

**Underrated Breaker Panel Replacement
National Gallery of Canada
Ottawa, Ontario**

SPECIFICATIONS

ISSUED FOR FINAL REVIEW

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Prepared For:

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Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical
- .2 Section 26 05 21 – Wires and Cables (0-1000V)
- .3 Section 26 24 16.01 – Retrofit Panelboards Breaker Type
- .4 Section 26 28 16.02 – Moulded Case Circuit Breakers

1.2 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Refer to CCDC 2 GC 3.11.
- .2 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.

- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .3 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .4 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .5 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .6 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .7 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .8 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .9 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .10 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .11 Delete information not applicable to project.
- .12 Supplement standard information to provide details applicable to project.

- .13 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.4 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 – Wires and Cables (0-1000V)
- .2 Section 26 24 16.01 – Retrofit Panelboards Breaker Type
- .3 Section 26 28 16.02 – Moulded Case Circuit Breakers

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, two final copies and one electronic copy of operating and maintenance manuals in English and French.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:

- .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.5 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of opaque drawings.
- .2 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .3 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Field changes of dimension and detail.
 - .2 Changes made by change orders.
 - .3 Details not on original Contract Drawings.
 - .4 References to related shop drawings and modifications.
- .4 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .5 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .6 Provide digital photos, if requested, for site records.

1.6 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.

- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .12 Include test reports as specified in Section 26 05 21 – Wires and Cables (0-1000V), Section 26 24 16.01 – Retrofit Panelboards Breaker Type, and Section 26 28 16.02 – Moulded Case Circuit Breakers.
- .13 Additional requirements: as specified in individual specification sections.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .3 Certificates:
 - .1 Provide CSA certified equipment.
 - .2 Where CSA certified equipment is not available, submit such equipment to authority having jurisdiction for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards and circuit breakers for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Contractor to pay associated fees.
- .3 Drawings and specifications required by Electrical Inspection Department and Supply Authority will be provided at no cost.
- .4 Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes.

- .1 Furnish Certificates of Acceptance from Electrical Inspection Department authorities having jurisdiction on completion of work to Departmental Representative.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification name plates for control items in English and French.
- .4 Use one name plate for both languages.

2.2 MATERIALS AND EQUIPMENT

- .1 Equipment to be CSA certified. Where CSA certified equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: lamicoid3mm thick plastic engraving sheet matt white finish, black core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Wording on name plates to be approved by Departmental Representative prior to manufacture.
- .3 Allow for minimum of twenty-five (25) letters per nameplate.

2.6 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light gray.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with other sections:
 - .1 Testing of all new thermal-magnetic circuit breakers.
 - .2 Insulation resistance testing for all existing supply and feeder cables.
 - .3 Thermographic scan of all retrofitted panelboards.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 SYSTEM STARTUP

- .1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.

3.5 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 24 16.01 - Retrofit Panelboards Breaker Type.

1.2 REFERENCES

- .1 InterNational Electrical Testing Association
 - .1 ANSI/NETA MTS Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems, 2015 edition.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Provide and install additional wiring, splicing to existing, as required in order to extend circuits to new circuit breakers.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests on all existing cables being connected to retrofitted panels in Section 26 24 16.01 - Retrofit Panelboards Breaker Type, using qualified personnel.
 - .1 Include necessary instruments and equipment.
 - .2 Inspect exposed sections of cable for physical damage and correction connection in accordance with the single-line diagram.
 - .3 Inspect bolted electrical connections for high resistance using low-resistance ohmmeter or by calibrated torque-wrench method in accordance with ANSI/NETA MTS-2015.
 - .4 Inspect compression-applied connectors for correct cable match and indentation.
 - .5 Inspect cable jacket insulation and condition.
 - .6 Acceptance tests:
 - .1 Before terminating cables, perform insulation resistance test on each conductor with respect to ground and adjacent conductors with 1000 V megger on each phase conductor. Test duration shall be one minute.
 - .2 Check insulation resistance after each termination.
 - .3 Perform continuity tests to ensure correct cable connection.
 - .4 Verify uniform resistance of parallel conductors.

- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 28 16.02 – Moulded Case Circuit Breakers.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.29-15, Panelboards and Enclosed Panelboards.
 - .3 CSA Z462-15, Workplace Electrical Safety
- .2 InterNational Electrical Testing Association:
 - .1 ANSI/NETA ATS-2015, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- .3 The American Society for Nondestructive Testing, Inc.:
 - .1 SNT-TC-1A, Qualification of Nondestructive Testing Personnel.
- .4 ASTM International:
 - .1 ASTM E1934-99a(2014)., Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Based on dimensions of existing boxes and trims, as indicated on drawings, and field verified by the contractor, submit the following:
 - .1 Breaker layout drawing with dimensions indicated, including trim dimensions/details, existing box dimensions/details, and nameplate designation.
 - .2 Component list.
 - .3 Conduit entry and exit locations and existing cable locations.
 - .4 Assembly ratings including:
 - .1 Short-circuit Rating
 - .2 Voltage Rating
 - .3 Continuous Current Rating
 - .5 Cable terminal sizes.
 - .6 Product Data Sheets.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for retrofitted panelboards including final as-built versions of all items included in shop drawing submission for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated in panel schedules and field verified by contractor.
- .3 Retrofit panels are to be listed by CSA, for retrofit applications, as built in manufacturer's factory, as approved for installation by authorized personnel, without modification to the panel assembly, to any manufacturer's existing panelboard box.
- .4 600 V panelboards: bus and breakers rated for 25,000 A (symmetrical) interrupting capacity or as indicated.
- .5 Panelboards shall be labeled with a CSA short-circuit rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided in accordance with the requirements of 14-014 of the CSA C22.1. It shall state the conditions of the CSA series ratings including:
 - .1 Size and type of upstream device
 - .2 Branch devices that can be used
 - .3 CSA series short-circuit rating.
- .6 Interiors for retrofit panelboards shall be completely factory assembled devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
- .7 Removable trims for retrofit panelboards shall be designed specifically for retrofit applications. Trims shall have concealed hardware.

- .8 The retrofit interior panel shall be provided with an integrated depth adjustment mechanism as part of the assembly that includes depth markings for use by the installer.
- .9 Surface trims shall be same height and width as box.
- .10 A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
- .11 All locks shall be keyed alike.
- .12 Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of ASA 61 gray paint applied.
- .13 Provide new drip shield for each retrofitted panelboard.

2.2 BUSBARS

- .1 Main bus bars shall be silver-plated copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

2.3 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: mounted on top or bottom of panel to suit existing configuration. When mounted vertically, down position should open breaker.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 Execution

3.1 INSTALLATION

- .1 The Contractor (coordinating with Manufacturer's site representative) shall install all equipment per the manufacturer's recommendations and the contract drawings.
- .2 Equipment warranty shall be extended to two years from date of installation when service representatives employed by the equipment manufacturer perform installation.

3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

3.3 FIELD QUALITY CONTROL

- .1 The contractor shall arrange for a thermographic survey to be done following re-energization of each retrofitted panelboard using the procedure outlined as follows.
- .2 Visual and Mechanical Inspection
 - .1 Remove all necessary covers prior to thermographic inspection. Use appropriate caution, safety devices, and personal protective equipment per CSA Z462.
 - .2 Inspect physical and mechanical condition of items.
 - .3 Note any code deficiencies.
- .3 Provide a report which includes the following:
 - .1 Note areas inspected, and list inaccessible and/or unobservable areas and/or equipment.
 - .2 Discrepancies between expected and as-found equipment.
 - .3 Provide photographs and thermograms showing temperature difference between any areas or items of concern and the reference area.
 - .4 Probable cause of temperature differences and recommendations.
 - .5 For all devices with noted issues, identify loading of the device.
 - .6 To provide positive 'Proof of Inspection', provide one of the following:
 - .1 Digital photos of every inspected device. Provide one close-up picture of the device nameplate, and one overall picture of the device with the cover removed. Provide all pictures to the client in electronic format saved on a CD or DVD as required. Use minimum resolution to provide overall device picture of at least 500kB.
 - .2 An equipment list with name and ID number of each device, plus basic electrical parameters (i.e. volts and amps, etc.)
- .4 Test Parameters
 - .1 Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
- .5 Test Results
 - .1 Suggested actions based on temperature rise can be found in NETA ATS Table 100.18.
- .6 Qualified Personnel:
 - .1 Personnel doing scanning and report to have Level II Infrared certification from an infrared manufacturer or training group in accordance to the American Society for Non-Destructive Testing Inc. standard SNT-TC-1A and ASTM standard E1934-99a(2014).

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No. 5-13, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).
- .2 InterNational Electrical Testing Association
 - .1 ANSI/NETA ATS Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems, 2015 edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Include time-current characteristic curves for panel main breakers.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 5-10 times current rating.
- .5 Circuit breakers to have minimum 25,000 symmetrical rms interrupting capacity rating or form part of a series-rated system where the equivalent rating is achieved.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

3.2 FIELD QUALITY CONTROL – CIRCUIT BREAKERS, MOULDED CASE

- .1 Visual & Mechanical Inspection, provide all typical inspections and cleaning, plus:
 - .1 Ensure that circuit breaker can be successfully opened and closed manually.
 - .2 Ensure that circuit breaker can be successfully opened via the “Push to Trip” button. Trip and verify correct operation of the circuit breaker a minimum of three (3) times by depressing button.
- .2 Electrical Tests
 - .1 Perform a contact resistance test with a low resistance ohmmeter on each phase of closed circuit breaker.
 - .2 Confirm shunt-trip operation of circuit breaker, where applicable.
- .3 Test Values
 - .1 Compare bolted connection resistances to values of similar connections.
 - .2 Bolt torque levels shall be in accordance with NETA ATS Table 10.12 unless otherwise specified by manufacturer.
 - .3 Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 25 percent of the lowest value. Microhm value should not exceed the following:
 - .1
$$\frac{0.050volts}{Equipment\ Continuous\ Current\ Rating} \times 1,000,000$$

3.3 FIELD QUALITY CONTROL - THERMAL MAGNETIC TRIP UNITS

- .1 Electrical Tests
- .2 Verify functionality of trip unit by tripping using the trip button of the trip unit, if present

END OF SECTION