External Policies

Introduction:

The purpose of this document is to outline policies that our subcontractors are required to follow on projects.

The Policies:

1) Anchor Bolt and Embed Policy
2) Camber Survey Policy
3) Cleanup Policy Procedures
4) Conduit in Metal Deck Policy
5) Flooring Policy
6) Masonry School Policy
7) Membrane Installation Policy
8) Moisture Control Policy
9) No Smoking Policy
10) Subcontractor Site Specific Quality Plan Policy
11) Substitutions Policy
12) Wall Cavity Policy
13) Window School Policy
14) Window Testing Policy
15) MEP Systems Pre-Testing & Project Completion Policy

External Policies

Introduction:

The purpose of this document is to outline policies that our subcontractors are required to follow on projects.

The Policies:

1) Anchor Bolt and Embed Policy
2) Camber Survey Policy
3) Cleanup Policy Procedures
4) Conduit in Metal Deck Policy
5) Flooring Policy
6) Masonry School Policy
7) Membrane Installation Policy
8) Moisture Control Policy
9) No Smoking Policy
10) Subcontractor Site Specific Quality Plan Policy
11) Substitutions Policy
12) Wall Cavity Policy
13) Window School Policy
14) Window Testing Policy
15) MEP Systems pre-Testing & Project Completion Policy

Anchor Bolt and Embed Policy

Introduction:

This policy outlines the requirements for verification of anchor bolt location and elevation by the Subcontractor and a professional surveyor. The policy also requires verification of embed location and elevation.

The Process:

1. Review contract documents and identify all required embeds and anchor bolts.
2. Determine who will provide embeds and anchor bolts and coordinate with schedule.
3. In the event anchor bolt repairs or modifications are required, the procedures must be approved by the Structural Engineer of Record and included as part of the Authorization to Proceed with Steel Erection Explanation form.
4. Review installation prior to concrete pour.
5. Verify orientation and placement of anchor bolts, plumb and level.
6. Verify embeds are plumb and level.
7. Subcontractor is responsible for verification. This should be done both pre-pour and post-pour.
8. Location and elevation to be confirmed by a professional surveyor after concrete pour and prior to commencing steel erection.
9. Document survey results and file in subcontractor contract file.

CAMBER SURVEY POLICY

Introduction:

The purpose of this policy is to outline the requirements for the proper documentation of the camber for steel and concrete structures, as indicated on the design drawings. The camber is determined by the design professionals to address issues of anticipated deflection. The required camber is based on theoretical data and is sometimes difficult to predict. Our responsibility is to document the camber prior to placement of concrete and the resulting deflection as a result of the loading. This documentation is to be submitted to the engineer of record, who will evaluate it and may make revisions to procedures.

The Process

1. Understand the design intent of the engineer through a Pre-Construction Conference. Ask how much of the camber should come out after loading.
2. Discuss concrete placement procedures, ie: loading the center of the bay and working out for a steel building, etc.
3. Discuss pour sequence.
4. Discuss wet screed vs. mechanical screed

Survey Requirements

1. Steel Frame Buildings

    a. Survey bottom of all beams, girders at center of span and the free ends of cantilevers prior to pour. This will show that the fabricator provided cambered material.
    b. Survey bottom of beam at center of span post pour. This needs to be performed prior to loading the floor with any other materials or loads. This will show how much of the camber came out with the pour.

2. Concrete Frame Building

    a. Requirements for survey should be established at Pre-Construction Conference.
        i. Center of Bays for flat plate work.
        ii. Joist and beam centers for beam and joist work.
        iii. The ends of any cantilevers.
        iv. Timing needs to be discussed as it will not be clear how much camber comes out until after the shoring is released.

3. Survey can be performed in house or by professional surveyor.

CLEANUP POLICY PROCEDURES

It is the expectation that all contractors on Power projects are to clean up as required to provide for a safe, productive project site.

Project teams are to set this expectation with each contractor during the buyout and pre-construction meetings and with each tradesperson during the orientation that clean up is frequent enough to provide a safe, productive work environment. These expectations are then reinforced during the Foreman's Meetings as well as daily interaction during Site Observation Reports. If these expectations are not met, Power has provided the means to enforce this expectation through Article 29: Clean Up in the Master Subcontract Agreement. It provides the right to clean up, on behalf of the subcontractor, in the event they fail to do so after proper notification.

Master Agreement Reference:

ARTICLE 29: CLEAN UP
Subcontractor shall perform regular cleanup and prompt removal from Job Site and adjacent roadways of all dirt, mud, excessive dust, and debris resulting from Work performed under the Contract notwithstanding any reference in the Contract Documents requiring General Contractor to perform said cleanup or rubbish removal. In cleaning or utilizing adjacent roadways, Subcontractor shall, at no cost to General contractor, provide flagman to the extent that General Contractor determines they are required. In the event Subcontractor fails to perform regular cleanup and prompt removal from the Job site, General Contractor shall perform said cleanup on Subcontractor's behalf and charge Subcontractor for the cost thereof. If a general cleanup of the Project is required on behalf of all subcontractors which either are working, or recently have worked, at the Job Site, General Contractor shall perform said cleanup and charge the cost thereof to said subcontractors on a prorated basis using its sole discretion to determine the basis for the prorated charge. Upon completion of the cleanup, Subcontractor will be notified in writing within a reasonable time period, as to the costs expended in its behalf. If Subcontractor disagrees with such charge, it may pursue its remedies under Article 14 of this Contract.

CONDUIT IN SLAB ON METAL DECK POLICY

General:

We are recommending that we never install conduits in a slab on metal deck for any Healthcare Projects. On other Non-Healthcare Projects we recommend certain practices be followed as outlined below.

The risk of hitting a conduit during subsequent work is too great. The inability to effectively use detection methods to locate embedded conduit is further support for this policy.

Other means of running conduit to particular locations must be implemented such as overhead and drop down or suspended under deck and "poked through". Most installations, though possibly more costly, can be achieved without embedding the conduit. Cost savings is not an acceptable justification for embedding conduit.

Exceptions in Healthcare Projects:

Instances may arise on Projects when despite all efforts to install a conduit in an acceptable method; the only solution is to embed the conduit. In these rare occasions the following steps must be taken.

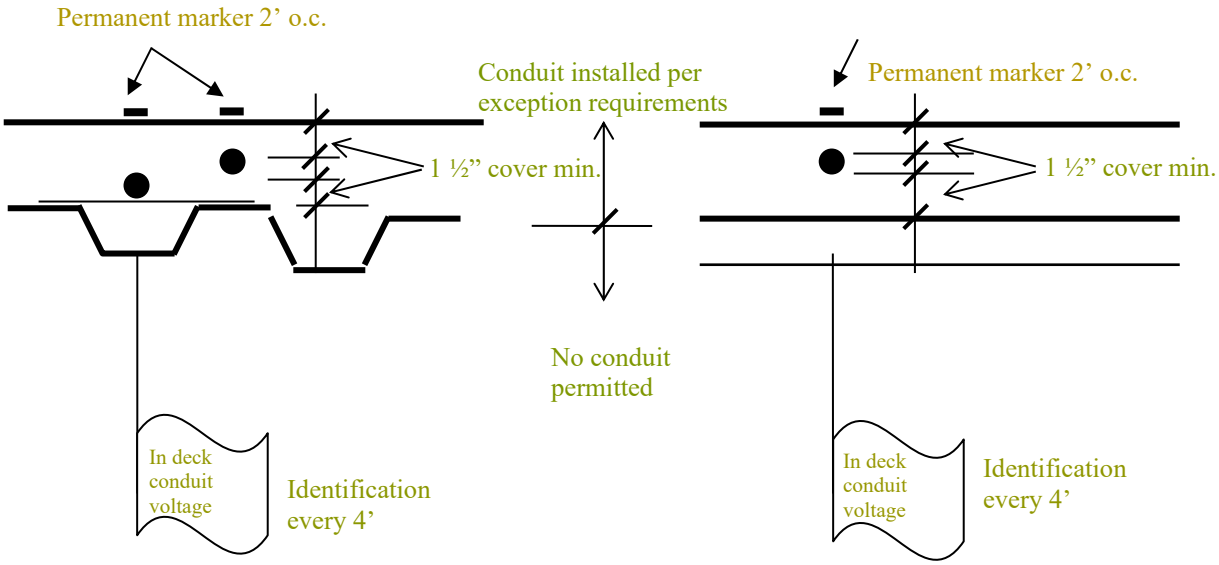
1. The conduit may ***never under any circumstance*** be placed directly on the metal deck parallel to the span in the bottom flute of the deck. ACI302.1R-16 section 3.4.6 requires a minimum of 1 ½" concrete cover top and bottom for all pipe and electrical conduit. Check with the Authority Having Jurisdiction (AHJ) for any other limitations.
2. Wherever the conduit is run the conduit must be identifiable from below with some sort of visual means to indicate the location of the conduit. Examples might include a "chair" screwed to the deck that holds the conduit up spaced 2' to 3' apart and leaves the screws exposed below for identification.
3. If the deck is to be fireproofed there may not be an adequate way to identify the location of embedded conduits. If this is the case install 12" hangers with red flags below the slab locating the conduit and its voltage.
4. The conduit must be located from above and marked every 2 feet in permanent marker immediately following the pour identifying it's location, including below the slab as recommended in # 3.
5. A precise as built accurately indicating the embedded conduit location must be submitted. The location must be referenced to a fixed building element that will be accessible after finishes are installed. (e.g.: column centerlines may not be accessible after finishes, fixed walls may be.)
6. If embedded conduits have been installed all subcontractors that may be effected must be made aware of the installation and the location.
7. Discussions with trades that will be installing anchors or hangers in slabs should always include limiting the location of these anchors or hangers to the deep flute of the deck only. No anchors or hangers to be installed in the shallow portion of the deck. A visual inspection of the area to locate the indicators of embedded conduits must occur prior to installing anchors or hangers. No anchors should be installed within 1' either side of the indicator.
8. A specific documented discussion with the subs must occur outlining the steps to be taken to meet the criteria outlined above. This discussion will be filed in the subcontractor file and the as-builts must be submitted within 1 week of the pour.

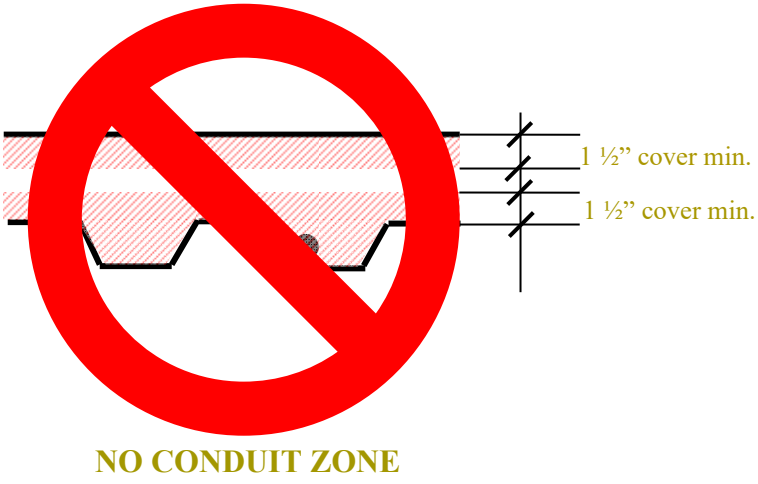
CONDUIT IN SLAB ON METAL DECK POLICY

Exceptions in Non-Healthcare Projects:

Any conduit embedded in the slabs on metal deck must meet the following requirements:

1. The conduit may ***never under any circumstance*** be place directly on the metal deck parallel to the span in the bottom flute of the deck. ACI302.1R-16 section 3.4.6 requires a minimum of 1 ½" concrete cover top and bottom for all pipe and electrical conduit. Check with the Authority Having Jurisdiction (AHJ) for any other limitations.
2. A precise as built accurately indicating the embedded conduit location must be submitted. The location must be referenced to a fixed building element that will be accessible after finishes are installed. (e.g.: column centerlines may not be accessible after finishes, fixed walls may be.)
3. A specific documented discussion with the subs must occur outlining the steps to be taken to meet the criteria outlined above. This discussion will be filed in the subcontractor file and the as-builts must be submitted within 1 week of the pour.





Flooring Installation Policy

Prior to installing ***any*** finish flooring over a substrate, that substrate must be tested and accepted by the manufacturer of the flooring material that will be covering it. For the majority of our projects, this means testing the concrete slab for surface moisture evaporation, relative humidity and alkalinity (pH). The specific tests will be determined by the manufacturer of each flooring product and will be identified in the product data.

There are three basic types of tests. One is the dome test for moisture vapor emission rate (ASTM-1869). This is an older test and is not commonly used. The more common test is the relative humidity test using probes drilled into the concrete slab (ASTM-2170). The third test is used to determine the alkalinity (pH) of the slab and is done in conjunction with either of the other two. It is vital that the project team adequately document the conditions of the substrate prior to releasing flooring for installation.

In preparation for installing any flooring product the project team must hold a preconstruction meeting with the flooring contractor and their manufacturer's technical representative(s) to discuss:

- The project's environmental conditions. The building should be at the anticipated normal operating temperatures and relative humidity.
- Identify curing compounds/ sealers (if any) used that may require surface preparation.
- Establish the appropriate number of tests, locations and protection of the areas.
- What surface preparation products, if any, have been used, or will be used, to level and or skim the concrete slab. Confirm compatibility of all products proposed for use. Discuss the need to take "mortar cube" compression test samples of any floor fill or surface preparation material that is being used.
- What the acceptable slab relative humidity and alkalinity levels are for each product being installed.
- What the action plan is if Rh levels remain too high. Mitigation is an option as well as waiting for the slab to dry out. Slab drying can be enhanced by dehumidifying the air. Probes should be placed well ahead of time to monitor the slabs rate of drying. Project teams can use this information to help decide the best approach to reducing the Rh to acceptable levels. Best practice is to use a different manufacturer's in situ probes, Delmhorst and Vaisala are two well respected industrial instrumentation manufacturers to verify readings which are above the allowable RH for the flooring adhesive to be installed.
- For projects with larger flooring installations (over 10,000 SF) it is best practice for a third party testing agency to confirm the contractor's test results with an independent test site or two.
- Discuss installation steps specifically. Establish and allow for "off-gassing" time of adhesive so bubbles and blisters will not occur.
- Discuss the proper materials/ method to protect the finished installation. Identify how long the flooring system must set before it cures and is useable.

MASONRY SCHOOL POLICY

Introduction:

It is critical that the masonry crew members understand the importance of their work as it relates to the long-term performance and durability of the building. A good mason produces a high quality, durable and attractive enclosure element that will perform well over the test of time. As each craftsperson will have different experiences and training, the purpose of these sessions is to ensure that Power's expectations and project requirements are clearly communicated to the crew.

The Process:

1) The masonry contractor is to coordinate the date and timing of any sessions with the International Masonry Institute and Power construction. As a guide this session must take place prior to more than 2% of any masonry being installed on the project. It is best that the project be fully staffed to minimize the amount of training required by the masonry contractor foreman to on-board new crew members.
2) There are typically two sessions for this Policy, one when starting block work and the other when starting masonry veneer work. If there is dimensional stone on the project that would be a separate session to cover that work.
3) Representation from the IMI is mandatory (Contact Jeff Diqui Director of Industry Development and Technical Service (630-606-8220 jdiqui@imiweb.org) as is Power Quality Support and Project team attendance. The masonry contractor is to have all masons on the project attend this session. If crew members are swapped out then new members must be brought up to speed by the foreman.
4) The agenda for the session will include the following general topic areas
    a. **Substrate review** – what to expect from the previous trade(s). What to do if previous work is not up to standard. Power staff will address this topic area
    b. **Membrane review** – Ideally the membrane manufacturer is in attendance as well and can speak to the proper procedures for:
        i. Installation
        ii. Repair of damage
        iii. Detailing around openings and other penetrations
        iv. Proper flashing
        v. Any additional work that may be required at the masonry ties

If the technical representative from the membrane manufacturer is not available, then Power expects the masonry contractor's Supervisory personnel to cover this topic area

c. Review of fundamentals for masonry laying (by IMI representative).
    i. Power expects that all head joints are full. This is a critical element for the water performance of the masonry veneer.
    ii. Power expects that minimum industry tolerances will be maintained, or better, for plumbness, alignment and coursing.
    iii. All end dams are to be installed per the flashing manufacturers recommendations and photos taken to document the installation. Photos are to be transmitted to Power on a regular basis, ideally uploaded into the Issues management software as they are taken.
    iv. Review Tie spacing
    v. Review project specific details for: Drip edge installation 2. Weeps and venting
    vi. Review proper installation procedures for cavity insulation materials
    vii. Review procedures for maintaining a clean masonry cavity including mortar collection device installation
    viii. Review jointing and tooling procedures
    ix. Review end of day protection procedures
    x. Review hot and cold weather masonry procedures as applicable for the project
d. Review other project specific details as agreed to between the Masonry Contractor and Power.

MEMBRANE INSTALLATION POLICY

Introduction:
This Policy applies to Air, Moisture, and Vapor membranes as well as Masonry Flashing, roofing and below grade waterproofing. Whichever type of system is being installed, all aspects of installation should be reviewed with the manufacturer and contractor, in the field, on an actual installation with the tradesmen installing the product.

The Process:

1. Review the construction documents and understand the systems involved.
2. Review manufacturer's product data for conformance to project specifications.
3. Is the system specified based on a manufacturer's standard, or based on performance criteria?
4. Is the membrane the appropriate product for where it is installed in the building and how it is expected to perform? Have the Manufacturer confirm it is the appropriate product.
5. Review shop drawings, product data and installation instructions for compliance with design intent and manufacturer's recommendations.
6. Coordinate with adjacent trades. Do not forget to include signage and the MEP trades who may have outlets, vents or sensors to be installed through these membranes. These trades will need to make provisions for proper sealing of their penetrations. They may choose to furnish sleeves, or expedite the installation of their piping, back boxes, devices, etc.
    a. Define the areas of work. Coordinate with the project schedule. This may be by elevation, area, enclosure system, or by floor. This will facilitate the documentation process.
    b. Understand the substrates that the membrane will be installed on and preparation requirements. Is primer required? Do seams need to be pre-treated? Etc.
    c. Understand limits on the size of gaps and out of plane limits.
    d. Review requirements for structure and thermal movements.
    e. Review compatibility issues with adjacent materials, waterproofing, roofing, sealants and finishes.
    f. Review the sequence of product installation for best performance. For example is sealant installed before or after the membrane?
    g. Discuss the appropriate measures that must be taken to maintain the integrity of the membrane when following trades install products over or through the membrane.
    h. Review continuity of enclosure. How are membranes tied into adjacent systems such as; roof membranes, windows, doors, waterproofing, etc?
7. Review and understand the installation process for limits on temperature, moisture and exposure duration.
8. Review the step by step process for all details during each phase of the work.
9. Review requirements for transition membranes, termination details and requirements for detailing penetrations through the membrane.
10. For masonry flashing pay particular attention to end dams.
11. Document the approved process.
12. Have the manufacturer confirm the process is per their recommendations.
13. Incorporate the process as developed above into a checklist that can be used by both the installer and Power personnel to confirm compliance. Use this checklist to do visual inspection

of the installed product. Pay close attention to termination details, flashing conditions, end dams, transitions to adjacent construction.

14. Photo document any terminations, penetrations and typical flashing details.
    a. Photos may be by Power staff or by the installing contractor.
    b. Photos are to be saved to a clearly labeled project file on Box on a weekly basis.
    c. Best practice is to identify the location where the photo was taken. A small dry erase board is one means of accomplishing this.
15. Sign off of proper installation is required prior to releasing an area for application or installation of finish or cladding materials.
16. Manufacturer's ***technical*** representation review during the initial installation and then periodic work in process reviews are required. Follow up to obtain documentation from the representative for their observations.

A few minutes spent in assuring proper detailing and installation will prevent hours and potentially thousands of dollars in investigating and resolving improper installations.

MOISTURE CONTROL POLICY

INTRODUCTION

The Moisture Control Policy consists of the following parts:

1. The Moisture Control Policy.
2. The Moisture Control Division Checklists: Divisions 1 through 33.
3. Training: An on-going procedure to assist all projects in providing and maintaining the correct and adequate means and methods for implementing moisture control during the project duration.

Implementation:

The Moisture Control Policy is incorporated into the Quality Control Program. It is part of the Pre-Construction Process. This ensures that we will provide a building product that complies with all aspects of this policy and program.

The place to discuss and implement the Moisture Control Policy is during the Team Strategic Planning Meeting and the Pre-Construction Meetings with all Subcontractors.

The Moisture Control Checklists are designed to be guidelines for understanding the moisture levels associated with each Division of the Work. Once it is understood that moisture is a part of each Trade Division Work, it can be identified, discussed, controlled, monitored, and documented.

Uncontrolled moisture, of any kind, on our projects is detrimental and contrary to our goals.

Assigning Roles and Responsibilities

Each Subcontractor shall be responsible for managing their Work and managing the moisture associated with their Work. Each Subcontractor needs to be informed of this necessity and needs to inform Power as to what techniques they will deploy to accomplish this responsibility.

Monitoring and Documentation

Monitoring and documentation of the process and procedures will be the responsibility of the Subcontractor. This monitoring and documentation will become part of the project record.
The monitoring and documentation procedures can be found in each Trade Division Checklist.

Purpose:

Power Construction Company, LLC pledges itself to provide this policy to ensure that moisture is controlled on all our projects. Controlling moisture ensures that all materials installed on our projects comply with their associated Standards of Quality.

The Power Construction Company, LLC Moisture Control Policy will be implemented and maintained on all our projects.

Moisture Control Policy

Management
Post-Award and Pre-Construction Meetings are to be held with all Subcontractors and all other parties responsible for implementing the Moisture Control Policy. The purpose of the Moisture Control portion of these meetings is to discuss, evaluate and plan for any issue associated with controlling moisture from the work or the natural elements. This portion of the meeting will establish the guidelines for implementing the program with each Trade Division. It will determine the Roles and Responsibilities for establishing and maintaining the Moisture Control System. The intention of this system is to prevent, detect, control, monitor, and document all moisture issues associated with the Work.

Each Trade Division has Checklists associated with Divisional Work and they are to be used as guidelines in the Pre-Construction Meetings.

The Moisture Control Checklists are part of this document and are intended for your use in the Pre-Construction Meeting process.

Industry Standards
Every specification division of the Work has specific Industry Standards that are associated with the Work. These Standards identify the criteria and the Work must comply with these Standards to be acceptable and meet our Contract responsibilities.

Environment
Environment is defined as the acceptable condition(s) of the project work space or area where the materials or products of the project are being installed. The acceptable conditions are defined in the Industry Standards associated with the materials or products. The manufacturer must participate and assist and confirm that the environment is acceptable for their product's use.

The acceptable environment shall be established and maintained as defined by the Industry Standards and manufacturer's requirements for the materials and products being delivered, handled, stored and installed.

The Moisture Control portion of the Post-Award and Pre-Construction Meetings must emphasize and focus on a discussion that reaches an agreement for creating the acceptable environment(s) for delivery, handling, storing and installation.

Quality Assurance
Discussions shall be held to establish the procedures for delivery, storing, handling and installing materials. These discussions will focus on inspections, testing and documentation of all materials and methods associated with the Work.

Roles and Responsibilities shall be established and assigned to specific Trades for implementing these procedures.

Trade Division Checklists are to be used as part of this assignment procedure.

Moisture Control Policy

Documentation will become part of the project record and shall be used to establish compliance with the Moisture Control Policy. When the project is completed, this documentation will also be used to confirm that every effort has been taken to construct our projects with the utmost concern for controlling moisture and meeting the Standards of Quality associated with the Work.

Moisture Damage
Moisture infiltration requires that an immediate investigation be conducted and the moisture problem identified, controlled and resolved.

Moisture has been identified by the experts as one of the main contributors to the growth of fungi. Since we are not experts in identifying mold and we do not intend to become experts, suspicions or evidence of fungi should be directed to the Director of Safety.

If you require assistance in creating or developing a moisture control program, you are to contact your project's Quality Support Manager.

As part of the Preconstruction Meeting, using the Moisture Control Policy will enable each of you to implement Moisture Control Procedures that will successfully manage moisture on your projects. This management and documentation ensures that we have complied with our contract responsibilities.

NO SMOKING/E-CIGARETTE USE POLICY

Smoking and or E-Cigarette use is strictly prohibited:

1. At any time in any Power/project field office.
2. In a build-out or addition to an occupied building (tie-in and existing structure).
3. Anywhere in the building once window installation has begun on any floor.
4. When any temporary or permanent enclosure is installed (either partial of complete) on the building.
5. In any areas identified on the project as “non-smoking”
6. In any areas covered by the Illinois Smoke Free Law.

Smoking or E-cigarette use may also be prohibited by owner/client requirements site/campus wide or in specific buildings.

This policy may be modified on a site-specific basis as long as it is a written policy and included in the site orientation. In no case shall the owner requirements or the prohibition on smoking when windows are glazed on a floor be relaxed. In compliance with our tolerance enforcement, anyone in violation of the above will be subject to appropriate disciplinary action which may include removal from the site or termination.

SUBCONTRACTOR'S SITE-SPECIFIC QUALITY PLAN

Site Specific Quality Plan
Each subcontractor shall establish and submit for review a written Site-Specific Quality Plan that includes details commensurate with the work to be performed. The subcontractor's Site-Specific Quality Plan shall clearly describe the subcontractor's methods for meeting its obligations as listed in the project documents. The subcontractor's Company Quality Manual will not be accepted as a substitution for a Site-Specific Quality Plan. The following will be submitted prior to the subcontractor's mobilization to the project:

- A written Project Site-Specific Quality Plan (paper or electronic copy as required by the Power project team);
- Identify Quality roles and responsibilities for subcontractor employees;
- Subcontractor's disciplinary action program;
- Process for managing tier subcontractors;
- Methods of procedure to achieve specified quality
- As a condition of their contract, all Subcontractors shall submit to Power or designee a Site-Specific Quality Plan within fifteen (15) days after receipt of notice to proceed and prior to start of construction activities.
- See attached Template for other specific requirements. Click here for the downloadable template.

The subcontractor shall be solely responsible for implementing the Site-Specific Quality Plan

Electronic Forms Process
Each subcontractor is solely responsible for providing access and the ability, to their project supervision, to upload and manage electronic documents required by Power Construction. This includes providing, at minimum, internet access and device (tablet or computer) to their project supervisor. Power Construction will provide portal access and initial use training as needed at no cost to the subcontractor and their tier subcontractors. All subcontractors are required to utilize the electronic forms process regardless of the scope of their work, contract value, contractor processes and forms, etc. Failure to provide documentation outlined in this section in its required timeframe will be a violation of this document resulting in disciplinary action, withholding of payment, and/or work stoppage.

Toolbox Talks
Each subcontractor shall conduct weekly quality toolbox meetings relevant to the work being performed by their employees. The toolbox talk or a description of the topic discussed along with all attendees' names shall be submitted to Power utilizing the electronic forms process. Power has developed some trade specific tool box talks which are expected to be covered during the project. Other suggested topics include a review of the installation instructions for materials being installed that week, review the industry standards associated with the work being installed that week a detailed walkthrough of any mock ups or accepted first installations so that project accepted quality standards are communicated clearly to the crew.

Inspections

In accordance with the contract documents, each subcontractor shall perform frequent and regular inspections of their work area(s) by a competent person. A copy of the report or documented inspection shall be submitted to Power within 24-hours of the commencement of the inspection. Subcontractor supervisors shall take immediate action to correct any issues found. The subcontractor will be solely responsible to review and monitor the work area or location of all their employees on a regular basis during the performance of work. In addition, each subcontractor must provide a documented inspection of the subcontractor's work by an individual not assigned to the daily operations on-site at a minimum of once per month.

Incident Reporting

Subcontractors are responsible to immediately notify Power of all Quality incidents including uncontrolled water intrusion from systems or the environment, or any other issues requiring re-work in excess of $2500.00

Each subcontractor is required to investigate all incidents incurred by their employees, or incidents that are the result of their operations. Each subcontractor shall provide to Power a documented Incident Investigation Report within 24-hours of the occurrence.

Power may conduct an independent investigation at their own discretion or when they deem it necessary as a supplement to that required of the subcontractor. Subcontractors and their employees are expected to fully cooperate with the investigation process including completion of witness statements, photographs, completion of Power required documents and any other elements of the incident investigation process. Upon request, subcontractors involved in the incident shall participate in Incident Review Meetings.

SUBSTITUTION POLICY

Introduction:

Substitution requests must be made in accordance with the Contract documents which typically restrict the contractor's ability to make substitution requests. **Substitutions are strongly discouraged after the Contract has been executed, unless absolutely necessary.**

Necessary Substitutions:

Instances may arise on Projects when a substitution of material is necessary, i.e., the material or product is no longer manufactured as specified, or the manufacturer has gone out of business. In these cases, a Request for Substitution, along with supporting data, should be made as soon as the situation comes to our attention. Any re-design required by this situation is the responsibility of the design professional, and may entitle us to additional fees.

Voluntary Substitutions:

In some cases, a voluntary substitution may be an advantage to us and our client, in reduced cost or accelerated schedule. In some cases, it may be to our advantage to submit a substitution, even if we are required to absorb the additional cost. In these cases, your experience and good judgment will be essential in determining whether to pursue or reject a substitution request.

Any voluntary "Request for Substitution" should be submitted, reviewed and a course of action decided before the Contract is signed; all voluntary substitutions must have been submitted and approved prior to the Pre-Construction meeting.

Voluntary substitutions should never be allowed if the substitution will compromise the design intent or schedule, or if the necessity of the substitution is based on poor scheduling by the Subcontractor.

Voluntary substitutions will be considered only under the following circumstances:

A. Making the substitution will result in a significant savings in price with no adverse affect on the schedule.
B. Making the substitution will result in a positive affect on the schedule with no significant cost increase.

There may be circumstances when a modest increase in price will benefit the schedule beyond the value of the additional cost. All other conditions being equal (design intent not compromised, etc.), serious consideration should be afforded this opportunity. Again, in these cases, your experience and good judgment will be essential.

Remember that by voluntarily using a substituted product, the Contractor and subsequently Power Construction assumes the responsibility for all adjustments required to fit that product into the work, and for providing all additional work, equipment and services made necessary by the use of that product, at no additional cost to the Owner. Carefully review all implications of the substitution and review costs, schedule impacts and coordination issues that may result from the substitution.

The Owner and the Design Professional must agree to <u>any</u> proposed substitution.

WALL CAVITY POLICY

Introduction:

The purpose of this policy is to emphasize portions of the Moisture Control Policy. The intent of the is policy is to define the steps required to assure our projects are clean and dry when they are turned over to the Owner.

The Process:

1. Review the expectations of each subcontractor in regards to the condition of the wall cavities at the Pre-construction meeting.
2. Review the condition of every wall cavity prior to closing the second side.
3. All wall cavities should be clean and dry. This requires shop vac or blowing the track clean.
4. Document the condition of the walls with pictures and notes. Each photo is to have its location identified. Identification is to include room number and wall direction. For example room 104 East wall. In the case of corridors or other long walls an additional identifier to locate along the length to be provided. For example corridor 205 North wall near door 208.
5. At any recessed accessory location re-inspect the wall and document the condition prior to the installation of the accessory.
6. Document that all walls have been reviewed with marked up plans or detailed description.
7. File all documentation in subcontractors contract file.

WINDOW SCHOOL POLICY

Introduction:

It is critical that project teams and subcontractors thoroughly understand the window system(s) being used on the project. All aspects of the fabrication and installation should be reviewed with the manufacturer, fabricator, and installing contractor for each system being used on the project.

The Process:

1. Review the construction documents and understand the systems involved.
2. Review manufacturer's product data for conformance to project specifications.
3. Is the system specified based on a manufacturer's standard, or based on performance criteria.
4. Review shop drawings for compliance with design intent for profile and details.
5. Coordinate with structural drawings and adjacent trades.
    a. Understand loading imposed on structure for gravity and wind load.
    b. Understand tolerances of adjacent trades.
    c. Review deflection requirements and thermal movement requirements.
    d. Review compatibility issues with dissimilar metals, sealants and finishes.
6. Review and understand the fabrication process from initial submittal, die approval, painting, stock lengths, cutting and fabrication in the shop, assembly, shipping and installation.
7. Review the step by step process during each phase of the work.
8. Visit the fabrication facility and review the process.
    a. Review the manufacturer's step by step instructions, confirm that they are being followed. If any deviations are noticed they are to be documented and the reasons for the deviation discussed with eth fabricator and they are to provide documentation from the manufacturer noting that they accept the modification.
    b. Ask to see their internal QA / QC logs for sealants
9. Once the material arrives on site hold a jobsite training session for the installation crew. This session does not have to be the very first day of install but must take place prior to the installation of any critical seals for the system being installed. Power expects that the installing contractor is responsible to schedule and follow the process outlined below.
    a. Review the steps required for on-site assembly and erection. Use the manufacturer's written assembly instructions as the basis for this review.
        i. Focus on "critical air and water seal" areas within the system. Specific crew members are to be responsible for these seals.
        ii. Installation crews are to photo document the installation of these seals
        iii. Discuss "reset" procedures to be implemented when the system is not fitting up correctly. This does not mean grab a bigger hammer.
            1. Evaluate cause of poor fit – is there an error in fabrication? Who at the fabricator / manufacturer is the point of contact to resolve these issues.
            2. Any field repairs to be properly documented – step by step instructions to be furnished by the manufacturer/ fabricator.
            3. All seals need to be re-established
    b. Manufacturer's representation is mandatory. Confirm with Contractor is manufacturer will charge for this service and budget accordingly.

c. Quality Support Manager attendance is mandatory for the initial meeting.
d. All crew members are to attend. If additional crews are added then additional training sessions will be required. The foreman is to train the additional crews and turn into Power the sign in sheets from those meetings.
e. Establish the field quality control process. Who verifies the critical seals to ensure that they are correct prior to placing the next lift or covering?

WINDOW TESTING POLICY

Introduction:
Testing of window systems is a critical step to ensure the performance of the building enclosure. Whether required by specification or not a minimum level of testing should be performed on each type of window, curtain wall or window wall. For those projects with less than 5000 SF of glazed area then a single 100 SF test area of curtain wall or storefront, or one unit for windows or window wall shall be the minimum. The minimum test procedure shall be an AAMA 501.2 or hose stream test. This testing is to be performed as soon as the test area(s) or unit(s) are ready and must be prior to installing ***any*** surrounding interior finishes.

The Process:

1. Understand the project requirements as defined by the construction documents.
2. Review the requirements at the Pre-Construction Conference.
    a. Determine if off site testing is required. Mock-up scope and details
    b. Determine if on site chamber testing is required.
    c. Determine if standard hose test is required.
    d. Is existing performance test data available and acceptable?
3. Review performance test mock-up submittal.
4. Schedule mock-up to allow for revisions if required.
5. Schedule any on site testing early in the installation process to allow for revisions if required.
6. Review in place mock-up locations and coordinate with installation sequence. Mock-up should occur in the area of initial installation when possible.
7. Establish who is responsible for testing and documentation.
8. Verify that the test is appropriate for the application. It is not uncommon to have an AAMA 501.2, or hose test specified for operable windows. This is not the appropriate test for this type of window, an AAMA 502 or chamber test is the correct test for this application.
9. If no other testing procedure is specified, a hose stream test (AAMA501.2) should be performed on a representative number of windows or area. This test can be performed by the contractors' labor or contracted to an independent testing company.
10. Documentation of all testing is critical and should be filed in the subcontractors file.
11. A representative from Power is to be present for each test.
12. In the event of a failed test a minimum of one additional unit or test area shall be tested at the contractor's expense for each failed test.
13. Follow this link for Window Testing Preparation

MEP Systems Pre-testing & Project Completion Policy

Power has many renovation and expansion projects. Many of these renovation or expansion projects include connecting to or remodeling existing mechanical and plumbing systems. We have had challenges at the completion of projects where existing systems could not meet the specified volume or quality requirements. Some of these challenges can be mitigated when the team understands the existing system conditions and performance prior to any new work being performed. Therefore, Power has established a Pre-testing Policy to ensure that such documentation is obtained. The requirements defined in this policy can be purchased through the applicable mechanical trades as they maintain responsibility for specification compliant systems.

Prior to starting construction involving hydronic system modifications, samples are to be obtained from existing systems for testing by an independent laboratory or treatment company. If you are building on a campus, either have a non-campus vendor obtain samples or have the campus vendor send out samples to an independent lab. These samples should be submitted for record to the design engineer and shared with our client.

The following systems are to be sampled if you are connecting to them on your project:

Heating Hot Water
Including glycol levels if there is glycol
Chilled Water
Including glycol levels if there is glycol
Condenser water
Domestic hot water
Domestic cold water
Steam
Refrigerant
Medical Gases
Instrument Air
Other "process" services

The following items should be included in the lab reports
Ph
Existing chemical inhibitor type and levels
Glycol content, if applicable
Suspended solids, if any
Attached is an example of a lab report from a water sample (Document #1).

For air, verify pre-reads have been taken to confirm the appropriate system capacity exists. Some design engineers have had challenges with existing systems, so they have had pre-reads done prior to starting their design. Inquire if the design team has completed a pre-survey of the system. If a pre-survey has been completed, nothing further needs to be done as the design team has done the appropriate due diligence.

MEP Systems Pre-testing & Project Completion Policy

The following air side systems should be measured and documented prior to construction. If you are doing a smaller renovation, make sure the branch ducts feeding your space have been read.

Supply Air, Return Air, Exhaust Air

If we are engaging in a negotiated project and the design team has not done pre-sampling, the items above should be carried in our mechanical and plumbing budget lines. A good budget number for a tech to come out and take approximately 6 hydronic samples is $2,000 (2023). Depending on the size of your project, the water testing budget could range from $2,000-$10,000 (2023). Air testing can be a bit more costly depending on how much needs to be tested. Review these scopes as a team to ensure we have the appropriate pre-read budget.

If we are on a competitive pursuit and a pre-read report has not been issued, we need to clarify that we are not responsible for existing conditions and recommend samples are taken prior to construction beginning. A good owner contract clarification is below.

Clarification for a competitive pursuit - Pipe cleaning, flushing, and treatment is limited to the newly installed pipe systems. Cleaning, flushing, and treatment of all other systems is not included. Sampling of existing systems should be completed prior to our work. Any remediation of existing water that is required to meet the project equipment specs is not included. Clarification for a GMP - An allowance of $XX is included for pre-testing of the water quality of the existing system. We have not included any costs to remediate existing systems if water quality results do not meet the requirements of the new equipment.

For campuses where we are adding major expansions and tying into their existing emergency generator systems we need to confirm that the existing system has adequate capacity and has been adequately maintained so that when we bring our new systems on line and test them in "Black-out" mode the existing system functions properly.

Project Closeout

How we train our clients to maintain the water and how we document the water that is being turned over are two very important steps during the closeout of our projects.

Whether water testing was performed by the Owners agent or through our Mechanical Subcontractor, it is important to make certain that the water chemistry is documented at the time of turnover or beneficial use. We should be submitting a package with the equipment water requirements, followed by lab results showing we are meeting those requirements. (Document #2 – attached)

This package should also include the recommended maintenance requirements and testing, along with documenting who is responsible to schedule those inspections and maintain the system after

turnover. Watching and maintaining the loop is very important. It would be great to revisit such during your 11- month warranty walk that these inspections are being completed. If specified or in our contract, we should have another test completed like the closeout package shown in document #2.

This policy is an extra step, but it is very important to have this data both early in the job and at the end of the job. It allows us to take a proactive approach with our client and design team versus a reactive approach and will help to mitigate substantial risk for all parties involved.

Document #1 - Page 1

LABORATORY REPORT - WATER ANALYSIS

WATER TECHNOLOGY

500 South Vermont Street
Palatine, IL 60067
(800) 577-2211
Fax: (847) 358-7082

Regarding: Kroeschell Engineering Company
Location: Wheaton College
501 College Avenue
Wheaton, IL

Customer No.: 1005944
Report No.: 57466
Report Date: 2/2/23
Login Date: 1/30/23
Sample Date: 1/13/23

				Chrouser Heat Exchanger		B"4" Water							
				Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble
	1.	Alkalinity ("P")	as $CaCO_3$	0		0							
	2.	Alkalinity ("M")	as $CaCO_3$	264		256							
	3.	Alkalinity ("OH") (calculated)	as $CaCO_3$										
W	4.	Free Mineral Acidity	as $CaCO_3$										
a	5.	Chemical Oxygen Demand (C.O.D.)		584		601							
t	6.	Chloroform Extractables											
e	7.	Dissolved Solids		376		328							
r	8.	Hardness (Calcium)	as $CaCO_3$	78		90							
	9.	Hardness (Magnesium)	as $CaCO_3$	38		44							
P	10.	Hardness (Total)	as $CaCO_3$	117		134							
r	11.	pH		6.4		6.2							
	12.	Refractive Index		1.3333		1.3333							
o	13.	Specific Conductance	µmhos/cm	553		483							
p	14.	Specific Gravity	g/ml	1.001		1.001							
e	15.	Suspended Solids			133		332						
	16.	Total Inorganic Carbon											
	17.	Total Organic Carbon											
r	18.	Aluminum	as Al	0.00	1.32	0.07	2.43						
t	19.	Barium	as Ba	0.02	0.01	0.05	0.07						
i	20.	Calcium	as Ca	31.3	0.00	36.1	2.63						
e	21.	Chromium	as Cr	0.00	0.09	0.00	0.25						
s	22.	Copper	as Cu	0.01	1.73	0.02	0.87						
	23.	Iron	as Fe	1.53	47.2	0.43	132						
	24.	Lead	as Pb	0.000	0.085	0.000	0.013						
	25.	Lithium	as Li	0.00	0.00	0.00	0.00						
	26.	Magnesium	as Mg	9.31	0.00	10.7	0.24						
	27.	Manganese	as Mn	0.62	0.10	0.73	0.35						
	28.	Nickel	as Ni	0.00	0.01	0.00	0.01						
	29.	Potassium	as K	60.2		58.1							
	30.	Silver	as Ag	0.00	0.00	0.00	0.00						
C	31.	Sodium	as Na	33.3		35.4							
a	32.	Strontium	as Sr	0.11	0.00	0.13	0.02						
t	33.	Zinc	as Zn	0.02	0.05	0.06	0.17						
i	34.	Total Cation Millequivalents		*5.259*		*5.523*							
o	35.	Acetate	as $C_2H_3O_2$	107		102							
n	36.	Bromide	as Br	0.00		0.00							
s	37.	Chloride	as Cl	22.3		29.0							
	38.	Chlorate	as ClO_3	0.00		0.00							
	39.	Chromate	as CrO_4										
	40.	Fluoride	as F	0.45		0.52							
	41.	Formate	as CHO_2	0.00		0.00							
	42.	Glycolate	as $C_2H_3O_3$	0.00		0.00							
	43.	Molybdate	as MoO_4	0.32		0.07							
	44.	Nitrate	as NO_3	0.14		0.14							
	45.	Nitrite	as NO_2	0.11		0.03							
	46.	Oxalate	as C_2O_4	0.25		0.61							
	47.	Phosphate (ortho)	as PO_4	0.00		0.00							
	48.	Phosphorus (total)	as P	0.01	3.20	0.00	7.51						
A	49.	Propionate	as $C_3H_5O_2$	392		391							
n	50.	Sulfamate	as NH_2SO_3	0.00		0.00							
i	51.	Sulfate	as SO_4	0.05		0.03							
o	52.	Sulfur (total)	as S	4.86	0.38	5.67	0.65						
n	53.	Total Anion Millequivalents		*8.006*		*8.095*							
s	54.	Ammonia	as NH_3	1.40		0.30							
	55.	Benzotriazole	as $C_6H_5N_3$	11.0		10.0							
	56.	Boron	as B	0.20		0.17							
	57.	Silica	as SiO_2	1.61	1.18	1.69	1.26						
	58.	Sodium Nitrite	as $NaNO_2$										
	59.	Sodium Sulfite	as Na_2SO_3										
	60.	Tolyltriazole	as $C_7H_7N_3$										

Analyst MV All data except pH in parts per million or as indicated

Continued on reverse side.

WATER TECHNOLOGY

500 South Vermont Street
Palatine, IL 60067
(800) 577-2211
Fax: (847) 358-7082

LABORATORY REPORT - WATER ANALYSIS

Regarding:	Kroeschell Engineering Company	Customer No.:	1005944
Location:	Wheaton College	Report No.:	57466
	501 College Avenue	Report Date:	2/2/23
	Wheaton, IL	Login Date:	1/30/23
		Sample Date:	1/13/23

			Chrouser Heat Exchanger		B"4" Water							
			Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble	Soluble	Insoluble
Compounds	61.	Bromate	as BrO_3									
	62.	Chlorite	as ClO_2									
	63.	Cyclohexylamine*	as $C_6H_{13}N$									
	64.	Diethylamine*	as $C_4H_{11}N$									
	65.	Diethylaminoethanol*	as $C_6H_{15}NO$									
	66.	Ethylamine*	as C_2H_7N									
	67.	Morpholine*	as C_4H_9NO									
	68.	Diethylene Glycol*	% by volume									
	69.	Ethylene Glycol*	% by volume									
	70.	Propylene Glycol*	% by volume									
	71.	Methanol*	% by volume									
Microbiological	72.	Heterotrophic Plate Count @ 22°C(Aerobic)	CFU/ml									
	73.	Heterotrophic Plate Count @ 37°C(Aerobic)	CFU/ml									
	74.	Heterotrophic Plate Count (Anaerobic)	CFU/ml									
	75.	Denitrifying Bacteria	CFU/ml									
	76.	Fecal Coliform	CFU/100 ml									
	77.	Iron Bacteria	CFU/ml									
	78.	Mold	CFU/ml									
	79.	Sulfate Reducers	CFU/ml									
	80.	Total Coliform	CFU/100 ml									
	81.	Yeast	CFU/ml									
	82.	E.Coli	CFU/100 ml									
	83.	Enterococci (Fecal Streptococci)	MPN/100 ml									
	84.	Pseudomonas Aeruginosa	MPN/100 ml									
	85.	Residue by Evaporation										
	86.	Volatile Solids										
	87.	System Capacity	gal.									
	88.	Turbidity	NTU									
	89.	P.T.S.A.	ppb									
	90.	Dissolved Oxygen	as O_2									
	91.	DEHA	ppb									
	92.	Erythorbic Acid	ppb									
	93.	Fluorescein	ppb									
	94.	Chlorine (free)	as Cl_2									
	95.	Sulfide	as S^{-2}									
	96.	Arsenic	as As									
	97.	Mercury	as Hg									
	98.	Nitrate-Nitrite Nitrogen	as N									
	99.	Nitrate Nitrogen	as N									
	100.	Nitrite Nitrogen	as N									

Analyst MV All data except pH in parts per million or as indicated

*Analysis by Gas Chromatography.

HOH WATER TECHNOLOGY

Service Report

CN1006207

Friday, March 31, 2023 12:22 PM CDT

One Chicago
Main Building
14 West Superior Street
Chicago Illinois 60654-3822
(312) 270-1111

Report Number: **613387**

Recorded By: Paul Nearing
(847) 436-7423
pnearing@hohwatertechnology.com

Tower C - Recirculating Water Systems

Test	Tower Water	Upper Condenser Water	Podium Condenser Water	Boiler Loop
P-Alkalinity, (ppm as $CaCO_3$)	100 80 - 130	332 100 - 500	820 100 - 500	304 100 - 500
M-Alkalinity, (ppm as $CaCO_3$)	400 320 - 520			
Chloride, (ppm as NaCl)	132 100 - 200			
Total Hardness, (ppm as $CaCO_3$)	552 500 - 700			8
PTSA (ppb)	102 90 - 110			
Bromine (as Br_2)	0.68 0.5 - 3			
Nitrite (ppm as $NaNO_2$)		555 600 - 900	795 600 - 900	570 600 - 900
Conductivity (µmhos)	1091 1000 - 1300	1761	3130	1764
Make-Up Meter (gal)	6276390			
Bleed-Off Meter	830757			

Tower Water System — Online

C-7801 Tank - 2/5
K-BAC 7115 Tank - 1/8
BromMax 7.1 Tank - 1/3
Tower Make-up = 3700 gallons / day
Excellent test results, with the bleed-off rate (Total Hardness mineral level) and the PTSA treatment level and the Bromine biocide residual all being good.

Upper Condenser Water System — Online

The "P" Alkalinity was good, but the Nitrite corrosion inhibitor level was a little low, so I will ship out a pail of CS-30 Closed System Nitrite Booster and add to it next time. The water clarity was excellent.

Podium Condenser Water System — Online

The "P" Alkalinity was above range, but okay, and the Nitrite corrosion inhibitor level was good. The water clarity was excellent.

Boiler Water Loop — Online

As in the Upper Condenser Water System, the "P" Alkalinity was good and the Nitrite inhibitor level slightly low. This should rise within range when I add the CS-30 to the Condenser Water System. The water clarity was excellent.

HOH WATER TECHNOLOGY

Service Report

CN1006207

Friday, March 31, 2023 11:07 AM CDT

One Chicago
Main Building
14 West Superior Street
Chicago Illinois 60654-3822
(312) 270-1111

Report Number: 613386

Recorded By: Paul Nearing
(847) 436-7423
pnearing@hohwatertechnology.com

Tower A - Recirculating Water Systems

Test	Tower Water	Condominium Condenser Water	Boilers Heating Water	Podium Heating Water
P-Alkalinity, (ppm as $CaCO_3$)		324 100 - 500	296 100 - 500	472 100 - 500
Total Hardness, (ppm as $CaCO_3$)			4	
PTSA (ppb)	161 90 - 110			
Bromine (as Br_2)	0.11 0.5 - 3			
Nitrite (ppm as $NaNO_2$)				900 600 - 900
Molybdenum, (ppm as Mo)		124 60 - 120	127 60 - 120	
Conductivity (µmhos)	735 1000 - 1300	1535	1604	2543
Make-Up Meter (gal)	2850343			
Bleed-Off Meter	179483			

Cooling Tower Water — Online

C-7801 Tank - 1/3
BromMax 7.1 Tank - 1/5
K-BAC 7115 Tank - 1/4
The tower has had essentially no use yet this season, so the chemistry is still upset.

Condominium Condenser Water System — Online

The CS-35 that I added to this system last time has brought the Molybdenum corrosion inhibitor level up to the proper range (even slightly above), and the "P" Alkalinity is good. The water clarity was excellent.

Boilers Heating Water System — Online

We have had thorough mixing of this Boilers Heating Water and the Condominium Condenser Water that I added the CS-35 to last time, so the Molybdenum corrosion inhibitor level is also good now in this Boiler Water System. The "P" Alkalinity is also good and the water clarity is excellent.

Podium Heating Water System — Online

The "P" Alkalinity and the Nitrite corrosion inhibitor level are both within range in this system. The water clarity is excellent.

Note: Corrosion and sludge deposits in old systems must be removed prior to installation of a new boiler.

49.1, 49.2, 49.3, 77.3

Table 2-2 Model CFLC Water Chemistry Requirements

Parameter	Limit	Means of control
Glycol	25-50%	Glycol fill/mixing station
pH	8.3 - 10.5	Buffering agent
Nitrates	50 ppm	Chemical additives
Sulfates	50 ppm	
Chloride	< 250 ppm	
Oxygen	< 0.1 ppm	Air separator/eliminator
Specific Conductivity	< 3500 μmho/cm	
Total Hardness	< 10 ppm	Softener

Table 2-3 Model CFLC Water Temperature Data (Non-Glycol)

Minimum inlet temp.	33°F
Maximum operating supply set point temp.	230°F
Maximum design temp.	250°F
Minimum supply set point temperature	130°F
Max allowable Delta T	100°F

2.5 BOILER FLUSH

Cleaver-Brooks recommends cleaning in accordance with the recommendations of the boiler owner's water treatment company for each individual site. The boiler may be flushed with or without heat applied, as deemed appropriate by the chemical treatment company. A traditional steam "Boil Out" is not required on Cleaver-Brooks hot water boilers.

Following are some general recommendations to help ensure long boiler life and efficient operation.

NOTE: these are recommendations only. The chemical treatment supplier should recommend a procedure based on the site conditions and quality of water being used to fill the system.

If the entire system is being flushed THROUGH the boiler, weld slag and deposits from the piping system may settle in the boiler. The boiler is typically a low velocity zone where these deposits tend to accumulate. The boiler should be drained periodically during the flushing process to keep any deposit build up to a minimum. When the system flush is complete, drain the boiler completely and open water side inspection ports for visual inspection. Any deposits should be manually flushed out.

If the boiler is isolated during the system flush, or if this is an equipment replacement only where minimal amounts of system piping have been replaced, there should be minimal manufacturing deposits inside the boiler and no boiler flush is required.

To provide the longest life of the equipment it is recommended but not mandatory to chemically treat the boiler prior to start-up. The owner's water treatment company should determine needed course of action for each installation.

2.6 USING GLYCOL

The Model CFLC boiler may be operated with a solution of glycol and water. Where glycols are added, the system must first be cleaned and flushed. Correct glycol selection and regular monitoring of the in-use concentration and its stability is essential to ensure adequate, long-term freeze protection, including protection from the effects of glycol-derived corrosion resulting from glycol degradation.

the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service.

The boiler room should have adequate ventilation and should be at positive pressure.

The flue gases from the Model CFC-E boiler should be removed via a gas-tight, temperature and corrosion resistant flue gas pipeline. Only flue gas systems approved and tested by the relevant region or province are to be connected to the boiler. Refer to flue piping manufacturer for proper installation and sealing instructions.

See also Chapter 3 of this manual for combustion air and flue gas venting requirements.

2.3 - WATER TREATMENT

Cleaver-Brooks ClearFire condensing boilers are suitable for closed loop heating systems. Systems with significant air accumulation due to unknown or unseen leaks must be equipped with a system air separation or pretreatment device.

Untreated drinking water is generally the best heating medium as filling and make-up water for a system that utilizes the Model CFC-E. If the water available from the main system is not suitable for use, then demineralization and/or treatment with inhibitors is necessary. Treated filling and make-up water must be checked at least once a year or more frequently if so specified in the application guidelines from the inhibitor manufacturer.

Those parts of the boiler in contact with water are manufactured with ferrous materials and corrosion-resistant stainless steel. The chloride content of the heating water must not exceed 30 mg/l and the pH level should be between 8.3 to 10.5 after six weeks of operation.

To maintain the boiler's efficiency and prevent overheating of the heating surfaces, the values in **Table 2-2** should not be exceeded. Water make-up during the lifetime of the boiler should not be greater than 3 times the system volume. A water meter should be installed on the feed line to monitor makeup water volume.

Following production of the pressure vessel, the interior surfaces are cleaned and therefore a pre-start boil out of the vessel is not needed. Should the system require flushing or cleaning after installation of the CFC-E, take care that no particulate matter reaches the boiler during the cleaning process. A removable filter should be used for this purpose.

Notice

Corrosion and sludge deposits in old systems must be removed prior to installation of a new boiler.

77.1 77.2

Table 2-1: Model CFC-E Water Chemistry

Parameter	Limit	Means of control
Glycol	50%	Glycol fill/mixing station
pH	8.3 - 10.5	Buffering agent
Nitrates	50 ppm	Chemical additives
Sulfates	50 ppm	
Chloride	< 250 ppm	
Oxygen	< 0.1 ppm	Air separator/eliminator
Specific Conductivity	< 3500 μmho/cm	
Total Hardness	< 10 ppm	Softener

Minimum inlet temperature	33°F
Maximum operating supply setpoint temperature	194°F
Maximum design temperature	210°F