamps.
2. Ballasts shall not have greater than 20 percent total harmonic current distortion and shall have a power factor of 95 percent or greater.
3. Ballasts shall be Underwriters Laboratory (UL) listed Class P and Certified Ballast Manufacturers (CBM) certified by ETL. Ballasts shall not exceed Class A ambient noise levels, shall withstand surges and line transients as outlined in IEEE 587A/ANSI C62.41 (CAT A) and shall meet the requirements for non-consumer equipment as specified in Federal Communication Commission (FCC) regulations, Part 18 (Subpart C for EMI).
4. Ballast marking and color coding of ballast leads shall be in compliance with ANSI C82.11, (High Frequency Fluorescent Ballast Specification), Section 4.

C. Lamps shall be as specified in the Fixture Schedule.

1. Incandescent lamps shall be clear when enclosed in diffusion glassware and frosted when exposed.
2. Four foot fluorescent lamps shall be T5 or T8 as required by fixture, 3500 degree Kelvin, unless specified otherwise.
3. Metal halide lamps shall be clear in lensed fixtures and phosphor coated in open fixtures, unless specified otherwise.
4. High pressure sodium lamps shall be clear, unless specified otherwise.

2.2 EXTERIOR POLE OR STANDARD MOUNTED LIGHTING FIXTURES:

A. Exterior lighting fixtures and standards shall be as specified on the Fixture Schedule.

3.0 PART 3 - EXECUTION

3.1 INTERIOR LIGHTING FIXTURES:

- A. All fixtures shall be firmly supported by structural members of the building. Fixture supports may be anchored to channels in the ceiling construction, to the structural slab or to structural members above the suspended ceiling.
- B. Surface or recessed lighting fixtures installed on/in suspended ceilings shall not be supported from the suspended ceiling structure. All other fixtures and outlets shall be rigidly supported from the building structure or rigid conduit.
 - 1. Chain suspended fixtures with chain rated to support a minimum of 200 pounds only if approved by OWNER
 - 2. Raceways serving such fixtures shall meet the requirements of Section 16110 of this Specification.
- C. CONTRACTOR shall supply all necessary accessory fittings, hangers, clamps, brackets, yokes or miscellaneous devices, as required for a complete installation.
- D. Provide suitable plaster frames for all recessed lighting fixtures, which are to be installed in plaster ceilings.
- E. Any type of fixture or its support may not be hung from mechanical piping or installed on sheet metal ducts without prior approval of the OWNER.
- F. Lighting fixtures on the emergency power system shall be identified per local site requirements. Identification shall be visible from floor level, but at the same time not conspicuously offensive. Where the emergency lighting fixtures are cord and plug attached, the identification shall also be attached to the receptacle box containing the emergency power circuit.
- G. For cord/plug connected fixtures, CONTRACTOR shall furnish and install twist-lock receptacles, plugs and SO type flexible cord.
- H. CONTRACTOR shall be responsible for the replacement of any burned out lamps installed by them which may occur throughout the construction schedule set forth in this Contract and prior to final acceptance of the Work by OWNER.
- I. Upon completion of the entire installation, or reasonable portions thereof, and prior to permanent energization, the lighting system shall be tested to insure freedom from short circuits and unintentional grounds.
- J. Surplus fixtures turned over to OWNER as a result of changes to the Work shall include new lamps for same.
- K. Provide outlet boxes with flexible connections for all recessed fixtures where required by the NEC and in accordance with approved wiring methods.
- L. Where fluorescent fixtures contain ballasts that supply power to lamps in adjoining fixtures, the fixtures not containing ballasts shall be marked "No Ballast" printed on 3M Brand SCS HB-19 wire markers, and attached to the edge of the fixture frame.

3.2 EXTERIOR POLE OR STANDARD MOUNTED LIGHTING FIXTURES:

- A. All excavating, backfilling and concrete work for the conduit, wire, handholes, grounding and foundations for lighting standards shall be provided by CONTRACTOR. Anchors bolts and the accurate placement of them in the foundation shall be the responsibility of the CONTRACTOR. Fixture bases shall be grouted, if the base is not resting on the foundation.

- B. In the base of each fixture there shall be an in-line fuse. Size fuses at least three times fixture current.

3.3 DISPOSAL OF LIGHTING BALLASTS, LAMPS AND FIXTURES:

- A. Handling:
 - 1. The following procedures must be followed when removing and/or disposing of fluorescent or HID lighting ballasts, lamps or fixtures. OWNER will provide necessary containers and retain custody of all waste materials. OWNER will mark and label all containers before CONTRACTOR places any waste into container. CONTRACTOR shall notify OWNER'S Designated Representative when a container becomes full or requires transfer to the facility's designated waste storage area.
- B. Ballasts:
 - 1. Lighting ballasts must be removed from fixtures prior to disposal of fixtures. Both polychlorinated biphenyl (PCB) containing and non-PCB (oil filled, electronic, etc.) may be present. CONTRACTOR shall properly segregate PCB, leaking PCB and non-PCB ballasts and place in separate containers for appropriate disposal by OWNER.
 - a. PCB: PCB ballasts are those that contain no markings indicating the absence of PCBs (e.g. "*Does Not Contain PCBs*" or similar language.)
 - b. Leaking PCB: Ballasts that contain no markings indicating the absence of PCBs which have an "oily" residue on the exterior surfaces. Ballasts with a "tar-like" substance on the exterior surface are not considered to be leaking.
 - c. Non-PCB: Non-PCB ballasts are those that are clearly marked with "*Does Not Contain PCBs*", "*Non-PCB*" or similar language.
- C. Lamps:
 - 1. Fluorescent or HID lamps scheduled for disposal shall be packaged in the cartons in which new lamps are shipped or in alternate containers provided and labeled by OWNER. CONTRACTOR shall use care when packing to prevent breakage.
- D. Lighting Fixtures:
 - 1. Fixtures, less ballasts and lamps, shall be disposed of as normal waste by the CONTRACTOR.

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENTS:

- A. 3M Standard Electrical Drawings required and/or referenced within this Section are listed under the Appendix and are a part of Work of this Section.
 - 1. 16500-1 Suggested Mounting Methods
 - 2. 16500-2 Suggested Mounting Methods
 - 3. 16500-3 For Future Use
 - 4. 16500-4 Explosionproof Fluorescent Fixture
 - 5. 16500-5 Explosionproof Fluorescent Fixture
 - 6. 16500-6 Outdoor Lighting Pole – New Pole Base
 - 7. 16500-7 Outdoor Lighting Pole – Conduit Extension
 - 8. 16500-8 Outdoor Lighting Pole – Conduit Extension

SECTION 16610

LIGHTNING PROTECTION SYSTEM

3M ELECTRICAL STANDARD SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions, and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install a complete lightning protection system as shown on Drawings and herein specified.

1.2 QUALITY ASSURANCE:

- A. Referenced Standards:
 - 1. The current edition of the "Standard for the Installation of Lightning Protection Systems, NFPA 780" of the National Fire Protection Association (NFPA) shall govern where applicable, unless otherwise specified.

1.3 SUBMITTALS:

- A. Shop Drawings:
 - 1. Prepare and submit shop drawings, including edited brochures, for OWNER'S approval of each item of material and equipment incorporated under this section.

2.0 PART 2 - PRODUCTS

2.1 MATERIALS:

- A. As specified in NFPA 780 or as specified on Drawings.

3.0 PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Furnish and install a "UL Master Labeled" lightning protection system as detailed on Drawings, complete with air terminals, down conductors, ground connections and grounding system as appropriate. Installation shall comply strictly with NFPA 780.
- B. On any flat roof portion of the installation subject to routine OWNER (i.e. maintenance, production, etc.) traffic, the CONTRACTOR shall install air terminals with an integral safety spring and a yellow plastic visibility ball.

4.0 PART 4 - RELATED DOCUMENTS - NOT APPLICABLE

SECTION 16941

INTRINSIC SAFETY

3M ELECTRICAL STANDING SPECIFICATIONS

1.0 PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The terms and conditions of the Agreement, Specifications Division 1 - General Requirements, Section 01016 General Provisions and Specifications Section 16010 General Provisions - Electrical, shall apply to the Work specified in this Section.
 - 1. If the information in this Section conflicts with the terms and conditions of the Agreement, the Agreement language takes precedence.
- B. Furnish and install raceway, wiring and components as shown on Drawings and herein specified.
- C. Related Work Specified Elsewhere:
 - 1. Raceway and Supports: Section 16110
 - 2. Wires, Cables and Buses: Section 16120
 - 3. Grounding: Section 16455
- D. Definitions:
 - 1. Intrinsically safe equipment and wiring shall not be capable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most easily ignited concentration

1.2 HAZARDOUS LOCATIONS:

- A. All equipment, materials, fittings, electric fixtures and wiring installed in areas identified on Drawings or specified herein as hazardous, shall be furnished and installed in accordance with Chapter 5 of the National Electrical Code.

1.3 SUBMITTALS:

- A. Material List:
 - 1. Submit list of products to be provided, including manufacturer and catalog number.
 - 2. Components listed on the OWNER furnished "Procurement List" may not be substituted without written permission of OWNER.

2.0 PART 2 – INTRINSICALLY SAFE WIRING

2.1 PRODUCTS:

- A. Wire and Cable (Non-shielded)
 - 1. General:
 - a. Light blue color shall be reserved for identifying intrinsic safe wire only. Blue colored wiring will be allowed for phasing of power feeders or branch circuit conductors.
 - b. Intrinsically safe non-shielded control wiring #16 minimum shall be the same as non-intrinsically safe, except it shall be light blue color. No other color shall be used without written permission from the OWNER.

- B. Shielded Cable
 - 1. General:
 - a. Two conductor shielded cable with light blue outer jacket shall be 1032A as manufactured by Belden, or OWNER approved equal (2/C-18 AWG).
 - b. Three conductor shielded cable with light blue outer jacket shall be 1036A as manufactured by Belden, or OWNER approved equal (3/C-18 AWG).
 - c. Four conductor shielded cable with light blue outer jacket shall be 1474A as manufactured by Belden, or OWNER approved equal (4/C-18 AWG).

3.0 PART 3 - EXECUTION

3.1 INSTALLATION (600 VOLTS AND BELOW):

- A. Intrinsically safe installations shall follow NEC Article 504.
- B. Shielded conductors may be grouped together, except that intrinsically safe wires shall not be run with any non-intrinsically safe wiring.
- C. Intrinsically safe conductors are to be run only in conduits containing IS wires. Shielded IS conductors may be run in the same conduit with non-shielded IS wires, unless otherwise shown on Drawings.
- D. If wire runs are used within panels, there must be a minimum of 2 inches between IS and non-IS conductors, or physical barrier which is grounded or non-conductive must be between the IS and non-IS wires.
- E. Conduit seals are not required for intrinsically safe circuits in hazardous areas except where the conduits enter a purged enclosure or leave the hazardous area.

3.2 GROUNDING:

- A. Intrinsically safe barriers must be grounded redundantly to a dedicated intrinsically safe ground bus as shown on Drawings. The ground wires, #12 minimum, shall be clearly identified and differentiated from other ground returns at both ends. Use green wire for ground with a wrap of blue tape at the end of the conductor for all points of connection for intrinsically safe ground. The ground wires shall be installed in conduit for physical protection and insulated to prevent spurious contact with ground. See Drawing Detail 16941-1A and 16941-3. Refer to Section 16455 of this Specification for ground connection requirements.
- B. Unless specified otherwise (i.e. manufacturer's wiring diagram), tie shields of shielded conductors together and ground at the intrinsically safe barrier. Cut and tape shields at devices. See Drawing Detail 16941-2.

3.3 LABELING:

- A. All 'Intrinsic Safety Wiring' labels will be furnished to the CONTRACTOR by OWNER. CONTRACTOR shall install these labels as shown on Drawing Detail 16941-3. On straight conduit runs, labels shall be installed every 15 to 20 feet and after every turn, bend, elbow or J-box. Example of labels are shown on Drawing Detail 16941-5.
- B. Intrinsically safe labels are controlled items and all unused labels must be returned to the OWNER'S Designated Representative.

3.4 COMMISSIONING:

- A. CONTRACTOR shall not energize any portion of the intrinsically safe installation without approval of OWNER'S Designated Representative.
 - 1. Before final inspection, Open-Flame and Spark Hazard Permits may be issued to energize portions of the intrinsically safe system. Un-inspected systems shall be viewed as potentially hazardous and shall not remain powered beyond the period indicated on the permit.
- B. For final inspection and where available, OWNER'S Designated Representative will request the Plant's System Safety Coordinator to inspect all intrinsically safe installations for acceptance by OWNER.

4.0 PART 4 - RELATED DOCUMENTS

4.1 ATTACHMENTS:

- A. 3M standard electrical drawings required and/or referenced within this Section are listed under the Appendix are part of the Work of this Section.
 - 1. 16941-1A Grounding System for Intrinsic Safety (ISB)
 - 2. 16941-1B Grounding System for Intrinsic Safety (ISU)
 - 3. 16941-2 Grounding Shields-Intrinsic Safe
 - 4. 16941-3 Marking of Intrinsically Safe Wiring
 - 5. 16941-4 Panel Wire Routing-Intrinsic Safe
 - 6. 16941-5 Intrinsic Safe Labels

Appendix

3M Equipment Use Agreement

Form 17558 - D

Article 1. Date of Agreement; Parties

This Agreement, made this _____ day of _____, 20____, is between 3M Company ("3M") and _____ ("**Contractor**"), with offices at _____.

Article 2. Purpose and Background

A. **Contractor** is performing work for 3M and wishes to use certain items of tools, machinery or other equipment owned or leased by 3M ("the equipment"). 3M is willing to allow **Contractor** to use the equipment but only if **Contractor** takes complete responsibility for the equipment's condition and accepts all liability for any loss or harm which may occur through **Contractor's** use of the equipment.

B. (1) Equipment to be used:

(2) Time period of use: Beginning _____ and ending _____.

Article 3. Payment

For the use of the equipment **Contractor** agrees to pay 3M the following _____.

Article 4. No Representation; No Warranties

A. **Contractor** acknowledges that 3M has made absolutely no representations or statements about the character, condition, quality or characteristics of the equipment. **Contractor** understands that 3M is not a merchant of the equipment, as the term merchant is defined in Article 2.104(1) of the Uniform Commercial Code. **Contractor** agrees that its use of the equipment is at **Contractor's** sole risk.

B. **3M NEITHER EXPRESSES NOR IMPLIES ANY WARRANTIES AS TO THE QUALITY OR CONDITION OF THE EQUIPMENT AND EXPRESSLY DISCLAIMS ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. 3M EXPRESSLY DISCLAIMS ANY REPRESENTATIONS ABOUT THE CONDITION, QUALITY, CAPACITY OR OTHER CHARACTERISTICS OF THE EQUIPMENT.**

Article 5. Contractor's Responsibility; Indemnification

Before using the equipment **Contractor** will do whatever is necessary to make certain the equipment is in safe and proper operating condition for its intended purpose. **Contractor** will defend, indemnify and hold harmless 3M and 3M's agents, employees, officers and directors, from any loss, claim or expense on account of any personal injury or property damage to anyone arising from or connected to **Contractor's** possession, use of maintenance of the equipment. Except to the extent prohibited by law, this indemnity applies regardless of the extent to which the underlying harm is attributable to the negligent or otherwise wrongful act or omission (including breach of contract) of **Contractor** or **Contractor's** agents.

Article 6. Proper Care of Equipment

A. **Contractor** will do everything necessary to keep equipment safe and in proper operating order and will return the equipment to 3M promptly at the end of the time period stated in Paragraph B of Article 2. If any of the equipment is damaged (beyond ordinary wear and tear), then on demand **Contractor** will immediately either: (1) restore the equipment to good repair and proper operating condition; or (2) replace the equipment with an equivalent item which is in good repair and proper operating condition, is of the same make as the equipment and is of the same or later model as the equipment.

B. If any of the equipment is lost, stolen, destroyed or damaged beyond repair, then on demand **Contractor** will immediately replace the equipment with an equivalent item which is in good repair and proper operating condition, is of the same make as the equipment and is of the same or later model as the equipment.

Article 7. Insurance

Throughout the time **Contractor** is using or has possession of the equipment, **Contractor** will maintain at its own expense at least the following minimum insurance:

Broad form contractual (to cover liability assumed by **Contractor** under this Agreement) and comprehensive public liability coverage, covering bodily injury, including death, up to at least \$500,000 for each person, \$1,000,000 for each occurrence, and property damage up to at least \$500,000 for each occurrence. The property damage coverage must be extended by a broad form endorsement to cover damage to 3M's property while that property is in Contractor's care, custody or control.

The public liability coverage must name 3M as an additional insured, with coverage primary for 3M regardless of any other insurance 3M may have available. 3M does not in any way represent or guarantee that the specified insurance will be adequate to protect **Contractor's** interests.

Accepted and Agreed to:

3M Company

By
Print Name
Title

Contractor:

By
Print Name
Title

Equipment Use Agreement

Instructions to Originator

(Plant Engineer or 3M Construction Representative)

1. Use this Equipment Use Agreement **before** lending or renting any 3M equipment to a Contractor.
2. First fill out and sign the Form for 3M. (If the Contractor is not paying 3M an equipment rental fee, be sure to write "None" in Article 3.)
3. Then have the Form signed by the Contractor's authorized representative.
4. When both you and the Contractor's authorized representative have signed the Form, distribute the copies as follows:
 - a.) Give the white copy to the Contractor.
 - b.) You keep the yellow copy for your records.
 - c.) Send the pink copy to 3M's Manager of Contract Administration.
 - d.) Keep the goldenrod copy until the equipment is returned. Then on that copy answer the questions stated below, and send the goldenrod copy to 3M's Property Accounting Department.

Information Required by Property Accounting

- A. When was the equipment taken by the Contractor? _____
- B. Did Contractor return the equipment in good condition? ☐ Yes ☐ No
If not, describe the damage and state whether the Contractor has agreed to repair or replace

CONTRACTOR'S PROPOSAL FOR CHANGED WORK AND/OR EXTRA WORK

ARTICLE 1.1 INTRODUCTION

- A. If CONTRACTOR is awarded the bid OWNER may require CONTRACTOR to perform Changed Work and/or Extra Work during the progress of the Work. The term "Changed Work" shall mean work which is deleted or omitted from or different from the original scope of the Work. The term "Extra Work" shall mean work which is extra or additional to the original scope of the Work.
- B. This Proposal states the guidelines upon which CONTRACTOR shall perform any Changed Work and/or Extra Work required by OWNER.
- C. Insert the percentage required for payroll taxes and insurance in the blank space provided in Section C. of Article 1.2 and the proposed Mark-up percentages for overhead and profit in the blank spaces provided in Article 2.2.
- D. It is understood that OWNER does not in any way obligate itself to have any or all of the said Changed Work and/or Extra Work performed by the successful CONTRACTOR.

1.2 CONTRACTOR'S COST FOR PERFORMING CHANGED WORK AND/OR EXTRA WORK SHALL BE DEFINED TO INCLUDE ONLY THE FOLLOWING ITEMS:

A. MATERIALS

- 1) The amount actually paid by CONTRACTOR for Materials used on the job after the deduction of all discounts, including but not limited to cash and trade discounts. This amount shall include transportation charges and sales or use taxes legally applicable to Materials purchased from third parties.
- 2) CONTRACTOR shall make every effort to obtain all Materials at the most favorable prices available under the prevailing circumstances.
- 3) Where CONTRACTOR has a supply of the Materials, CONTRACTOR may furnish such Materials at an amount reimbursable of the net cost to CONTRACTOR or market value (market value at time the Materials are furnished), provided that it is not possible to obtain the Materials at a lower price from third parties. Materials furnished from CONTRACTOR'S supply shall be itemized with quantity and unit prices indicated for each item supplied.
- 4) There shall not be included in Cost any amount representing surplus Materials, whether left over after completion of the Work or otherwise.

B. STRAIGHT TIME WAGES

- 1) The amount of wages normally and actually paid by CONTRACTOR to all workmen and working foremen employed on the job performing Changed Work and/or Extra Work, and, if approved in writing in advance by OWNER, the amount of wages paid to workmen employed in CONTRACTOR'S shops in the performance of fabrication work.
- 2) The amount shall include that portion of the wage rate applicable to vacation pay, if required by CONTRACTOR'S existing union contract or CONTRACTOR'S wage agreement.
- 3) The amount shall include only straight time amounts paid to workmen for overtime hours worked. However, there shall not be included any amount for the straight time portion of wages or salaries representing overtime, unless prior to such overtime being worked. CONTRACTOR shall have obtained OWNER'S written consent to such overtime being worked.

C. CONTRACTOR'S EMPLOYEE CONTRIBUTIONS

- 1) The product of _____percent (_____%) multiplied by the amounts calculated and determined under the provisions of Straight Time Wages - Section 1.2.B. of this article, said amount being compensation to CONTRACTOR for Social Security Taxes, Federal and State Unemployment Insurance, Workmen's Compensation Insurance and Contractor's Public Liability and Property Damage Insurance; plus
- 2) The product of _____percent (_____%) multiplied by any amounts calculated and determined under the provisions of Premium Portion of Overtime - Section 1.2.E.1 of this article, which includes compensation to CONTRACTOR for Social Security Taxes, Federal and State Unemployment Insurance.

D. FRINGE BENEFITS BASED UPON STRAIGHT TIME WAGES

- 1) Fringe benefits paid for the benefit of workmen engaged in the performance of the Work hereunder and based upon the straight time wages paid to workmen for all hours worked.

E. PREMIUM PORTION OF OVERTIME RELATED PAYMENTS

- 1) The premium amounts normally and actually paid to workmen for overtime hours worked, if required by CONTRACTOR'S existing union contract or CONTRACTOR'S wage agreement.
- 2) The fringe benefits paid for the benefit of workmen engaged in the performance of Work hereunder and based upon the premium amounts paid to workmen for overtime hours worked, if required by CONTRACTOR'S existing union contract or CONTRACTOR'S wage agreement.
- 3) There shall not be included any amount for the premium portion of wages or salaries representing overtime nor any related payments, unless, (a) prior to such overtime being worked, CONTRACTOR shall have obtained OWNER'S consent to such overtime being worked and (b) such overtime work shall not be for the purpose of correcting Defective Work.

F. EMPLOYEE TRANSPORTATION AND OR SUBSISTENCE COSTS

The cost of transportation and or subsistence of construction workmen and working foremen which CONTRACTOR is required to pay under the provisions of the applicable and governing union contract or wage agreement; provided that the said union contract or wage agreement must require all contractors doing similar work in the area to pay the said transportation or subsistence costs.

G. RENTAL FOR CONTRACTOR'S TRUCKS

Cost of use and operation of CONTRACTOR'S pick-up trucks and service trucks shall be included in the CONTRACTOR'S overhead. No additional fee will be paid for this cost.

H. RENTAL FOR CONTRACTOR'S EQUIPMENT

- 1) Rental for the actual time CONTRACTOR'S equipment is necessarily in use in the performance of Changed Work and/or Extra Work. Rental rates shall include all costs and repair.
- 2) Rental shall not be paid for equipment which has a value of \$1000 or less, small tools or those tools which it is customary for the workmen and foremen to furnish, as well as CONTRACTOR'S owned pickup trucks.
- 3) CONTRACTOR will submit to OWNER'S Contract Management Department a list of the daily, weekly and monthly rates for each piece of equipment to be used. Those rates shall not be in excess of One Hundred Percent (100%) of the current Rental Rate Blue Book for Construction Equipment published by the Machinery Information Division of K-III Directory Corporation, San Jose, CA.
- 4) For each piece of equipment used, OWNER shall pay CONTRACTOR the rate most favorable to OWNER based upon the amount of time the piece of equipment is used on the job.

I. RENTAL OF THIRD PARTY TRUCKS AND EQUIPMENT

- 1) The net amount (after deducting all discounts) paid by CONTRACTOR for rental from third parties of trucks and equipment necessary for the performance of Changed Work and/or Extra Work.
- 2) Rental shall not be paid for small tools or tools which it is customary for the workmen and foreman to furnish.
- 3) CONTRACTOR shall make every reasonable effort to obtain the said rentals at the lowest rates available.

J. SUBCONTRACTS

- 1) The amounts necessarily paid subcontractors for performance of work hereunder, said Changed Work and/or Extra Work to be performed directly under the supervision of CONTRACTOR.
- 2) No portion of the Changed Work and/or Extra Work shall be sublet without OWNER'S prior consent and approval both as to the subcontractor and as to the contents of the subcontract.

K. BUILDING PERMIT FEES

Fees paid by CONTRACTOR for building permits required for the performance of the Changed Work and/or Extra Work, if any.

1.3 To be included in Cost, each item hereinbefore set out in this article must be an expense incurred by CONTRACTOR and must be necessary and incidental to the Changed Work and/or Extra Work to be performed.

1.4 OWNER reserves the right to furnish any of the Materials and/or equipment, to do any portion of the Changed Work and/or Extra Work itself, and to sublet any portion of the Changed Work and/or Extra Work to any subcontractors, and the cost of such Materials, equipment, work or subcontractors shall not be included in "Cost" as defined in this Proposal.

1.5 The expense of correcting any Defective Work shall not be included as an item in "Cost" as defined in this Proposal.

ARTICLE 2.1 DEFINITION OF CONTRACTOR'S MARK-UP FOR OVERHEAD AND PROFIT:

It is understood and agreed that CONTRACTOR'S mark-up for overhead and profit covers all costs of CONTRACTOR other than CONTRACTOR'S Cost as specifically defined in Article 1.2, including but not limited to, the following: Normal safety expenses, including fire resistant clothing; CONTRACTOR'S trade association dues, all CONTRACTOR'S home office and site office general, administrative and operational costs such as communication and reproduction costs, estimating and purchasing, awarding subcontracts, preparation of invoices and payrolls, interest on capital, insurance, CONTRACTOR'S costs for correcting Defective Work, CONTRACTOR'S cost for use and operation of all pick-up trucks and service trucks, site specific transporting, and pick up and delivery costs, CONTRACTOR'S cost (including but not limited to wages, fringe benefits, transportation and subsistence costs) for supervisory personnel (including but not limited to Superintendents and or non-working foremen), use of CONTRACTOR'S owned equipment with a value of less than \$1,000.00, including repairs and maintenance, all small tools, expendable tools and consumable supplies (see Exhibit - B) required in the performance of Work under this agreement, CONTRACTOR'S shop facilities, and other similar items necessary in the performance of Changed Work and/or Extra Work under this Contract.

2.2 CONTRACTOR'S MARK-UP FOR OVERHEAD AND/OR PROFIT SHALL BE ONLY THE FOLLOWING AMOUNTS WHICH ARE PERCENTAGES OF THE COSTS DESCRIBED IN SECTIONS A, B, C, D, E, I, AND J. OF ARTICLE 1.2. CONTRACTOR SHALL NOT BE ENTITLED TO A MARK-UP ON ANY OTHER COSTS.

- A. **Overhead and profit** of _____percent _____% of the amount calculated under Section 1.2 A. (MATERIALS) of this Proposal, on any Addendum or Field Change Request; plus
- B. **Overhead and profit** of _____percent _____% of the amount calculated under Section 1.2 B. (STRAIGHT TIME WAGES), 1.2 C.1 (CONTRACTOR'S EMPLOYEE CONTRIBUTION – on Straight Time Wages only) and 1.2 D. (FRINGE BENEFITS BASED UPON STRAIGHT TIME WAGES), of this Proposal, on any Addendum or Field Change Request; plus
- C. **Profit only** of _____percent _____% of the amounts calculated under Section 1.2 E. (OVERTIME RELATED PAYMENTS) and), 1.2 C.2 (CONTRACTOR'S EMPLOYEE CONTRIBUTION – on Premium Portion of Overtime only) of this Proposal, on any Addendum or Field Change Request; plus
- D. **Overhead and profit** of _____percent _____% of the amounts calculated under Sections 1.2 I. (RENTAL OF THIRD PARTY TRUCKS AND EQUIPMENT) and 1.2 J. (SUBCONTRACTS) of this Proposal, on any Addendum or Field Change Request.

ARTICLE 3.1. CHANGED WORK AND/OR EXTRA WORK REQUESTS:

- A. OWNER may require CONTRACTOR to perform Changed Work and/or Extra Work by issuing either a Field Change Request, an Office Rider or a Contract Rider. The issued document will declare whether the Changed Work and/or Extra Work is to be performed on a lump sum or cost plus basis.
- B. Prior to requiring CONTRACTOR to perform any Changed Work and/or Extra Work, OWNER may submit to CONTRACTOR an Addendum outlining Changed Work and/or Extra Work which OWNER may request CONTRACTOR to perform. The Addendum will state that either 1) a lump sum price quotation is requested or 2) a detailed price quotation is requested.
 - 1) If a lump sum price quotation is requested, CONTRACTOR shall submit a lump sum price quotation for each item of Changed Work and/or Extra Work set forth in OWNER'S Addendum. CONTRACTOR shall use the items of Cost and the Mark-up percentages contained in Articles 1 and 2 of this Proposal as guidelines in arriving at the price quotation of each item.
 - 2) If requested in the Addendum or subsequently requested because OWNER, in good faith, does not agree with CONTRACTOR'S lump sum price quotation, then CONTRACTOR agrees to promptly submit a detailed estimate using the items of Cost and the Mark-up percentages contained in Articles 1 and 2 of this Proposal.
- C. If OWNER elects to have the Changed Work and/or Extra Work performed on a cost plus basis and issues the CONTRACTOR a Field Change Request authorizing CONTRACTOR to proceed on this basis, then the change, if any, in the Contract Price shall be computed using the items of Cost and the Mark-up percentages contained in Articles 1 and 2 of this Proposal.

CONTRACTOR will be required to furnish OWNER with the below listed documentation:

1) Canary copy of OWNER'S "Daily Report of Cost Plus Work" (Form 5611) approved on a daily basis by OWNER'S Designated Representative. Said form must list the following information:

- a) employee names;
- b) employee classifications;
- c) base wage rates applicable to each classification;
- d) number of hours worked;
- e) a list of CONTRACTOR-owned rental equipment describing the type of equipment and the number of hours utilized;
- f) a list of third-party rental equipment describing the type equipment and the number of hours utilized; and
- g) type and quantities of Materials furnished from CONTRACTOR'S stock.

- 2) If required by OWNER, a copy of CONTRACTOR'S payrolls.
- 3) Invoices (originals if requested by OWNER) received from third party vendors for Materials purchased; also, if requested by OWNER, receiving reports or signed packing slips.
- 4) Invoices (originals if requested by OWNER) received from third parties showing transportation charges and rental for equipment.
- 5) Invoices (originals if requested by OWNER) from subcontractors; if required by OWNER, receipts of payments in connection therewith.

Firm Name	
Street	
City and State	
Officer's Signature	
Title	
Date	

Field Change Request

FCR Number

Supplier Information

Supplier Type <input checked="" type="radio"/> Construction Contractor ✓ <input type="radio"/> Design/Engineering Firm	Contractor's Name ✓		Supplier ID
Address	City	State	Zip Code

FCR Information

Title ✓	<input checked="" type="radio"/> Contract <input type="radio"/> Activating Letter Contract ✓	Plant City, State ✓	Building ✓
Create Date 05/26/2005 ✓	Completion Date ✓	Will work affect the Contract's Completion Date? <input type="radio"/> Yes <input checked="" type="radio"/> No ✓	
FCR Terms No Change ✓	Original Contract Terms	Total Estimated Amount \$0.00	Total Actual Amount \$0.00

Work Detail

This Field Change Request is made this 26th day of May, 2005 by 3M Company (OWNER) and (CONTRACTOR). OWNER hereby requests CONTRACTOR to perform the Extra Work and/or Changed Work described below:

Change Details 1

Change Type	Cause Code	Estimate \$0.00 ✓	Actual \$0.00
Work Description ✓			

The OWNER agrees to pay for all Extra Work and/or Changed Work performed by the CONTRACTOR under this Field Change Request according to the terms of the Contract. The amount paid by the OWNER shall be full compensation for all Work requested for all effects of this FCR on the Contract. The change, if any, in the Contract Price shall be computed according to the OWNER'S choice of one of the following methods and itemized in a subsequent addendum or Rider to the Contract:

- ☒ No Change
 ☐ Cost Plus
 ☐ Unit Price
☐ Lump Sum
 ☐ Cost Plus Not To Exceed

Unless No Change, Unit Price or Lump Sum is checked, the CONTRACTOR shall submit promptly to OWNER such itemized labor and material breakdowns as OWNER may require.

The Change, if any, in the Completion Date resulting from the work requested by this FCR will be determined according to the terms of the Contract.

CONTRACTOR:		OWNER:	
		3M COMPANY	
By		By	
Name		Name	
Title	Date	Title	Date

3M Contractor's Daily Work Report - Cost Plus Work

Form 5611 - M

[illegible]

3M Contractor's Final Waiver and Affidavit

Form 15159 - 1 - B - PWO

For and in consideration of the receipt of the sum of _____
_____ representing final payment, pursuant
to the provisions of Contract No. _____, dated _____,
between the undersigned CONTRACTOR and 3MCompany (hereinafter called OWNER),
for performing certain _____ work on OWNER'S premises at _____
_____, the undersigned CONTRACTOR hereby:

1. Knowing and voluntarily waives, releases and discharges OWNER from all claims, liens and lien rights which CONTRACTOR has or might assert against OWNER, under any present or future law, for work, labor, skill, services, materials and machinery performed, and/or furnished prior to this date in connection with said contract;
2. Knowingly and voluntarily covenants and warrants that:
 - a. There are no outstanding liens or lien rights (other than those arising from retainages held by CONTRACTOR) against CONTRACTOR or against the premises affected by said contract;
 - b. OWNER has paid in full CONTRACTOR for all work, labor, skill services, materials and machinery performed, rendered and/or furnished prior to this date in connection with said contract;
 - c. CONTRACTOR has paid in full or has otherwise satisfied all obligations for work, labor, skill, services, materials and machinery performed, rendered and furnished prior to this date in connection with said contract by any subcontractor, materialman, laborer, or other persons;
 - d. The following chart lists the names of all parties who have contracted to perform and/or furnish work, labor, skill services, materials, and/or machinery in an amount in excess of \$ _____ in connection with said contract and the present status of their contractual claims against CONTRACTOR:

Name	Services of Materials Supplied	Contract Price	Amount Paid	Amount Retained

- e. CONTRACTOR has paid in full or has otherwise satisfied all known indebtedness and claims against CONTRACTOR for damages arising in any manner in connection with the performance of said contract for which OWNER or his/her (their) property might in any way be held responsible;
- f. No claim, lien or lien right connected with the performance and/or furnishing of work, labor, skill, services, materials or machinery under said contract has been assigned.

(See Reverse Side)

IN WITNESS WHEREOF, the undersigned CONTRACTOR(S) has (have) hereunto set his/her (their) hand and seal, or causes this instrument to be executed on its behalf by its duly authorized officer, and its corporate seal to be hereunto affixed, this _____ day of _____, 20 ____ .

CONTRACTOR -

By _____

Its _____

WITNESS: _____

ATTEST: _____

NOTE: If waiver is for a corporation, the corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth. If waiver is for a partnership, the partnership name should be used, all partners should sign and designate themselves as partners.

NOTARIAL CLAUSE FOR CORPORATION

STATE OF:

ss:

COUNTY OF:

On this _____ day of _____, 20 ____ , before me, a Notary Public in and for said county and state, personally appeared _____ and _____, to me known to be the _____ and _____, respectively, who executed the foregoing Contractor's Waiver and Affidavit, and they acknowledged the execution of the same, and being by me duly sworn, did depose and say, that they knew the seal of said Corporation and that the seal affixed to said Waiver was such corporate seal; that said corporate seal and their signatures as such officers were duly affixed and subscribed to the said Waiver by the authority, order and direction of the Board of Directors of said Corporation and that they signed their names thereto by like authority, order and direction; and acknowledged said Waiver to be the free act and deed of said Corporation; that they have read the foregoing Waiver and know the contents thereof, and that the statements therein made are true to their knowledge.

Notary Public

NOTARIAL CLAUSE FOR INDIVIDUAL OR PARTNERSHIP

STATE OF:

ss:

COUNTY OF:

On this _____ day of _____, 20 ____ , before me, a Notary Public in and for said county and state, personally appeared _____ to me known to be the person(s) described in and who executed the foregoing Contractor's Waiver and Affidavit, and he/she (they) duly acknowledged to me that he/she (they) executed the same, and being by me duly sworn, depose(s) and say(s), that he/she (they) read the foregoing Waiver and know(s) the contents thereof, that the statements therein made are true to his/her (their) knowledge, and that with full knowledge of his/her (their) rights he/she is (they are) voluntarily waiving such rights.

Notary Public

3M Contractor's Partial Waiver and Affidavit

Form 15159 - D - PWO

For and in consideration of the receipt of the sum of _____
_____ representing partial payment, pursuant
to the provisions of Contract No. _____, dated _____
between the undersigned CONTRACTOR and 3MCompany (hereinafter called OWNER),
for performing certain _____
work on OWNER'S premises at _____
_____, the undersigned CONTRACTOR hereby:

1. Knowing and voluntarily waives, releases and discharges OWNER from all claims, liens and lien rights which CONTRACTOR has or might assert against OWNER, under any present or future law, for work, labor, skill, services, materials and machinery performed, and/or furnished prior to this date in connection with said contract;
2. Knowingly and voluntarily covenants and warrants that:
 - a. OWNER has paid CONTRACTOR an amount equal to ninety percent (90%) of that percentage of the Contract Price that the work completed bears to the Total Work for all work, labor, skill services, materials and machinery performed, rendered and/or furnished prior to this date in connection with said contract;
 - b. The following chart lists the names of all parties who have contracted to perform and/or furnish work, labor, skill services, materials, and/or machinery in an amount in excess of \$ _____ in connection with said contract and the present status of their contractual claims against CONTRACTOR:

Name	Services of Materials Supplied	Contract Price	Amount Paid	Amount Retained

- c. CONTRACTOR has paid in full or has otherwise satisfied all known indebtedness and claims against CONTRACTOR for damages arising in any manner in connection with the performance of said contract for which OWNER or his/her property might in any way be held responsible;
- d. There are no outstanding liens or lien rights (other than those arising from retainages held by CONTRACTOR) against CONTRACTOR or against the premises affected by said contract; and
- e. No claim, lien or lien right connected with the performance and/or furnishing of work, labor, skill, services, materials or machinery under said contract has been assigned.

(See Reverse Side)

IN WITNESS WHEREOF, the undersigned CONTRACTOR(S) has (have) hereunto set his/her (their) hand and seal, or causes this instrument to be executed on its behalf by its duly authorized officer, and its corporate seal to be hereunto affixed, this _____ day of _____, 20 ____.

CONTRACTOR -

By _____

Its _____

WITNESS: _____

ATTEST: _____

NOTE: If waiver is for a corporation, the corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth. If waiver is for a partnership, the partnership name should be used, all partners should sign and designate themselves as partners.

NOTARIAL CLAUSE FOR CORPORATION

STATE OF:

ss:

COUNTY OF:

On the _____ day of _____, 20____, before me, a Notary Public in and for said county and state, personally appeared _____ and _____, to me known to be the _____ and _____, respectively, who executed the foregoing Contractor's Waiver and Affidavit, and they acknowledged the execution of the same, and being by me duly sworn, did depose and say, that they knew the seal of said Corporation and that the seal affixed to said Waiver was such corporate seal; that said corporate seal and their signatures as such officers were duly affixed and subscribed to the said Waiver by the authority, order and direction of the Board of Directors of said Corporation and that they signed their names thereto by like authority, order and direction; and acknowledged said Waiver to be the free act and deed of said Corporation; that they have read the foregoing Waiver and know the contents thereof, and that the statements therein made are true to their knowledge.

Notary Public

NOTARIAL CLAUSE FOR INDIVIDUAL OR PARTNERSHIP

STATE OF:

ss:

COUNTY OF:

On the _____ day of _____, 20____, before me, a Notary Public in and for said county and state, personally appeared _____ to me know to be the person(s) described in and who executed the foregoing Contractor's Waiver and Affidavit, and he/she (they) duly acknowledged to me that he/she (they) executed the same, and being by me duly sworn, depose(s) and say(s), that he/she (they) read the foregoing Waiver and know(s) the contents thereof, that the statements therein made are true to his/her (their) knowledge, and that with full knowledge of his/her (their) rights he/she is (they are) voluntarily waiving such rights.

Notary Public



(Lump Sum) Standardized Invoice (All Fields Must Be Completed)

Form 36268 - B

Company Name	Contract # _____
Address	Invoice # _____
City, State, Zip Code	Invoice Date _____ Mo. _____ Day _____ Yr. _____
3M Supplier #	<input type="checkbox"/> Partial Payment
Discount Terms	<input type="checkbox"/> Final Payment

Contract	Original Contract \$	Riders To Contract \$	Total Contract \$
	\$	\$	\$

	Completed To Date	Previous Billed	Work Completed This Period
Gross Amount (Before Taxes)	\$	\$	\$
Taxes (Taxes paid by contractor directly to the state. Do not include taxes paid by contractor to vendors on this line. There must be an entry on this line even if it is zero.)	\$	\$	\$
Gross Amount (After Taxes)	\$	\$	\$
Retention	\$	\$	\$
Total	\$	\$	\$



Amount Due

Break down of charges for the current invoice

Ctl	Main	Sub	Job/Project #	Shop W/O #	Gross Amount	Retained Amount	Net Amount
Total (Must Equal Amount Due) ➡							

The following to be completed by 3M prior to payment.

Designated 3M Rep

Signature	Typed or Printed Name	3M Employee #
-----------	-----------------------	---------------

Originator's Approval For Payment

Signature	Typed or Printed Name	3M Employee #
-----------	-----------------------	---------------

Manager's Approval For Final Payment Or Retention Payment

Signature	Typed or Printed Name	3M Employee #
-----------	-----------------------	---------------

Form 36269 - B

All Fields Must Be Completed

Company Name
Address
City, State, Zip Code

Contract # _____			
Invoice # _____			
Invoice Date	Mo.	Day	Yr.
	_____	_____	_____

3M Supplier #
Discount Terms

☐ Partial (P) **See: P & F Columns**
☐ Final (F) **By "Gross Amount"**

Supporting Documents and Calculations Must Be Attached

Materials	
Labor	
Transportation and Subsistence	
Contractor Owned Rental Equipment	
Third Party Rental	
Sub-Contractor's	
Permits and Fees	
Other Charges	
Taxes (Taxes paid by contractor directly to the state. Do not include taxes paid by contractor to vendors on this line. There must be an entry on this line even if it is zero.)	
Amount Due ►	

Break down of charges for the current invoice

Ctl	Main	Sub	Job/Project #	Shop W/O #	Gross Amount	P	F
Total (Must Equal Amount Due) ►							

The following to be completed by 3M prior to payment.

Designated 3M Rep

Signature	Typed or Printed Name	3M Employee #
-----------	-----------------------	---------------

Originator's Approval For Payment

Signature	Typed or Printed Name	3M Employee #
-----------	-----------------------	---------------

Manager's Approval For Final Payment Or Retention Payment

Signature	Typed or Printed Name	3M Employee #
-----------	-----------------------	---------------

EQUIPMENT & MATERIAL PROCUREMENT LIST
Field Mounted Equipment

Project ID:
Project Title:

Panel/Device	Type Nameplate	Description	Furnished By	Mounted By	Drawing #	P.O. #

3M Innovation
~ Exceeding Your Electrical Product Needs ~
visit us at www.3m.com/electrical/

3M COMPACTOR/DUMPSTER PROCEDURE

Concern for our own 3M employees' health and safety coupled with stringent environmental disposal regulations require that each 3M employee scrutinize all waste carefully and dispose of it legally in accordance with all 3M waste disposal procedures.

The 3M Compactor/Dumpster Procedure provides the requirements to protect 3M employees and our environment and to eliminate incidents involving inappropriate materials being put into compactors, dumpsters, trash containers and wastebaskets, ultimately destined for the landfills. Each person at 3M who has a position requiring them to discard anything other than paper or food in wastebaskets, trash containers, compactors or dumpsters must read, understand and follow these requirements. More details regarding waste disposal are found in the 3M Waste Management Program Manual Volume I. Your Waste Management Coordinator has a copy of this document. Additional local and state disposal requirements must also be considered.

Any material considered for compactor/dumpster disposal should be evaluated for resale or recycle value prior to disposal. Contact 3M Resource Recovery at 651/733-2131 or 778-6689 for questions concerning resale or recycle opportunities. Common recoverable materials include paper or plastic film, cardboard and wood, plastic pellets and resins, solidified melts of adhesives, and plastics and metals.

Questions regarding this procedure, or how it relates to materials not specifically listed, should be directed to your Waste Management Coordinator or your Environmental Engineering and Pollution Control contact (general phone number: 651/778-4335).

I. Compactor/Dumpster Unacceptable Items

A. Hazardous materials or articles contaminated with hazardous materials, through federal EPA, DOT or OSHA and state and local regulations. These materials include but are not limited to:

- | | |
|---------------------------------------|---------------------------------------|
| • Asbestos | • nonflammable gases |
| • biological waste | • organic peroxides |
| • carcinogens | • oxidizers |
| • combustible or ignitable liquids | • poisonous solids, liquids and gases |
| • corrosive solids or liquids | • polychlorinated biphenyls (PCBs) |
| • explosives | • radioactive materials |
| • flammable solids, liquids and gases | • regulated medical waste |
| • infectious waste | • sensitizers |
| • initiating materials | |

B. All liquids.

C. Items capable of causing injury to waste handlers or creating a scavenging, security, or public image problem at the disposal site. These include:

- medical waste (e.g., syringes, used bandages)
- knives, razor blades, scissors, needles
- used gloves
- 3M confidential or restricted materials
- large quantities of any product or intermediate
- chemically contaminated containers (e.g., glassware) and equipment

D. Any container that does not meet the empty container requirements given in section II.B.

E. Landfillable industrial wastes in large quantities.

- F. Mercury, lithium, nickel-cadmium, silver and lead-acid batteries (alkaline and carbon-zinc batteries are acceptable).

II. Compactor/Dumpster Acceptable Items

- A. Small, non-recyclable amounts of paper, wood, cardboard, plastic and metal NOT contaminated with hazardous materials. (See examples of hazardous materials in section I)
- B. Empty containers that meet the following criteria:
- Cannot be reconditioned or reused.
 - Rinsed or wiped clean, with no remaining residue (dispose of residue in appropriate waste container if hazardous).
 - All labeling or marking indicating or suggesting hazardous characteristics completely removed or obliterated beyond identification.
 - Open, with cap or lid removed.
 - Crushed, or rendered unusable by punching at least two holes in the bottom (excluding glass containers).
- Some sanitary landfills restrict the disposal of certain types of containers. In such case, an alternative disposal method must be found.
- C. Empty, small, pressurized gas containers (excluding aerosol cans) with fill-valve removed. This should not include propane containers, which are generally recycled. See document number I-31 in Appendix I of 3M Waste Management Program Volume I for more details on gas cylinder management.
- D. Any small volumes (less than 1 pound) of dusty or fine loose non-hazardous material which is double-bagged in plastic or otherwise totally sealed.
- E. Alkaline and carbon-zinc batteries only. See document number I-20 in Appendix I of 3M Waste Management Program Volume I for more information on battery disposal.
- F. Cafeteria waste (food grade, or articles contaminated with food).

Large quantities of the above materials may not be suitable for compactor or dumpster disposal. Questions regarding large quantities should be directed to your Waste Management Coordinator. Some states also require permits and/or manifests for disposal of non-hazardous industrial waste in a sanitary landfill.

More details on waste management procedures for certain specific wastes (i.e. gas cylinders, batteries, etc.) can be found in Appendix I of the 3M Waste Management Program Manual Volume I.

3M Open-Flame and Spark Hazard Permit
(Non-Transferable)

Form 4345 - O

PLEASE TYPE OR PRINT

No. 228176

Assigned To →			(Employee or Contractor)
For →			(Type of Work)
On →			(Specify Equipment)
At →			(Building or Location)
Permit Valid From: _____ (Month/Day/Year) _____ Time (AM/PM) To: _____ (Month/Day/Year) _____ Time (AM/PM)			
Item: (To be completed by authorizer of permit) Check All			
		Not Applicable	Complete
1. Remove all flammable and combustible liquids from work area		<input type="checkbox"/>	<input type="checkbox"/>
2. Monitor area with L.F.L. (Lower Flammable Limit) analyzer		<input type="checkbox"/>	<input type="checkbox"/>
3. Inert vessel(s). Inerting requires continuous L.F.L. Monitoring of work area		<input type="checkbox"/>	<input type="checkbox"/>
4. Relocate all combustibles 35 feet from work area or shield from hazards with flame-proof covers		<input type="checkbox"/>	<input type="checkbox"/>
5. Protect surrounding equipment with flame-proof covers		<input type="checkbox"/>	<input type="checkbox"/>
6. Protect sprinkler heads, Heat Activating Devices, and flame or smoke detectors		<input type="checkbox"/>	<input type="checkbox"/>
7. Close all fire doors		<input type="checkbox"/>	<input type="checkbox"/>
8. Cover or shield all duct, wall and floor openings with flame-proof covers		<input type="checkbox"/>	<input type="checkbox"/>
9. Fill traps with water		<input type="checkbox"/>	<input type="checkbox"/>
10. Monitor sewers, trenches, manholes, floor drains, elevator pits, sumps and low areas with a L.F.L. analyzer		<input type="checkbox"/>	<input type="checkbox"/>
11. Cover floor drains, trenches, manholes and sewers		<input type="checkbox"/>	<input type="checkbox"/>
12. Provide _____ fire watcher(s), trained in the proper use of portable fire extinguishers and Facility emergency notification procedures. Emergency phone no. _____		<input type="checkbox"/>	<input type="checkbox"/>
13. Provide the following quantity of fire extinguishers: (_____ Water) (_____ CO2) (_____ Dry Chemical) (_____ Light Water)		<input type="checkbox"/>	<input type="checkbox"/>
14. Review Emergency Evacuation Procedures		<input type="checkbox"/>	<input type="checkbox"/>
Special Requirements:			
Authorizer:	(Signature and Department Number)	(Phone or Pager)	(Date)
Firewatcher's Signature:	(Signature and Department Number)	(Phone or Pager)	(Date)
Signature of person(s) using flame or spark producing device:	(Signature and Department Number)	(Phone or Pager)	(Date)
Other Signatures (as required by facility):	(Signature and Department Number)	(Phone or Pager)	(Date)
3M Designated Representative →	(Signature and Department Number)	(Phone or Pager)	(Date)
Contractor Designated Representative →	(Signature and Department Number)	(Phone or Pager)	(Date)

White Original - Area Supervisor or Designee

Pink - Post in work area

Green - Authorizer



Confined Space Entry Permit Includes All Permit Required Confined Spaces

Working Copy Permits Kept For 1 Year
Non-Transferable

Entry Supervisor	Company Name	3M Location
Purpose of Entry <input type="checkbox"/> Cleaning <input type="checkbox"/> Maintenance <input type="checkbox"/> Modification <input type="checkbox"/> Repair		
Specify Confined Space		Confined Space Number
Check Hazards: <input type="checkbox"/> Atmospheric <input type="checkbox"/> Engulfment <input type="checkbox"/> Entrapment <input type="checkbox"/> Equipment <input type="checkbox"/> Heat <input type="checkbox"/> Electrical <input type="checkbox"/> Other (list) _____		
Valid From: Date: _____ Time _____ Hrs. To: Date: _____ Time _____ Hrs.		

Preparation Procedures *Check each pre-entry item to confirm review*

Completed

Yes N/A

1. Classification of Space (permit required): _____

☐ ☐

2. Verify Training _____

☐ ☐

3. Atmospheric Testing

a) Proper test equipment available and calibrated prior to entry _____

☐ ☐

1) Oxygen content (Range 19.5% - 23.5%) prior to entry _____

☐ ☐

Monitor continuously and record every 30 minutes _____ % _____ % _____ % _____ % _____ % _____ % _____ %

Initial Reading _____ % _____ % _____ % _____ % _____ % _____ % _____ %

Initials _____

2) Flammable vapors 10% LFL maximum Target 0% LFL. _____

☐ ☐

Monitor continuously and record every 30 minutes _____ % _____ % _____ % _____ % _____ % _____ % _____ %

Initial Reading _____ % _____ % _____ % _____ % _____ % _____ % _____ %

Initials _____

3) Toxic Substances. List materials and permissible limits: _____

☐ ☐

Monitor continuously and record every 30 minutes _____

Initial Reading _____

Initials _____

4. Space Purged and/or Ventilated (forced air) _____

☐ ☐

5. Preparation of Facilities and Equipment.

a) Hazardous Area Classification _____

☐ ☐

b) Space cleaned out _____

☐ ☐

c) Hazardous energy sources isolated or controlled. _____

☐ ☐

d) Area supervisor and other appropriate personnel notified _____ Initials _____

☐ ☐

e) CO₂ Fire protection and inerting systems controlled _____

☐ ☐

6. Open Flame and Spark Hazard Permit _____

☐ ☐

7. Respiratory Protection Required _____

☐ ☐

8. Warning Signs, Barriers, and Shields to Guard Openings _____

☐ ☐

9. Entry Equipment and Rescue Devices:

a) Harness, retrieval line attached to hoist system. _____

☐ ☐

b) Rescue equipment including SCBA or combination Type C airline/SCBA readily available _____

☐ ☐

c) Proper electrical classification for entry equipment _____

☐ ☐

d) Proper fire extinguishers _____

☐ ☐

e) Proper personal protective equipment _____

☐ ☐

f) Ladders properly secured _____

☐ ☐

10. Entrants Residence Time _____

Hrs/Min _____

a) State exceptional conditions _____

☐

11. Communication System Reviewed _____

☐ ☐

12. Emergency Procedures

a) Emergency procedures reviewed with all participants _____

☐ ☐

b) Rescue Team is notified and available _____

☐ ☐

13. Post Entry Review

a) Remove equipment and tools _____

☐ ☐

b) Procedure critique by entry team _____

☐ ☐

c) Supervisor closes entry and files permit _____

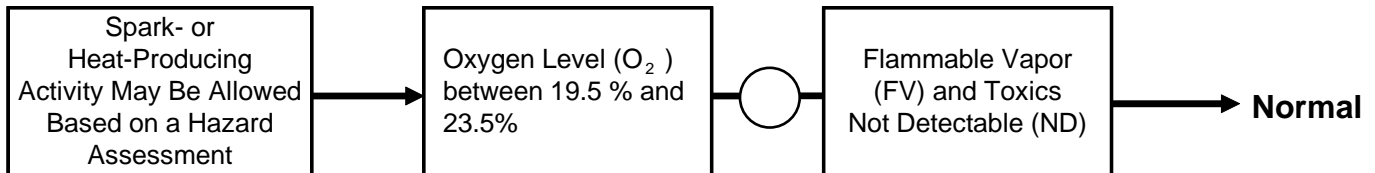
☐ ☐

Signatures - We have received instructions on safety procedures and hazards of this job and the permit is complete.

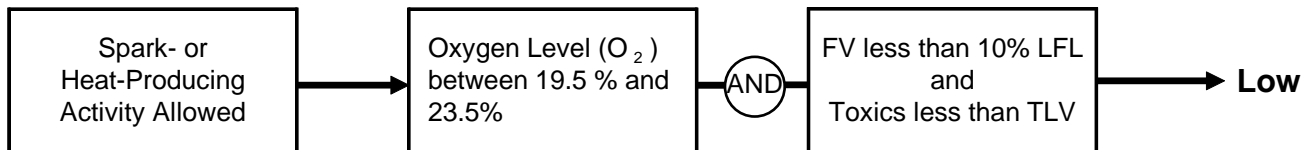
Entrants		
Attendant	Emergency Phone No.	Permit Close (Signature, Date, Time)
Entry Supervisor (Signature)	Contractor Representative	

To determine the exposure condition in a confined space, you must:

1. Determine if the space is indeed a confined space †
2. Conduct a confined space hazard assessment
3. Test the confined space atmosphere ‡

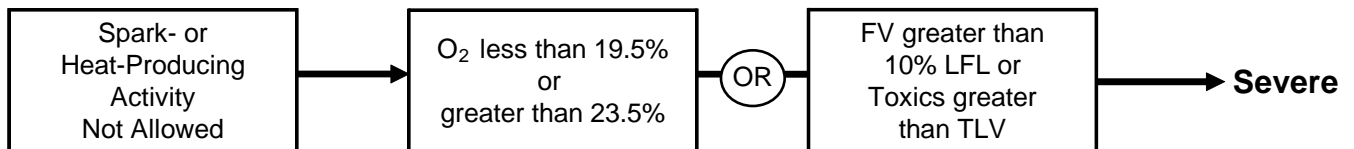


Permits Required Below This Line



Severe Exposure Entry Conditions Below This Line

**Plant/Site Manager or designee approval required.
Entry allowed only after all efforts to reduce the hazard have failed.
Appropriate respiratory protection required.**



† A confined space has all of the following characteristics:

1. Sized and figured so that a person can enter and perform work, and
2. Limited or restrictive means for entry or exit, and
3. Not designed for continuous occupancy.

‡ As recorded on the Confined Space Entry Permit, use the levels of oxygen, flammable vapors and toxics to determine the exposure condition according to this chart.

**Confined-Space Entry Exposure Conditions
(This chart is based on Fig. 3-1 from A-120)**



Contractor Representative Safety Walk - Through Checklist

Form 37832 - C

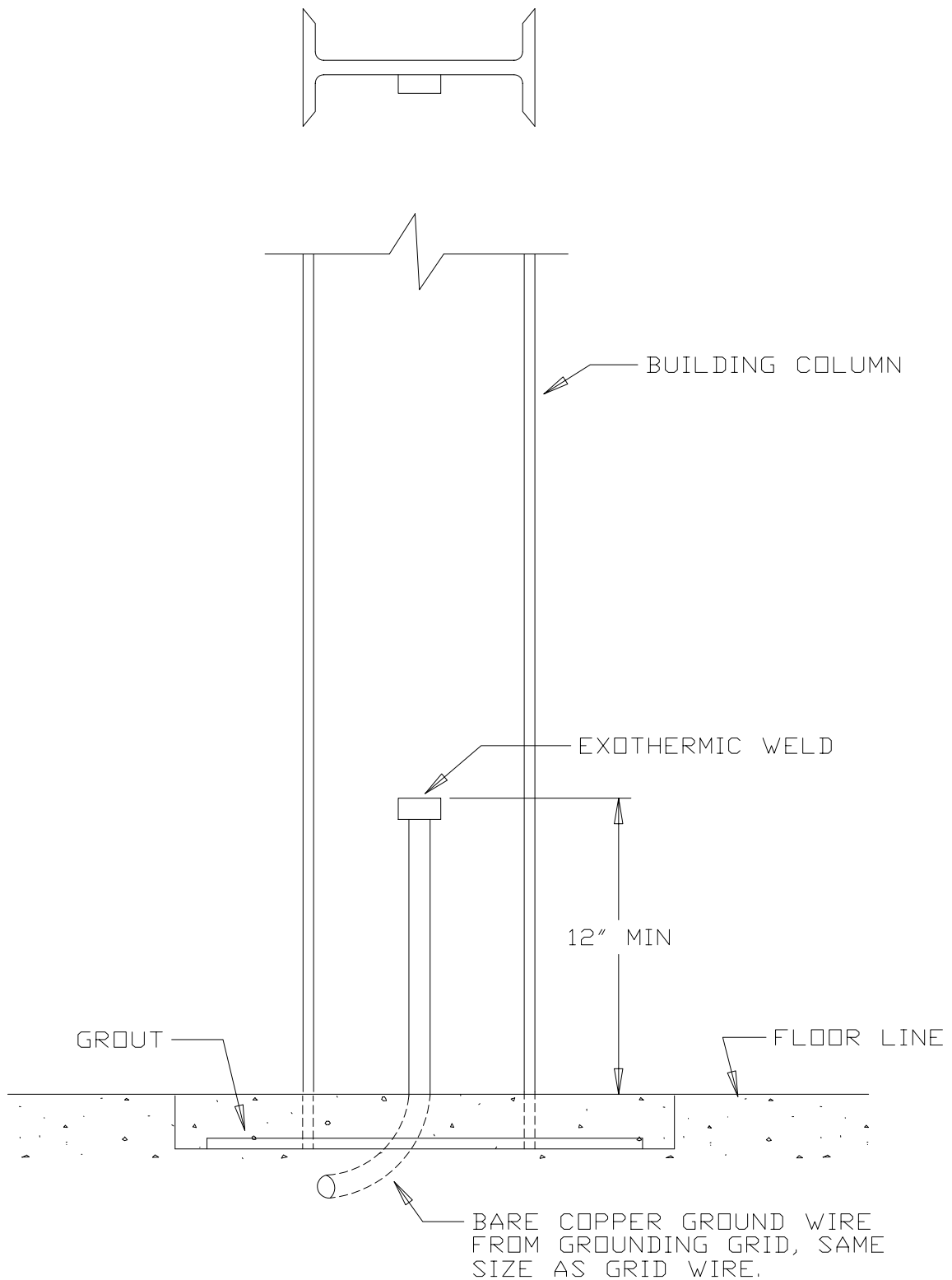
				Serial Number		Expiration Date	
Contractor Company							
Contractor Company			Contractor Designated Representative			Phone Number	
						Pager Number	
3M							
3M Designated Representative						Phone Number	
						Pager Number	
Work Area							
Process/Equipment				Building Number		Floor Number	
						Date Work to Start	
Requirements							
General Information				Personal Protective Equipment			
<u>Review:</u> Completed N/A Proper and safe site and area entrance <input type="checkbox"/> <input type="checkbox"/> Proper parking area <input type="checkbox"/> <input type="checkbox"/> Smoking area <input type="checkbox"/> <input type="checkbox"/> Break area <input type="checkbox"/> <input type="checkbox"/> Rest rooms <input type="checkbox"/> <input type="checkbox"/> Dock use <input type="checkbox"/> <input type="checkbox"/> Cafeteria <input type="checkbox"/> <input type="checkbox"/>				<u>Review:</u> Completed N/A Safety Glasses (w/side shields, if applicable) <input type="checkbox"/> <input type="checkbox"/> Safety Shoes <input type="checkbox"/> <input type="checkbox"/> ESD shoes required? <input type="checkbox"/> <input type="checkbox"/> Conductivity meter location and use <input type="checkbox"/> <input type="checkbox"/> Respirator <input type="checkbox"/> <input type="checkbox"/> Hard Hat <input type="checkbox"/> <input type="checkbox"/> Other <input type="checkbox"/> <input type="checkbox"/>			
Emergency Response				Appropriate License / Certification			
<u>Review:</u> Completed N/A Emergency evacuation route <input type="checkbox"/> <input checked="" type="checkbox"/> Emergency assembly area <input type="checkbox"/> <input type="checkbox"/> Severe weather procedures <input type="checkbox"/> <input type="checkbox"/> Eye wash and safety shower locations <input type="checkbox"/> <input type="checkbox"/> Special alarms <input type="checkbox"/> <input type="checkbox"/>				<u>Review:</u> Need Have N/A Electrical <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Steam/Pipe Fitter <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Fire Protection <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Plumber <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			
Special Permits/Procedures				Appropriate Safety Training			
<u>Review:</u> Need Have N/A State/City <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Daily Work/Permit <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Spark/Open Flame <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Roof and penthouse entry <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Confined Space entry <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Energized Work <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Other (Line-Breaking, Trenching) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>				<u>Review:</u> Completed N/A LOTO <input type="checkbox"/> <input type="checkbox"/> Confined Space <input type="checkbox"/> <input type="checkbox"/> Respirator <input type="checkbox"/> <input type="checkbox"/> Hazardous Waste <input type="checkbox"/> <input type="checkbox"/> Asbestos <input type="checkbox"/> <input type="checkbox"/> Other (Refer to Training Matrix) <input type="checkbox"/> <input type="checkbox"/>			
Hazard Communication				Fire Protection Systems			
<u>Review:</u> Completed N/A Review area special hazards <input type="checkbox"/> <input type="checkbox"/> Additional hazards or areas to avoid <input type="checkbox"/> <input type="checkbox"/>				<u>Review:</u> Completed N/A Fire extinguisher location <input type="checkbox"/> <input type="checkbox"/> CO2 system and related procedures <input type="checkbox"/> <input type="checkbox"/>			
Additional Information							
Hazard Waste Guideline:				Housekeeping Requirements:			
Contractors generating hazardous waste on 3M sites will be responsible for the proper disposal of the material. Please ask Designated Representative with questions.				Upon completion of a project, it is expected that 3M property will be returned as the contractor received it from 3M (except modifications per the project).			
3M Equipment Use Procedure:				Incident Reporting:			
A contractor will not use any 3M tool or equipment unless a Equipment Use Agreement" has been completed. Refer to corporate policy "3M's Use of Outside Contractors".				Incidents (injuries/illness, fires, explosions, etc.) will be reported promptly to the Designated Representative and/or area supervisor. A copy of the contractor's report will be given to the PE Safety Engineer.			
Signatures Required After Completion							
Contractor Representative Signature						Date	
3M Designated Representative Signature						Date	

Emergency Phone: _____

Form 38194 - E

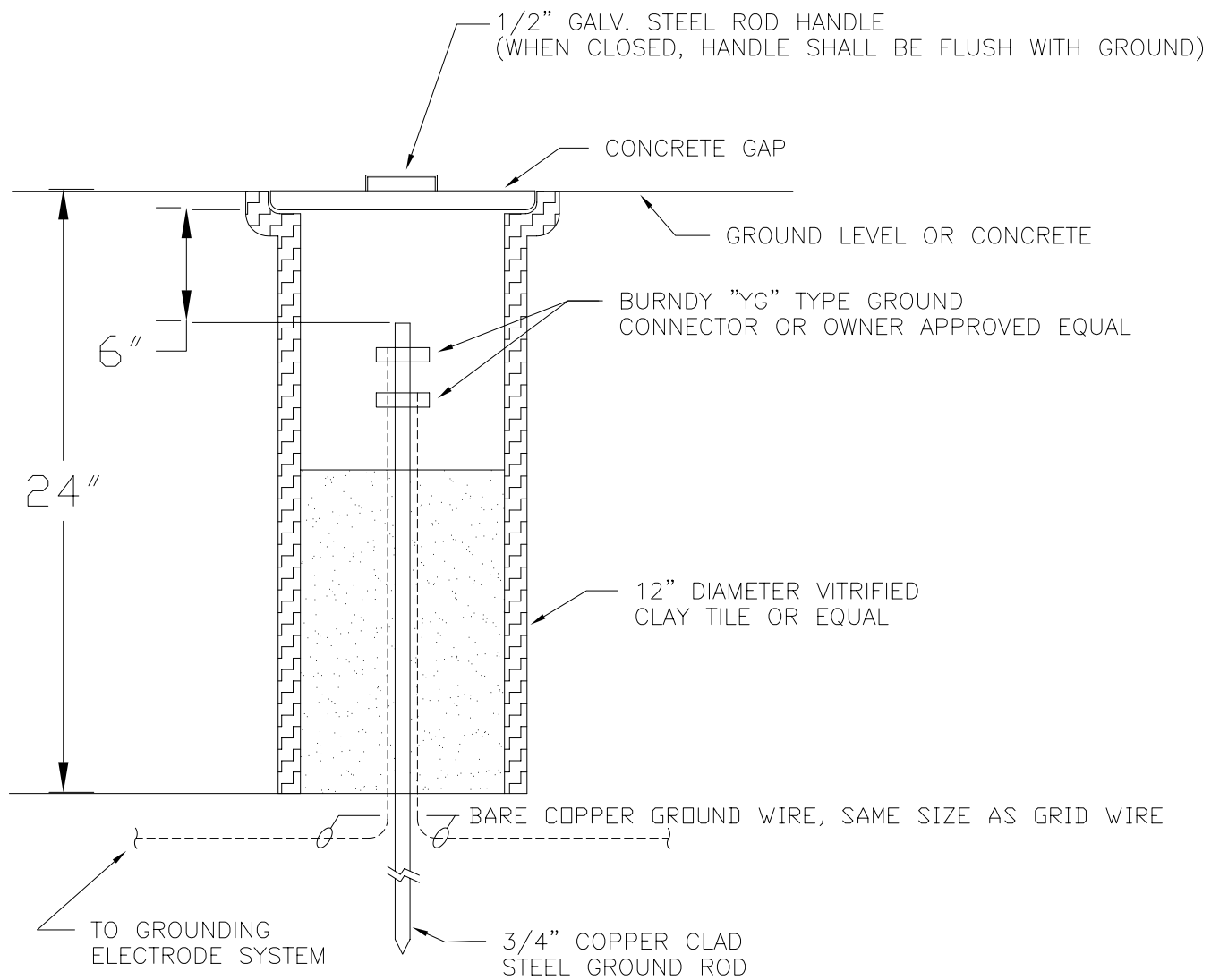
[illegible]

TYPICAL GROUNDING DETAIL



3M COMPANY
ST. PAUL MN

16455-1
RELATED DOCUMENTS

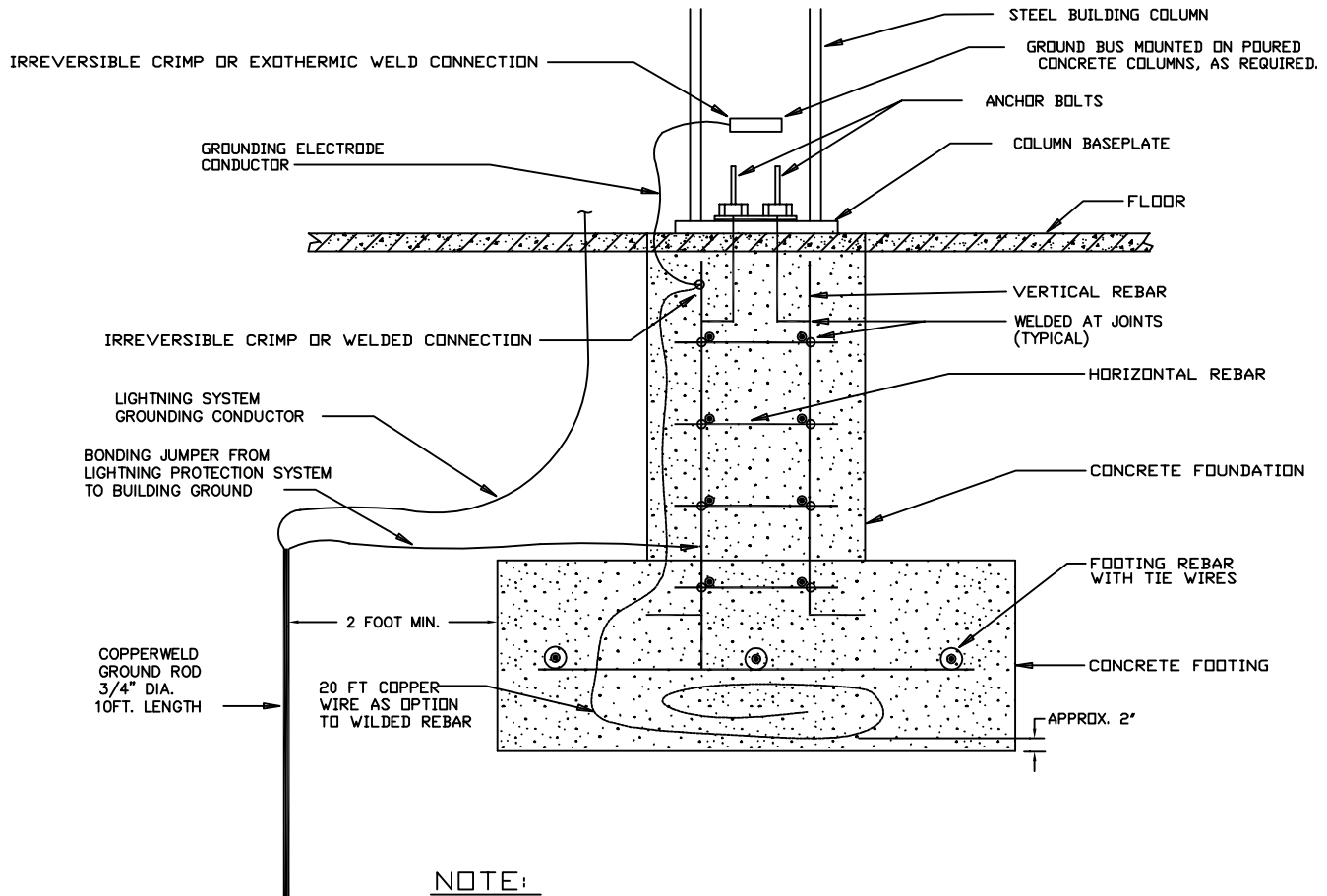


GROUND TEST POINT
NO SCALE

GROUND
TEST
POINT

UFER GROUNDING SYSTEM

STEEL BUILDING STRUCTURE



NOTE:

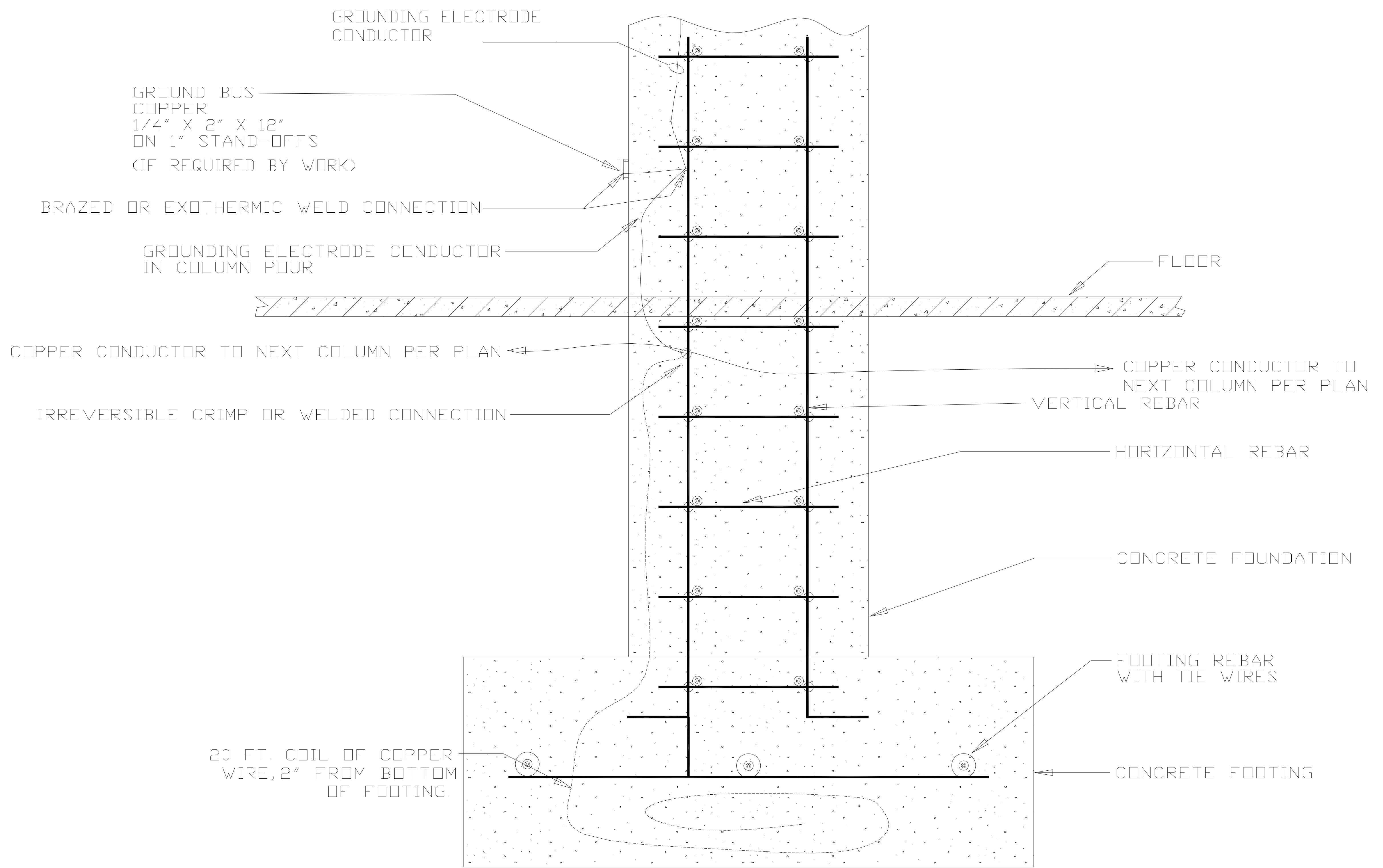
IF ELECTRICAL CONTINUITY IS OBTAINED BETWEEN THE ANCHOR BOLTS AND FOUNDATION REBARS, THE GROUNDING ELECTRODE CONDUCTOR MAY BE BONDED DIRECTLY TO THE ANCHOR BOLT ABOVE THE COLUMN BASE PLATE. AT LEAST ONE ANCHOR BOLT SHALL HAVE THE NUT TACK WELDED TO THE BOLT AND BASE PLATE TO ELIMINATE THE USE OF THE GROUNDING ELECTRODE CONDUCTOR BETWEEN THE COLUMN AND THE REBAR. IF A SEPARATE SYSTEM IS USED FOR GROUNDING OF THE LIGHTNING PROTECTION SYSTEM, THE GROUNDING ROD MUST BE KEPT A MINIMUM OF 2 FEET FROM THE BUILDING FOOTINGS.

3M COMPANY
ST. PAUL MN

16455-3
RELATED DOCUMENTS

UFER
GROUND
SYSTEM

UFER GROUNDING SYSTEM
POURED CONCRETE STRUCTURE



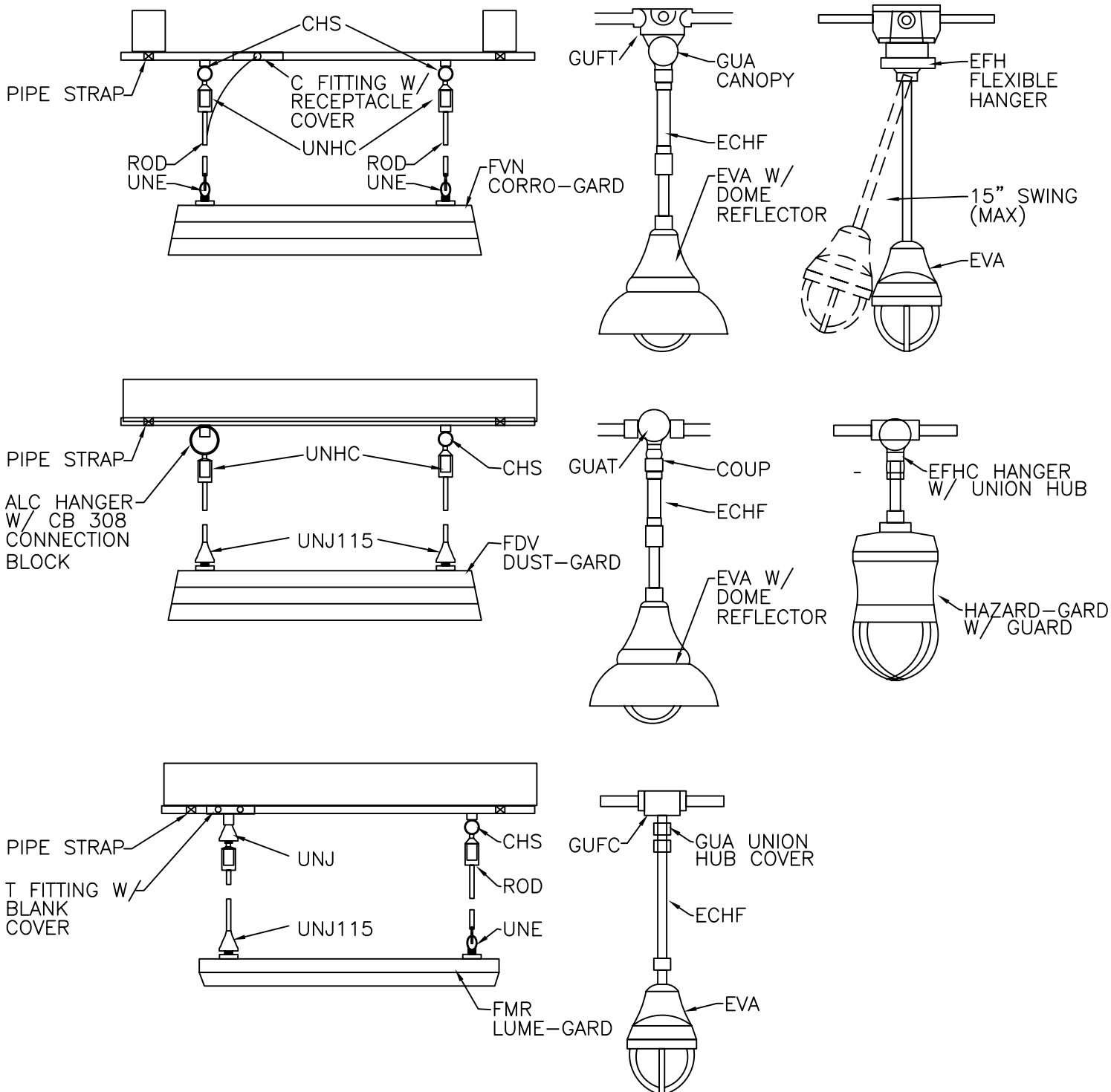
NOTE:

1. CONNECT ABOVE GROUNDING SYSTEM TO NEW FOOTINGS/SLAB REBAR NETWORK AS SHOWN, RECEIVE LOCAL ELECTRICAL INSPECTOR APPROVAL NECESSARY BEFORE CONCRETE POUR.

3M COMPANY
ST. PAUL MN

16455-4
RELATED DOCUMENTS

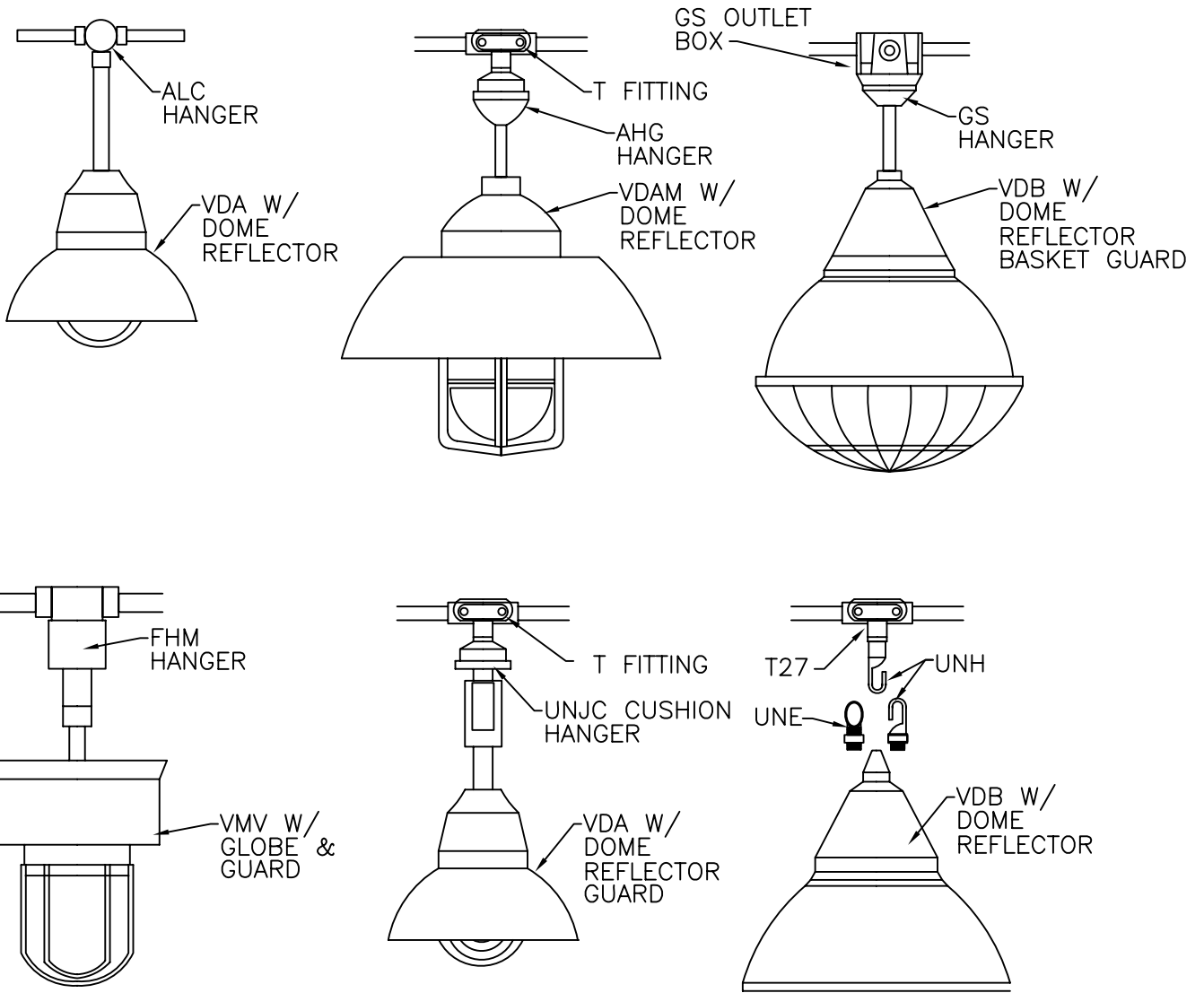
UFER
GROUND
SYSTEM



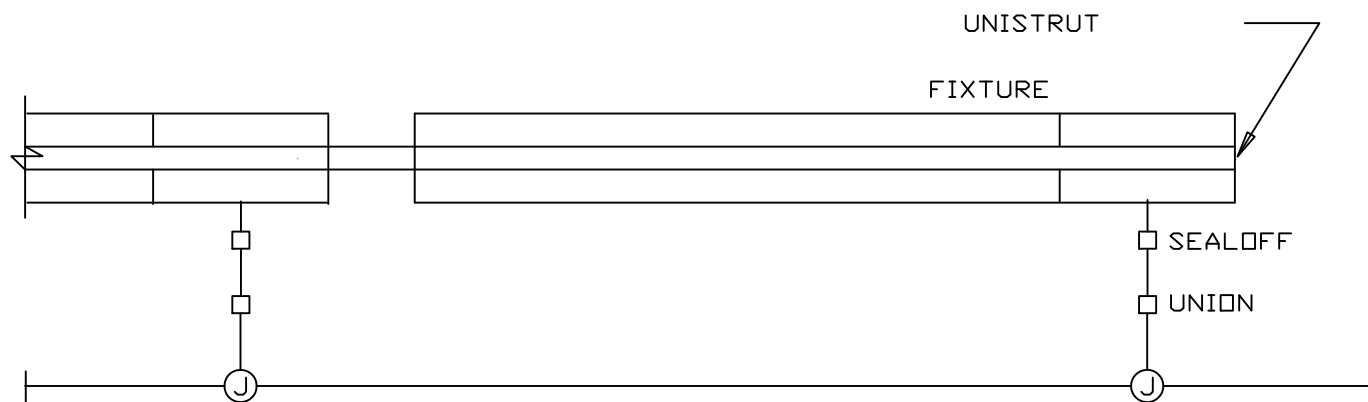
3M COMPANY
ST. PAUL MN

16500-1
RELATED DOCUMENTS

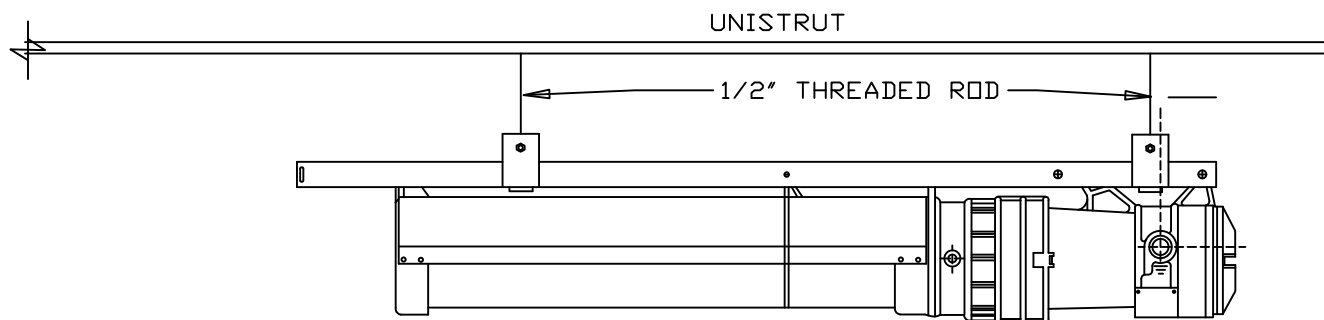
SUGGESTED
MOUNTING
METHODS



TYPICAL MOUNTING OF EXPLOSION PROOF FLUORESCENT FIXTURE



PLAN VIEW
NO SCALE

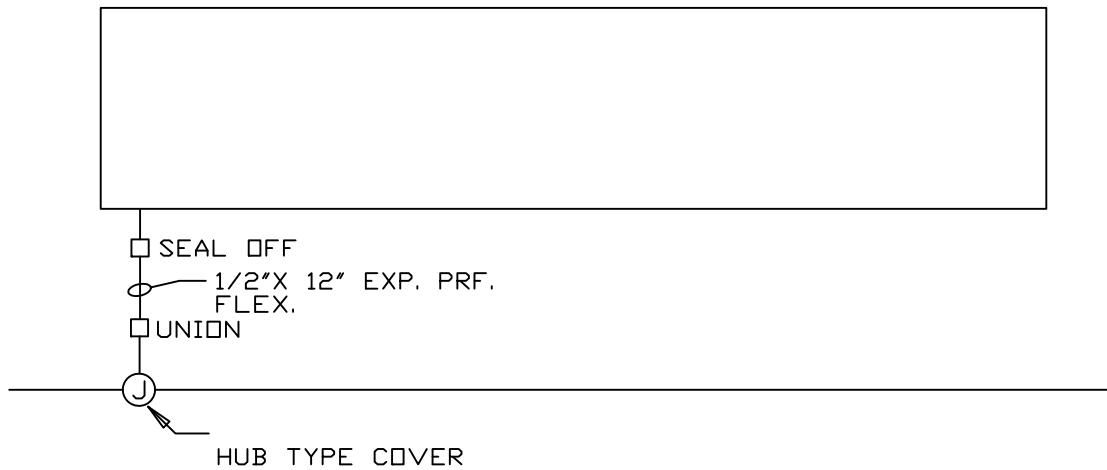


SIDE VIEW
NO SCALE

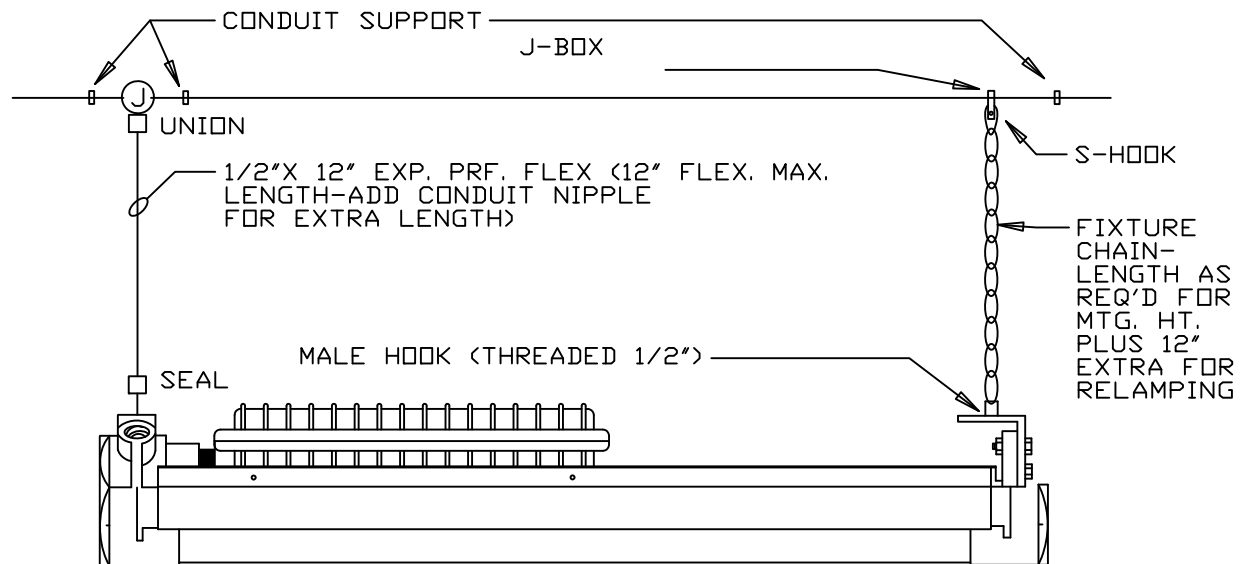
NOTE:

ALL MOUNTING MATERIAL, CONDUIT
AND CONDUIT FITTINGS PROVIDED
AND INSTALLED BY E.C.

TYPICAL MOUNTING OF EXPLOSION PROOF FLUORESCENT FIXTURE

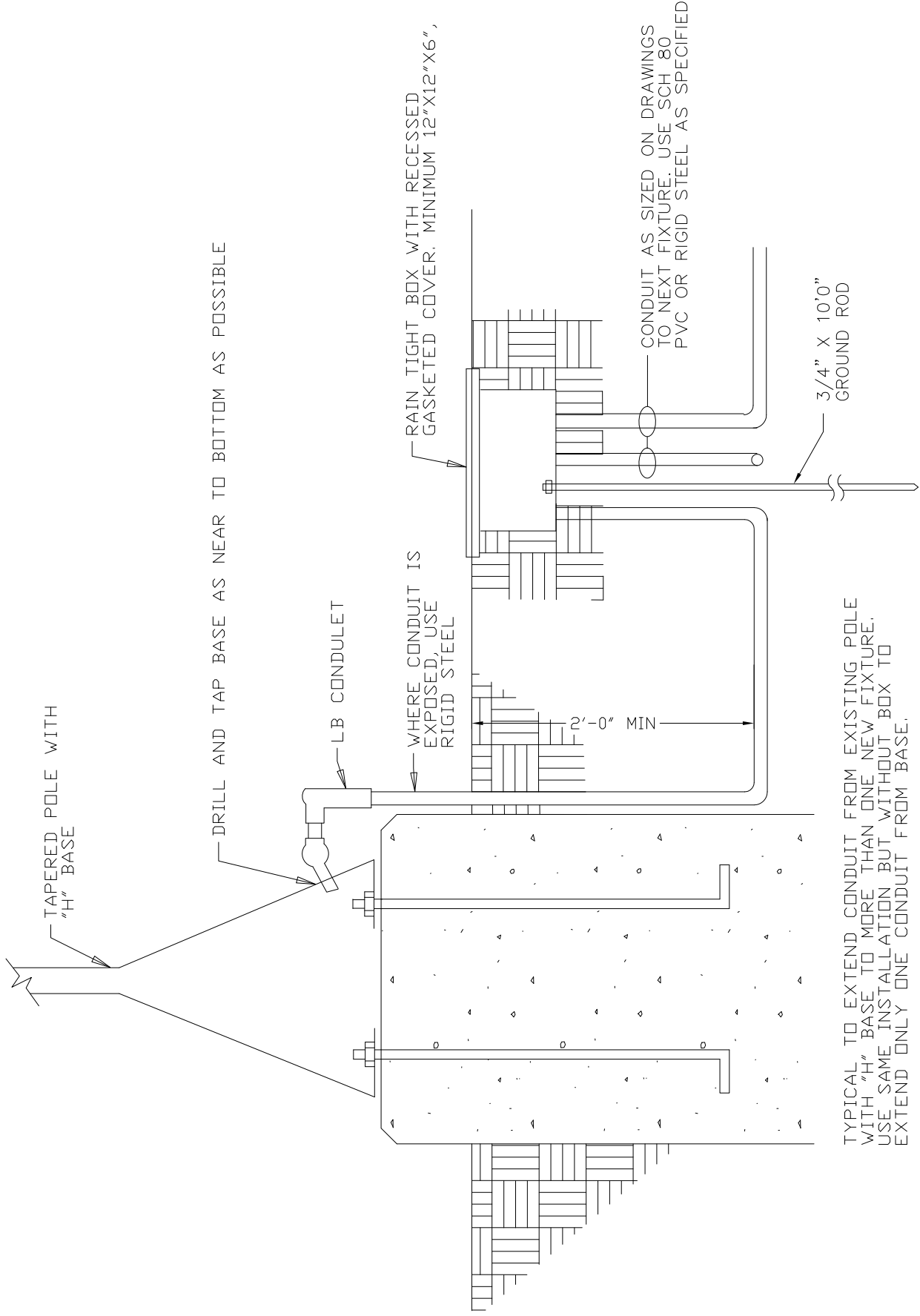


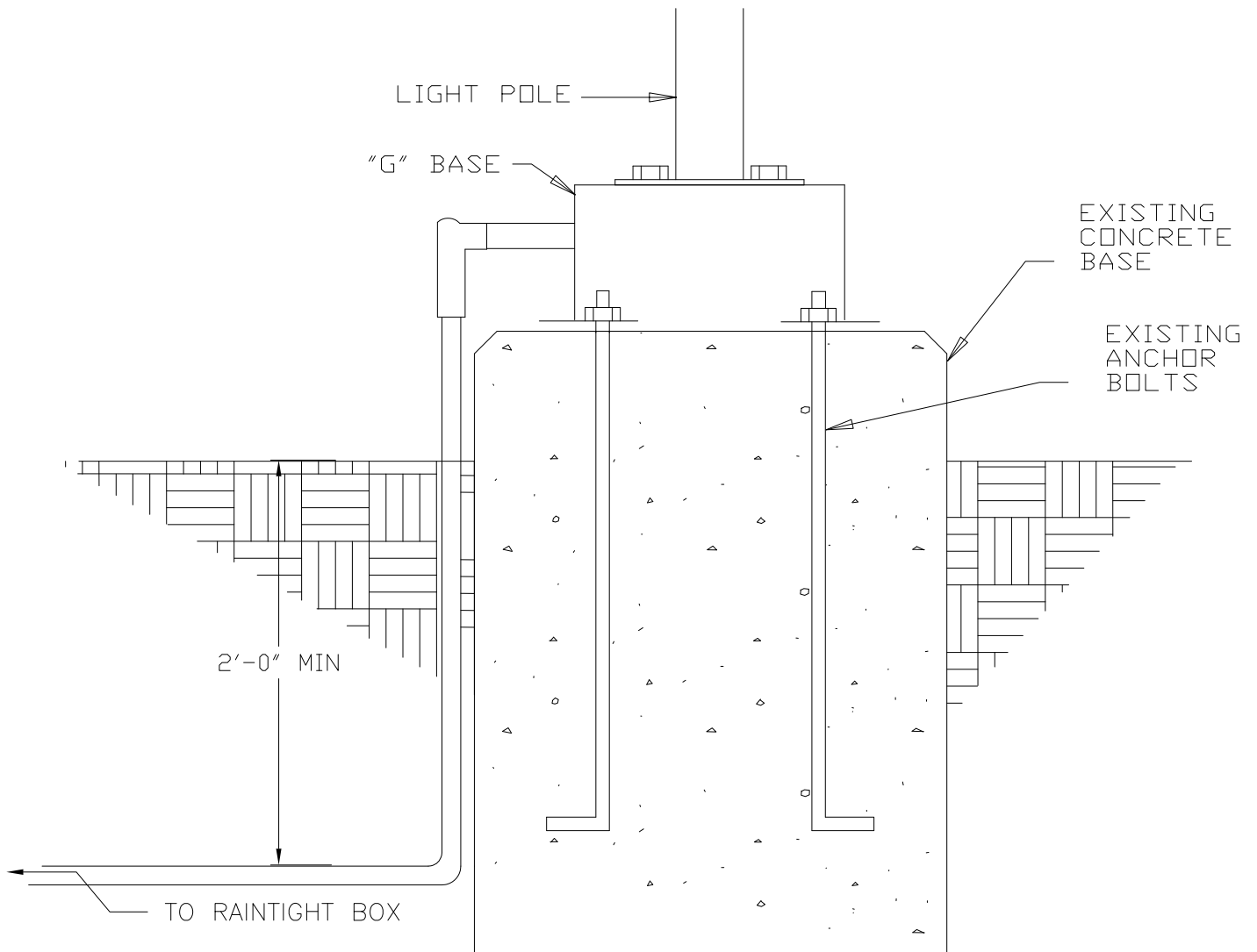
PLAN VIEW
NO SCALE



(FOR CLOSE MTG. OR END-TO-END MTG.)

SIDE VIEW
NO SCALE





TYPICAL FOR THE INSTALLATION OF
NEW POLES ON EXISTING CONCRETE
BASES. CONDUIT FROM "G" BASE TO
RAINLIGHT BOX.

OUTDOOR
LIGHTING
POLE

3M COMPANY
ST. PAUL MN

16500-8
RELATED DOCUMENTS

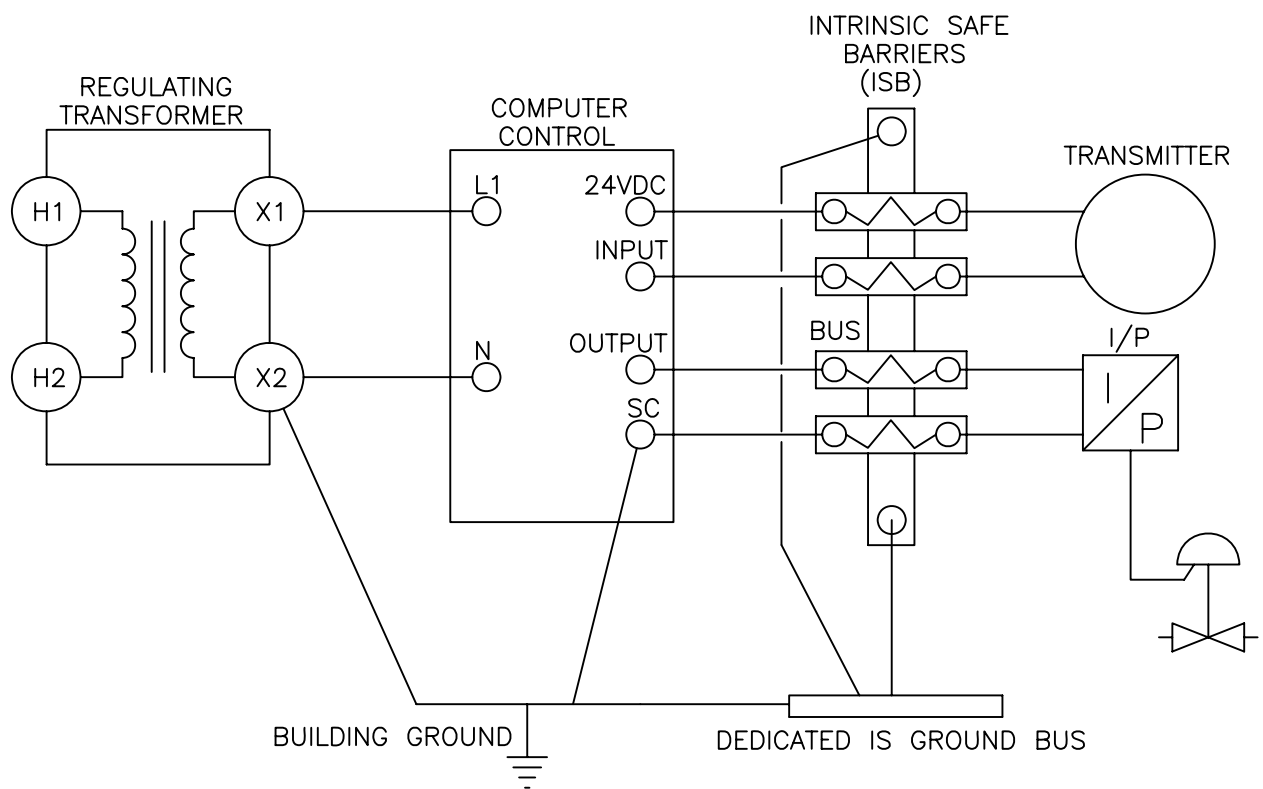
\\3M ELECTRICAL STANDING SPEC\S16500-8.DWG

3M Security CCTV Check List		
Are the cameras labeled with the appropriate text?	YES	NO
Is the software used to review the video left on site?	YES	NO
Who is the person that has the software	Name:	
Has training been completed to the site security representative ?	YES	NO
Is there an I.P. address ?	NO	Address
What is the camera size of the DVR ?	Amount	
What is the hard drive size of the DVR ?	Size	
Who from the site has reviewed the live video ?	Name:	
Are the camera views acceptable?	YES	NO
Has the DVR been setup correctly	YES	NO

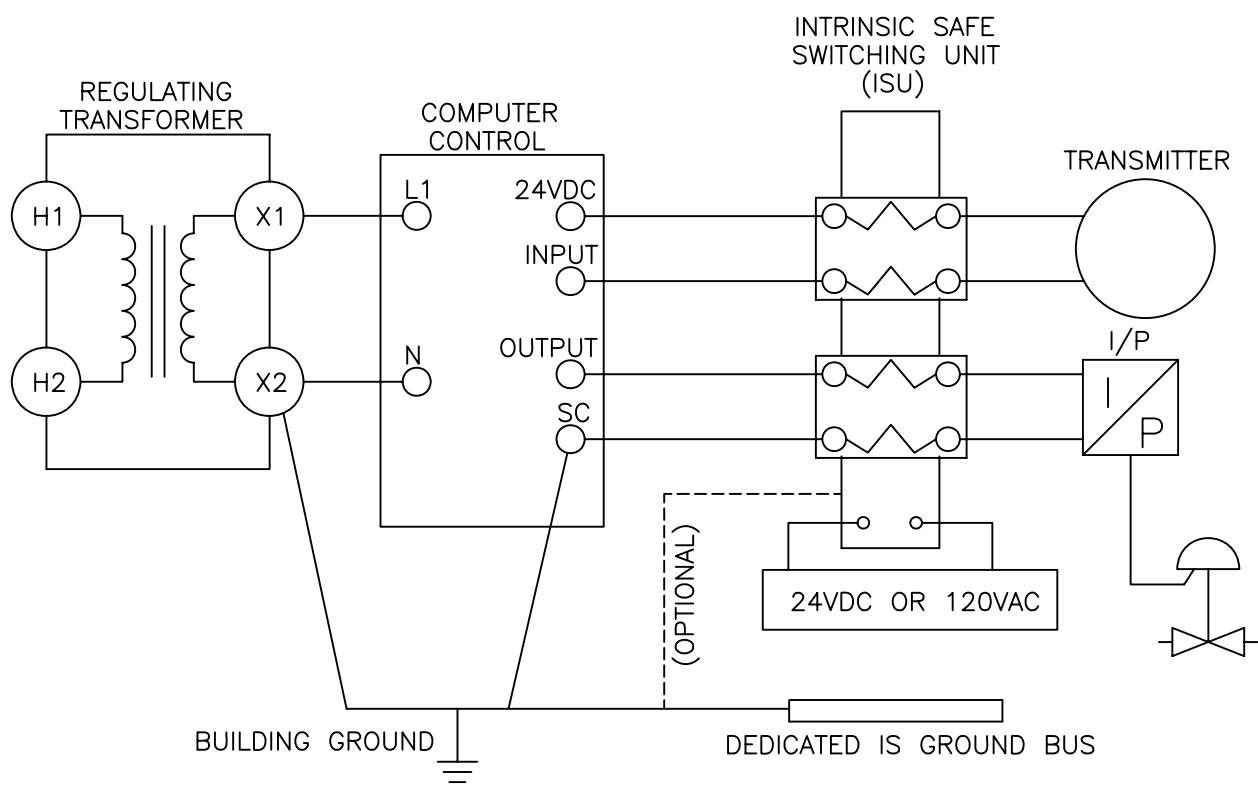
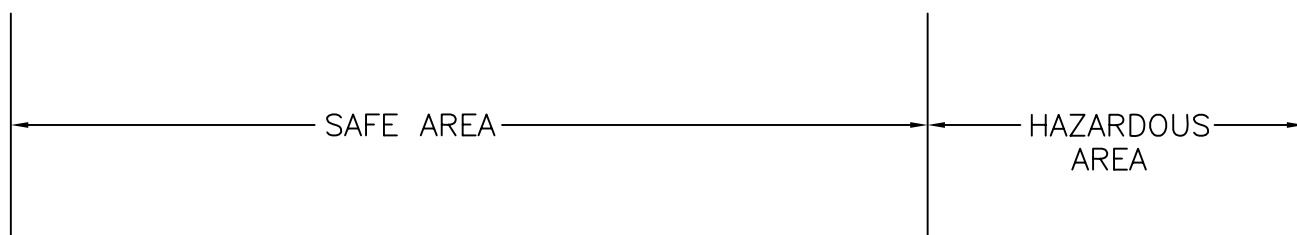
Recommend Setup

Record on event only - This setting will record only when there is motion in the camera view.
Pre event duration set to 5 - This setting will record activity 5 seconds before the activity happens.
Post event duration set to 10 - This setting will record activity 10 seconds after the activity happens.
Event record rate set to 3.0 pps - This setting will record 3 pictures per second.
The failure notification should be turn on. Enter the e-mail address for the person responsible for the CCVE equipment. – This setting will notify an e-mail address if the system fails.
The internal clock is to be set by the use of a I.P. address. 196.10.9.134 is the time clock address; it should be updated once a day

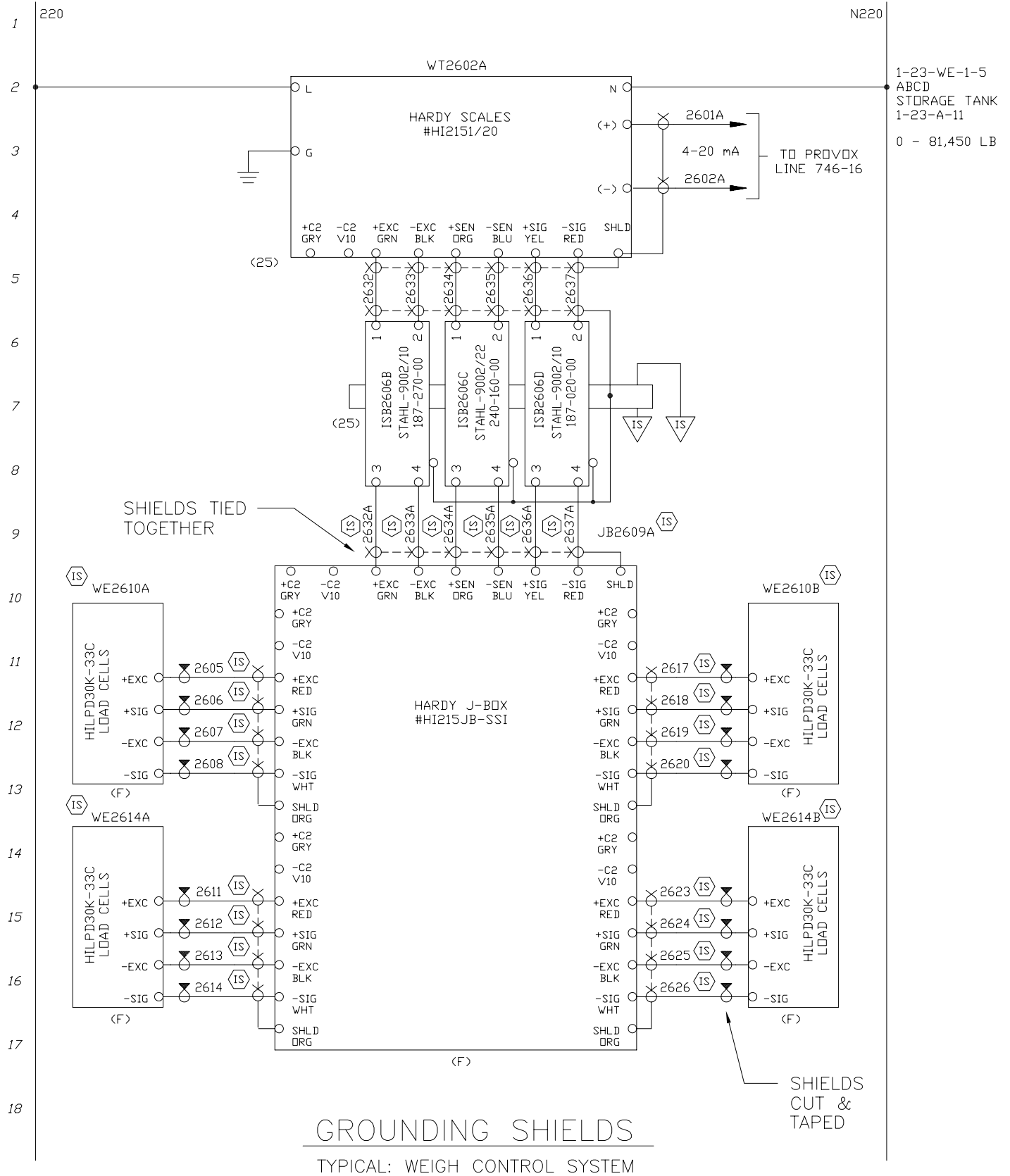
Sign, Date and add Telephone Number
Vendor
Designer
Customer

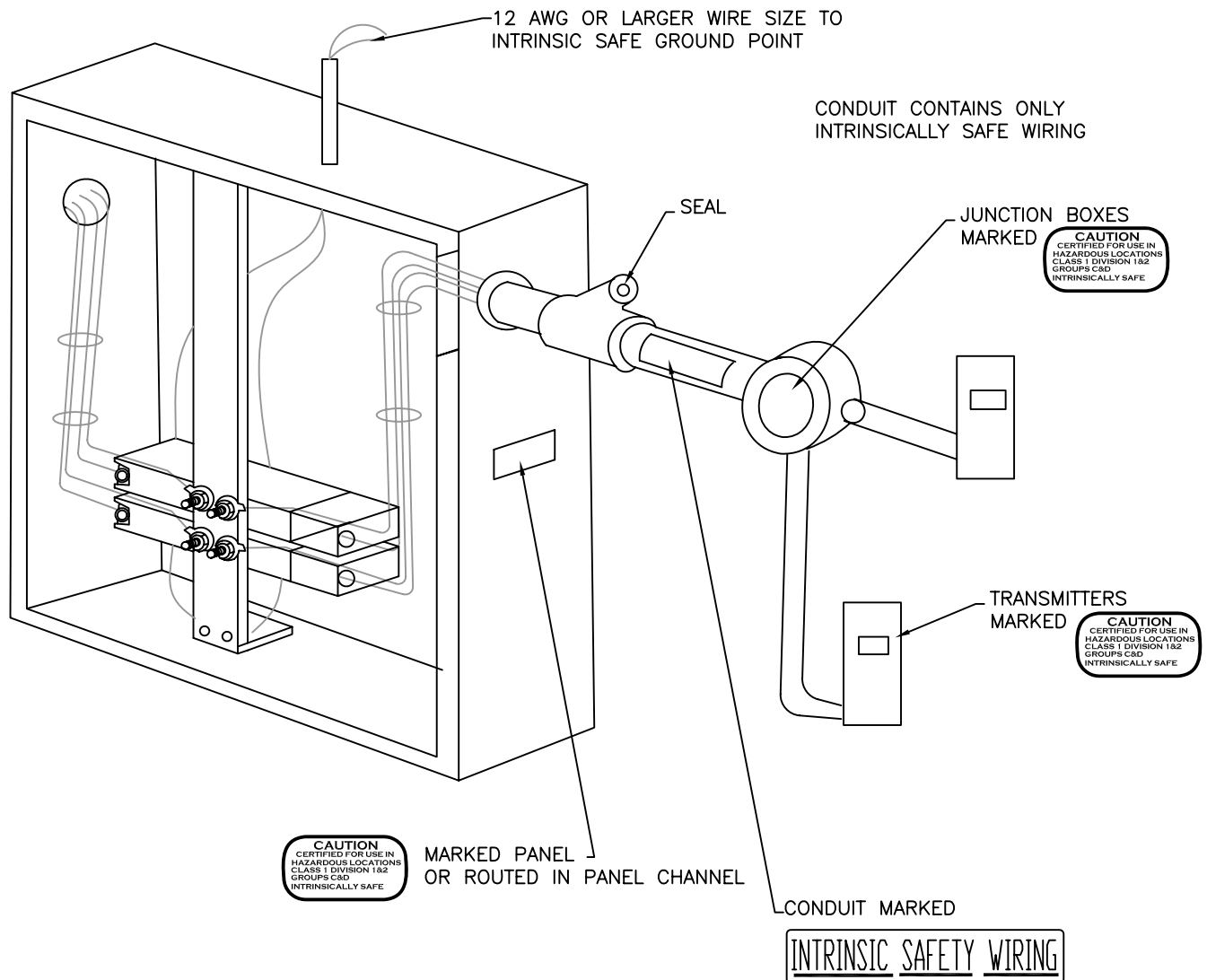


GROUNDING SYSTEM FOR INTRINSIC SAFETY (ISB)



GROUNDING SYSTEM FOR INTRINSIC SAFETY (ISU)

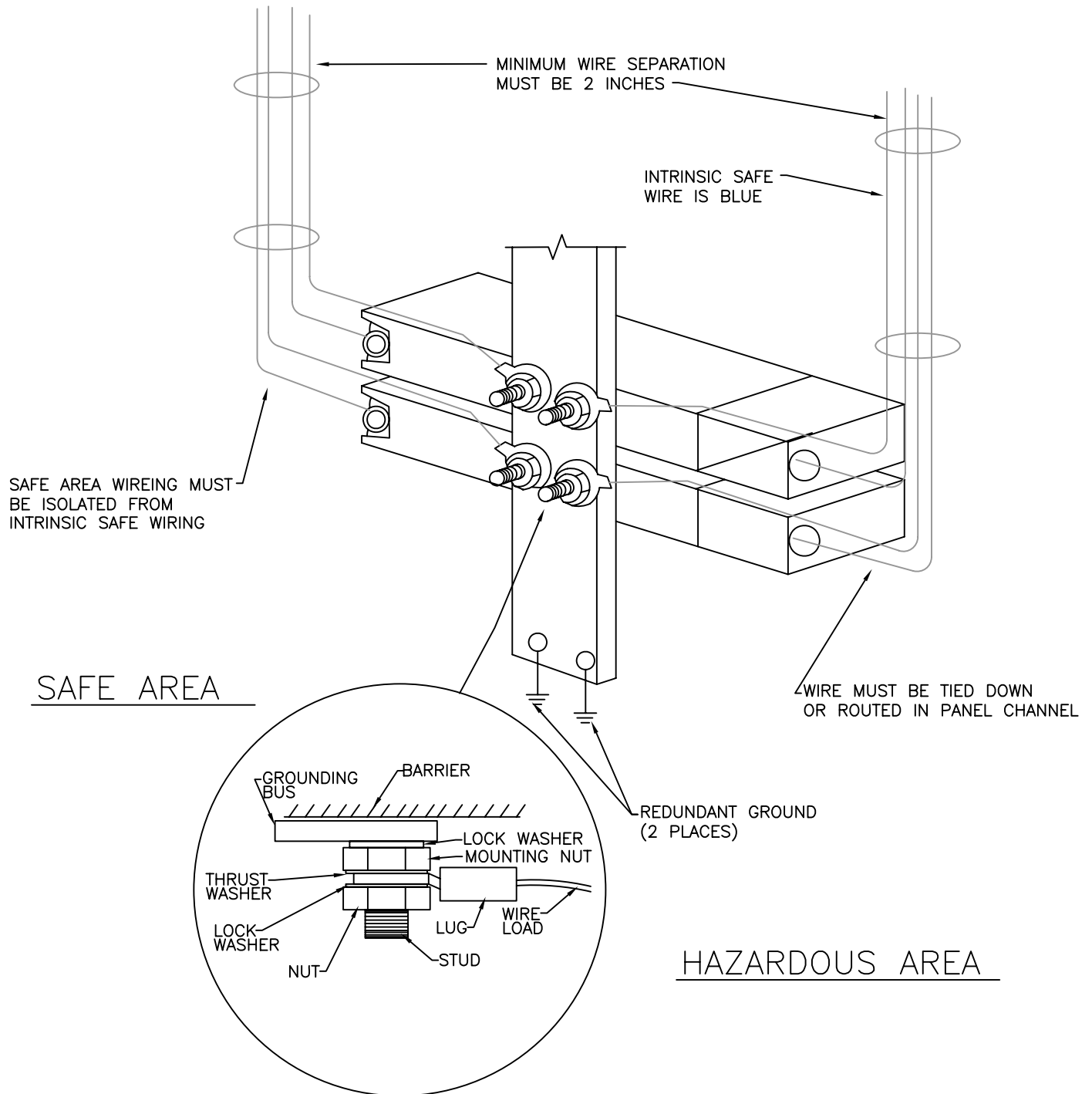




(TAKEN FROM 3M INTRINSIC SAFETY GUIDEBOOK, 1993)

MARKING OF INTRINSICALLY SAFE WIRING

PANEL WIRE ROUTING





PANEL AND DEVICE MARKING DECAL
3M PART NO. 27-63-0105

INTRINSIC SAFETY WIRING

CONDUIT MARKING DECAL
3M PART NO. 27-63-0104