

Section No.	Section Title
Division 13	
13 40 00	Swimming Pool – General Conditions
13 40 01	Swimming Pool Piping
13 40 02	Swimming Pool Pumps
13 40 04	Swimming Pool Equipment
13 40 05	Swimming Pool Commissioning



Part 1 General

1.1 Conformance

- .1 Conform to Division 01, General Requirements.
- .2 Comply with Division 01 – Submittal Procedures and Closeout Procedures.

1.2 Scope

- .1 Provide complete, fully tested and operational pool mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.
- .2 Install in accordance with the National Plumbing Code, Saskatchewan Swimming Pool Design Standards, and the National Electrical Code describe minimum standards of installation only and may be superseded by contract document requirements.
- .3 Contract documents of this Division and Drawings are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .4 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .5 Install equipment generally in locations and routes shown close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Consultant at no extra cost. Coordinate with other trades prior to installing piping or equipment. If conflicts are found, notify consultant for instruction. Extras for improper coordination and removal of equipment to permit remedial work shall not be allowed.
- .6 Should inconsistencies exist such as the drawings disagreeing within them or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise clarified by the Consultant in writing during the bidding period.
- .7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories
- .8 Work of Division 13 shall be performed by a contracting agency who has successfully completed the construction of a minimum of five (5) projects of the size and complexity described under division 13 of this project, within five (5) years the tender closing date. The agency shall have a proven five (5) year record of competence and experience in the construction of similar facilities of this size and complexity.

1.3 Related Work Specified In Other Sections

- .1 13 40 01 Swimming Pool Piping Division 13

.2	13 40 02 Swimming Pool Pumps	Division 13
.3	13 40 03 Swimming Pool Treatment	Division 13
.4	13 40 04 Swimming Pool Equipment	Division 13
.5	13 40 05 Swimming Pool Commissioning	Division 13
.6	Plumbing	Division 22
.7	Mechanical	Division 23
.8	Controls	Division 25
.9	Electrical	Division 26

1.4 Tender Price Breakdown

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the Consultant.
- .2 As a minimum, include the following in the tender price breakdown:
 - .1 Mobilization
 - .2 Swimming Pool Underground: Materials, Labour
 - .3 Swimming Pool Above Ground: Materials, Labour
 - .4 Swimming Pool Mechanical Room: Equipment, Materials, Labour
 - .5 Swimming Pool Commissioning, Start-up and O&M development/preparation
 - .6 Structural: Materials, Labour
 - .7 Electrical: Materials, Labour
 - .8 Architectural: Materials, Labour

1.5 Materials

- .1 Materials and equipment installed shall be new, full weight and of quality specified. Use same brand or manufacturer for each specified application.
- .2 Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level.
- .3 Each major component of equipment shall bear manufacturer's name, address, catalogue and serial number in a conspicuous place.

1.6 Cutting And Patching

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from Consultant before cutting or burning structural members. This work shall be carried out by the specialist trade only.
- .4 Provide openings and holes required in precast members for mechanical work. Cast holes larger than 100mm in diameter tight to columns shall not exceed 200mm in diameter. Cast or field cut holes smaller than 100mm.

- .5 Water stop all penetrations through pool tank, backwash tank and surge tank. Provided gasket type water stop on manufactured paneled structure. Refer to details for water stopping in concrete.
- .6 Repair building where damaged from equipment installation, improperly located holes etc. by this section of the work. This repair work shall be carried out by the specialist trade at the expense of this section of work. Use matching materials as specified in the respective sections.

1.7 Shop Drawings

- .1 Shop drawings will be submitted in electronic format which will be converted to pdf Hyper-link documents for the maintenance manuals.
- .2 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues that are available in the Consultant's office. Maintenance and operating manuals are not suitable submittal material.
- .3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capabilities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps, seals, material, or painting.
- .4 Include dimensional and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes.
- .5 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Consultant.
- .6 Shop drawings not requested for review by contractor will not be reviewed and processed by the Consultant.
- .7 Do not order equipment or material until the Consultant has reviewed and returned shop drawings.
- .8 Shop drawings shall be reviewed by the Trade contractor indicating that the shop drawings have been reviewed, co-ordinated with the work and that the shop drawings are submitted without qualifications. Shop drawings shall bear the 'reviewed' stamp dated and initialled by the trade contractor prior to submitting the shop drawings to the consultant. Shop drawings which do not bear the trade contractors 'reviewed' stamp, initials and date will be rejected and sent back as 'not reviewed'.
- .9 Submit weights of all major equipment for review such that the loads can be reviewed by the appropriate Consultant.
- .10 Submit as a shop drawing, an electrical equipment list for any equipment supplied by the mechanical contractor or his/her subtrades. The list is to be submitted in a timely fashion so that the electrical contractor can utilize the list as a final check prior to ordering motor control centres, starters, or disconnects. The list is to indicate the following:
 - .1 The horsepower size and number of motors.
 - .2 The minimum circuit amps (MCA) for packaged equipment.

- .3 The voltage and phase of the motors.
- .4 Whether or not a starter or disconnect is included as part of the package.
- .11 Acquire and review shop drawings of mechanical equipment supplied by other divisions but connected to by this division. Note any conflicts with installation methods described in drawings and specification sections of this scope at time of shop drawing review.

1.8 Standards Of Materials, Equipment And Installation

- .1 Equipment used shall not exceed space limitations in any dimension. Replace any equipment or apparatus which does not meet this Specification at no cost. Assume full responsibility for the expense of redesign and adjustment to other parts of the building when proposing the use of acceptable equal or alternate equipment. It is the contractors responsibility to confirm all quantities. Dimensions, performance and accessories required for all equipment, including matching “standard” and operational accessories between “equal” and “acceptable” products/suppliers/manufacturers.
- .2 Provide equipment from the approved manufacturers list covered in each section. Those manufacturers not listed are considered as alternatives. All mechanical equipment shall have the manufacturers name permanently affixed to it. It is the responsibility of both the ‘named’ product/supplier as well as the following listed “acceptable” products/suppliers to ensure that they meet or exceed the scheduled performance and are suitable for the intended use.
- .3 Alternate manufacturers may be submitted, if so desired, along with a cost-savings for consideration, however these alternatives must be shown as an alternate price, in addition to a manufacturer from the acceptable list.
- .4 Equipment on acceptable manufacturers list must be equal or better in quality and performance of the model specified. Equipment which is not equal will be replaced with the specified equipment at no cost to the Owner. Should an item not have an approved manufacturers list the above note will be required.
- .5 If shop drawings are rejected technically after 3 submissions, the Contractor at no additional expense to the Owner shall revert to the specified product and manufacturer for this project.

1.9 Performance Verification Of Installed Equipment

- .1 Installed mechanical equipment whose performance is questioned by the Consultant, may be subject to performance verification as specified herein.
- .2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.
- .3 The Consultant will determine by whom testing shall be carried out. When requested, the contractor shall arrange for services of an independent testing agency.
- .4 Testing procedures shall be reviewed by the Consultant.
- .5 Maintain building comfort conditions when equipment is removed from service for testing purposes.

- .6 Promptly provide the Consultant with all test reports.
- .7 Should test results reveal that originally installed equipment meets specified performance requirements, Owner will pay all costs resulting from performance verification procedure.
- .8 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected and the following shall apply:
 - .1 Remove rejected equipment. Replace with equipment which meets requirements of Contract Documents including specified performance requirements.
 - .2 Replacement equipment will be subject to performance verification as well, using same testing procedures on originally installed equipment.
 - .3 Contractor shall pay all costs resulting from performance verification procedure.

1.10 Operating And Maintenance Data

- .1 Instruct the building operators in the operation and preventative maintenance of each piece of equipment and system supplied and installed. Complete and turn over documentation prior to substantial performance.
- .2 Provide operation and maintenance data as required under this section.
- .3 Provide a 760 mm x 900 mm (30" x 36") wall chart for each pool filtration system, as well as a reduced photocopy of each wall chart in the maintenance manuals. Using reference to keyed valves and wall diagram, include specific written instructions for procedures to be followed for:
 - .1 Emptying and refilling the pools including de-watering during the period that the pool will be empty.
 - .2 Filter operation and backwashing.
 - .3 Super chlorination.
 - .4 Water level control and adjustment/.
 - .5 Chemical controllers.
 - .6 Lubrication and maintenance instructions.
 - .7 Guide to "troubleshooting".
 - .8 Parts list and predicted life of parts subject to wear.
 - .9 Test all motors and provide written confirmation.
 - .10 Specific written instructions for procedure for emptying and refilling the pools including de-watering during any period that the pool will be empty. Provide a red sign with minimum 25.4 mm (1") letters in the equipment room reading as follows: WARNING DO NOT DRAIN POOL WITHOUT FOLLOWING THE PROCEDURES IN THE POOL OPERATION MANUAL.
 - .11 Provide 213 mm x 275 mm (8-1/2" x 11") laminated pump curve for each and every pump, posted next to the specific pump.

- .4 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Consultant prior to Substantial inspection.
 - .1 Information shall be developed in the most current pdf format with Hyper-linked table of contents capability.
 - .2 Table of contents to be sectioned into each Tab sub-category. (example each shop drawing product to be tabbed)
 - .3 Within the manual provide digital copy of a keyed building plan with links to photographs of all equipment and service locations.
 - .4 Each submitted manual will have a revision number to be documented within the title block.
- .5 Once Final document has been approved, provide (3) three 216 mm x 280 mm capacity, expanding spine catalogue binders, bound with heavy fabric, hot stamped lettering front and spine.
 - .1 Load the entire pdf Hyper-link document c/w final As-builts onto the BMS – PC.
 - .2 Provide pdf Hyper-link document to consultant on a transferable stick drive
- .6 Index Division 13 of maintenance manuals according to the following index system.
- .7 Tab 1.0 Pool Systems:
 - .1 Provide title page with clear plastic cover.
- .8 The front title page shall include the cover information in addition to:
 - .1 The Owner
 - .2 The Architect
 - .3 The Engineer
 - .4 The Construction Manager
 - .5 The Pool Contractor
 - .6 The Agency preparing the Manuals
 - .7 The addresses, phone and fax numbers for the above will be shown adjacent to their name.
- .9 Tab 1.1 List of Mechanical Drawings.
- .10 Tab 1.2 Description of Systems:
 - .1 Provide complete description of each system.
 - .2 Include detailed system description and components comprising that system, explanation of how each component interfaces with others to complete the system, location of each control device as well as operating set points.
 - .3 Provide a complete description of emergency shut-down and start-up procedures for all major equipment, systems and controls, including power failure mode, back-up equipment/systems operation.
- .11 Tab 1.3 Operating Division:

- .1 Provide complete and detailed operation of each major component.
 - .2 Include starting procedure, exact switch and / or valve and control location.
 - .3 Describe trouble shooting sequence when set points cannot be maintained.
 - .4 Describe safe guards to check if equipment goes off line.
- .12 Tab 1.4 Maintenance and Lubrication Division:
- .1 Provide detailed preventative maintenance and lubrication schedule for each of the major components including daily, weekly, monthly, semi-annual and yearly checks and tasks.
 - .2 Provide an “enhanced” version of the Manual including a digital copy with hyperlinked table of contents, and a keyed building plan with links to photographs of all equipment and service locations.
 - .1 Each piece of equipment shall have all preventative maintenance requirements. Provide individual tables for Daily, weekly, Monthly, quarterly, Seasonal and Yearly requirement.
 - .2 Describe the procedure or cross reference sections via hyper-link within the manuals so the contractor understands the procedures in detail.
 - .3 Describe lubrication and maintenance procedure for equipment components such as bearings, drives, motors, and filter backwashing, probe cleaning and / or replacing, UV bulb cleaning and / or replacing, acid and chlorine treatment maintenance.
 - .4 Compile this information for each piece of equipment.
- .13 Tab 1.5 List of Equipment Suppliers:
- .1 Provide complete list of Equipment Suppliers and Sub-contractors, including address and telephone number.
 - .2 Outline procedures for purchasing parts and equipment.
 - .3 Provide a parts list and repair manual for each piece of complete equipment specified.
 - .4 Provide a warranty list for all items that extend beyond the standard one year contractor’s warranty period. Indicate the start date of the one year contractor’s warranty period.
- .14 Tab Certification (2.0, 2.1, etc.) Include copies of:
- .1 Hydrostatic and air tests performed on piping systems.
 - .2 Equipment alignment certificates.
 - .3 Balancing reports water systems.
 - .4 Valve tag identification. Schedule including location, service and normal position.
 - .5 Pipe colour code.
 - .6 Inspection approval certificates systems.
 - .7 Start-up reports of equipment
 - .8 Guarantee certificate.

- .15 Tab Shop Drawings (3.0, 3.1, etc.):
 - .1 Include copy of all reviewed only Shop Drawings.
 - .2 Include reduced record control drawings (8½" x 11" or 11" x 14" fold out).
- .16 The divider tabs shall be laminated mylar plastic, and coloured according to Section. The colouring is as follows: Mechanical Systems - 1.0 - 1.5 - Orange, Certification 2.0 - 2.4 - Green, Shop Drawings and Maintenance 3.0 - 3.17 - Yellow. Plastic tabs with typed insertions will not be accepted.

1.11 Record Drawings

- .1 Refer to this section for as-built format and requirements.
- .2 Submit record drawings identifying location of pool piping and components.
- .3 The Trade Contractor shall be responsible for and keep one set of white prints, including revision drawings, in job site office. Backfilling will not be allowed until underground service dimensions are marked on plans. Set of white prints shall be maintained in constant up-to-date condition by each trade (as-built conditions marked in red pencil). The white set of prints will be provided to the contractor by the Owner.
- .4 The "Record Drawings shall include, but not be limited to, the following changes and shall be recorded daily.
- .5 Size, location, arrangement, route and extent of ductwork, piping, conduit, terminal units, equipment, fixtures, cleanouts, valves, rough-in, etc., above and below grade inside the building, including dimensioned locations of buried piping from building walls.
- .6 Piping Elevations
 - .1 Under-ground pool piping: All pool lines. Invert elevations and type of piping material used and locations to be given at each junction, changes of direction horizontally and vertically and at every 30 M of run.
 - .2 All services located below ground level and in or below a building slab.
- .7 Location, tagging and numbering of all valves except individual plumbing fixtures or equipment isolation valves.
- .8 The as-built daily marked-up prints shall conform to the standards of the contract drawings and shall include all details from revision drawings, supplementary drawings, change orders, addenda and site revisions, etc.
- .9 Each white print drawing sheet shall be marked: "We hereby certify that these drawings represent the building, as built" with signatures immediately below of authorized personnel of this Sub-Contractor.
- .10 At substantial completion, employ a competent (CADD) drafts person to transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings, and change orders, on a copy of tender CADD files. From these files plot a set of reproducible drawings to be signed. Drafting quality shall be same as original drawings.
- .11 The CADD disks may be borrowed from the Consultant. Each "as-built" drawing shall bear the Contractor's identification, the date of record and the notation "We

hereby certify that these drawings represent the As-Built Record of Construction." The Contractor's signature and company seal shall be placed below that notation. Contractor to sign release agreement before consultant shall provide drawings.

- .12 Should the contractor not have drafting capability then they may choose to retain the consultant. The cost per drawing sheet for transferring information to the record drawings by the Consultant shall be \$500.00 per drawing. Should the Contractor undertake major re-routing of services where the original layout is appropriate or should major changes in the scope of work occur, additional charges may apply. Costs for printing and transferring into pdf is included.

1.12 Fire-Stopping

- .1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The contractor is required to coordinate with the architectural drawings to contractual rated wall types and installation details.
- .2 Submit shop drawings of systems before installation for approval by the Engineer of Record.
- .3 Refer to section 23 07 11 for additional scopes of work.

1.13 Identification

- .1 Clean all exposed bare metal surfaces supplied by the Trade Contractor by removing all dirt, dust, grease and millscale.
- .2 Repaint all marred factory finished equipment, which is not scheduled to be repainted, to match the original factory finish.
- .3 Pipe Markers and Direction Arrows
 - .1 This piping identification system leads itself to commercially available pipe markers having standard sizes of lettering and colours. Standard colours designate classes of materials as follows, and are consistent with those specified by the CSA and the USASI.

Yellow	Dangerous Materials
Blue	Protective Materials
Green	Safe Materials
 - .2 The pipe markers and direction arrows shall be applied in accordance with the manufacturer's instructions, and shall be applied by the mechanical trade.
 - .3 Pipe markers and direction arrows shall be made of a vinyl film material that becomes permanent after curing in place for 24 hours.
 - .4 Pipe markers and direction arrows shall be suitable for continuous operating temperatures between -40°F and 120°F.
 - .5 Pipe marker letters are to be 50mm high for pipes 75mm and larger outside diameter (including insulation) and not less than 15mm high for smaller diameters.

- .6 Pipe marker direction arrows are to be 150mm long by 50mm wide for pipes 75mm and larger outside diameters (including insulation) and 60mm long by 15mm wide for smaller diameters. Mini-markers are to be used for very small diameter pipes.
 - .7 When it is necessary to use lettering that is not factory printed, the lettering shall be done to sign painting standards on black pipe markers.
- .4 Location of Pipe Markers and Direction Arrows
- .1 Pipe marker and direction arrow shall be placed side by side in the bottom quarter of the pipe to be identified.
 - .2 Adjacent to all major changes in direction.
 - .3 At least once in each room that the pipe passes through.
 - .4 Where piping passes through walls, partitions, or floors, identify piping on both sides of the section.
 - .5 Where piping is concealed in a chase, shaft, gallery or other confined space then identify the piping at the points of entry and leaving, and at each access opening.
 - .6 At the beginning and end points of each run; and, at each piece of equipment in each run.
 - .7 On long straight runs of horizontal piping in open areas of buildings, galleries, or tunnels, locate markers and arrows so that at least one identification is clearly visible from any point of view in operating areas or walking aisles. In no case shall the distance between markers (and arrows) be more than 8M.
 - .8 Locate markers and arrows at all major valves in a system at a point as close as is practical to the upstream side of the valve.
- .5 Equipment
- .1 Each piece of equipment shall be identified by lamocoid lettering at least 25mm high and shall be governed by the size of the equipment.
 - .2 An identification logic should be developed and followed consistently throughout the project. Some acceptable examples are:
 - .3 Main Pool filter designate as PF-1, etc.
 - .4 Filtration Pump: designate as PP-001, etc.
 - .5 The nomenclature for identification of equipment shall be consistent with the designations in the plans and specifications.
- .6 Valve Tags
- .1 All valves, except convector hand valves and individual plumbing fixture stop valves, shall be provided with 50mm x 30mm brass tags with stamped numbers, secured by chains to the valve concerned. Numbers shall be prefixed by the letter "PF" indicating that the valve is on pool filtration service.
 - .2 Each trade shall prepare a list detailing the valves, location; normal position, and purpose served. Trades shall co-operate in preparing a white print chart showing location of all valves.

.3 Chart lists shall be approved by the Architect, subsequent to which one copy of each shall be provided in a non-glare glazed frame, mounted to the Architect's direction, and one copy of each shall be inserted in each Maintenance Manual.

.7 Chemical Storage Rooms

.1 Provide proper CSA approved labeling for doors and within the room for the storage and handling of the pool chemical.

.2 Refer to WHIMIS for product safety requirements.

.3 Labeling to match – signage requirement specifications.

1.14 Pool Controls:

.1 Installation,

.1 All Pool equipment specified in Division 13 shall be installed by the pool contractor.

.2 Wiring of Pool Controls:

.1 Line voltage wiring for line voltage power source to equipment shall be by the electrical contractor.

.2 Line and low voltage wiring between pool equipment and control device shall be by this contractor. Scope of work to include but not limited to:

.1 Wiring of flow meters from Sensor to wall mounted control panel

.2 Wiring of Level sensor to Level control panel

.3 Wiring of Chemical controller to flow cell assembly probes and flow switch.

.4 Wiring of UV controls from control panel to UV filter.

.5 Wiring of Solenoid valves for chlorine equipment to chemical controller.

.3 All DDC controls installation to be carried out by mechanical controls contractor under division 25. This includes all control wiring from DDC system to pool control components. Refer to Pool control points for scope of work.

.4 Water Feature Control Panel, emergency stop buttons and all other associated controls shall be by the DDC Controls contractor as defined under Division 25.

.3 Commissioning and verification of pool controls shall be by a Pool commissioning agent and / or factory representative as outlined in section 13 11 11 Pool Commissioning.

1.15 Equipment Protection And Clean-Up

.1 Protect equipment and material in storage on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and equipment systems.

.2 As one pool will be operational at all times, assure the existing filter room is cleaned daily. Coordinate with building operations staff to provide sufficient access to existing equipment during construction.

- .3 All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area.
- .4 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance. All substantial equipment must have a “NEW” finish to all piping & equipment. Dirt, concrete, glue and other construction materials sprayed onto the piping and equipment MUST be cleaned.
- .5 Thoroughly clean piping, and equipment of dirt, cuttings, and other foreign material.
- .6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .7 All piping stored outdoors shall sit above ground and protected against warping, contamination and UV damage at all times.

1.16 Electrical Motors

- .1 Supply mechanical equipment complete with electrical motors with the Minimum certified motor efficiency as outlined in ASHRAE 90.1: 2010
- .2 Provide motors to CEMA and CSA standards for hard, continuous service, designed to limit temperature rise to 130°F for open housing and 148°F for drip proof housing, and operate 1200 or 1800 r/min unless otherwise specified. Do not use air over ratings.
- .3 Motors shall have ball or roller type bearings with grease lubrication fittings.
- .4 Where equipment has been specified in Division 13 to be complete with starters, disconnects and/or control panels, this contractor shall provide any required control wiring and conduit between the equipment and the above items. All power wiring to the units and between devices shall be by Division 16 Electrical.
- .5 Refer to electrical specification for voltage, phase and cycle.
- .6 Motors of 15 HP and greater shall have soft start, capacitor and thermistor over heat protection. Motor noise criteria shall not exceed NC-60.
- .7 Be responsible for the protection and maintenance of the work of this Section until the work has been completed and accepted by the Owner for storing materials inside and out of the way, and for cleaning up all refuse caused by this work to the Consultant's approval.
- .8 On completion of the work, all tools and surplus and waste materials shall be removed and the work left in a clean and perfect condition.

1.17 Guarantee Warranty

- .1 This Trade Contractor shall furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance, which shall include one (1) complete summer and one (1) complete winter of uninterrupted operation. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under

normal operating conditions and/or for the purpose of which they were intended. **In addition to this, underground piping to have a warranty of five (5) years. Manufacturer for UV to have additional warranty requirements as noted in 13 40 03.**

- .2 The above parties further agree that they will at their own expense promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guarantee-warranty.
- .3 **Additionally, refer to section 13 11 13, paragraph 1.7 for additional requirements for warranty under this contract. Specifically involving buried/underground/encased pool piping systems.**

1.18 Substantial Performance Inspection

- .1 Prior to the Trade Contractor requesting an inspection for substantial performance all the following items must be provided to permit beneficial use by the Owner.
 - .1 Comply with requirements within division 13 and 22
 - .2 Preliminary Maintenance and Operating Manuals to be submitted and approved.
 - .3 Preliminary Record drawings.
 - .4 Balancing reports (flow and chemistry)
 - .5 All motor name plate ratings and actual operating amps and voltages.
 - .6 All systems shall be certified in writing by the Contractor as complete and fully operational.
 - .7 Instructions to the Owner's operating personnel shall be provided in accordance with the specifications. A signed statement to this effect, countersigned by the Owner, shall be submitted to the Construction Manager.
 - .8 A complete list of items which the Trade Contractor has not finished, or are deficient shall be provided. If, in the opinion of the Consultant, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
 - .9 The Trade Contractor shall be fully responsible for obtaining all necessary data from Sub-trades and suppliers and for presenting this data in an acceptable format for the approval by the Construction Manager.

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Division 09 - Interior Painting.

- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.
- .4 Clean exposed bare metal surfaces supplied under Division 13. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .5 Paint all pipe hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer.

3.2 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.
- .2 All equipment MUST appear NEW. Remove construction debris including paint, dust and scratches.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written reports from manufacturers' verifying compliance of the work, in handling, installing, applying, protecting, cleaning and start-up of a product.
 - .2 Submit Manufacturer's Field Reports as described in Division 13 : PART 1 - Submittals.
 - .3 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 DEMONSTRATION

- .1 Consultant and/or Owners representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct the operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Where specified elsewhere in Division 13 manufacturers to provide demonstrations and instructions.
- .4 Use operation and maintenance manual, record drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration requirements shall be as specified in the appropriate sections.
- .6 Contractor will record these demonstrations on digital video for future reference.

- .7 Refer to 13 40 05 : Swimming Pool Commissioning for additional scopes of work.

3.5 ELECTRICAL MOTORS

.1 Manufacturer's instructions

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Installation

- .1 Unless otherwise noted starters and protection devices will be included under Electrical.
- .2 Co-ordinate with Electrical Contractor to ensure proper connection, correct thermal overload protection and correct motor controls.
- .3 Where starters are included in this Division as an integral part of packaged equipment, they shall contain thermal overload protection in all ungrounded lines.
- .4 Equipment, which has more than one voltage rating, shall be fed from a single power source through a disconnect switch.
- .5 Fasten securely in place.
- .6 Make removable for servicing, easily returned into, and positively in position.

.3 Setting and Alignment

- .1 Employ a journeyman millwright to align all V-belt drives and/or shaft coupling drives. The millwright shall check that centrifugal fan wheels are properly centred on fan shafts.
- .2 Align shaft couplings, using a dial indicator, to within +/-0.051 mm [0.002"] after grouting is complete and the piping system is operational.
- .3 Align V-belt drives using a straight edge.
- .4 Submit a certificate from the millwright employed, certifying that all shaft couplings and V-belt drives have been aligned and centrifugal fan wheels centred prior to initial start up and checked again after final system balance adjustment.
- .5 Submit a certificate from the millwright employed, certifying that all shaft couplings and V-belt drives have been aligned and centrifugal fan wheels centred prior to initial start up and checked again after final system balance adjustment.
- .6 Submit a certificate from the millwright employed, certifying that all shaft couplings and V-belt drives have been aligned and centrifugal fan wheels centred prior to initial start up and checked again after final system balance adjustment.

3.6 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

- .2 All Equipment and Piping must be suspended above ground and covered to protected.

3.7 SUBSTANTIAL PERFORMANCE INSPECTION

- .1 Prior to the Trade Contractor requesting an inspection for substantial performance all the following items must be provided to permit beneficial use by the Owner.
 - .1 Comply with requirements within division 13
 - .2 Preliminary Maintenance and Operating Manuals to be submitted and approved.
 - .3 Preliminary Record drawings.
 - .4 Balancing reports (flow and chemistry)
 - .5 Preliminary commissioning manuals on site until final manuals are provided
 - .6 All motor name plate ratings and actual operating amps and voltages.
 - .7 All systems shall be certified in writing by the Contractor as complete and fully operational.
 - .8 Instructions to the Owner's operating personnel shall be provided in accordance with the specifications. A signed statement to this effect, countersigned by the Owner, shall be submitted to the Construction Manager.
 - .9 A complete list of items which the Trade Contractor has not finished, or are deficient shall be provided. If, in the opinion of the Consultant, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
 - .10 The Trade Contractor shall be fully responsible for obtaining all necessary data from Sub-trades and suppliers and for presenting this data in an acceptable format for the approval by the Construction Manager.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of pool piping above & below grade.
 - .2 Installation of valves and accessories.
- .2 Related sections
 - .1 Read in conjunction with all front-end documents. Note any discrepancies at time of bid.
 - .2 13 40 00 – Swimming Pool – General Conditions
 - .3 13 40 02 – Swimming Pool Pumps
 - .4 13 40 04 - Swimming Pool Equipment
 - .5 13 40 05 – Swimming Pool Commissioning
 - .6 Division 26 – Electrical
 - .7 Architectural Documents
 - .8 Structural Documents

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM D 1784, Rigid Poly (Vinyl-Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - .2 ASTM D 2564, Solvent Cement for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-B137.3, Rigid PVC Pipe for Pressure Applications.
 - .2 CSA-B137.6, CPVC Pipe, Tube & Fittings.
 - .3 CSA B137.4 HDPE High Density Poly-ethylene

1.3 MAINTENANCE

- .1 Extra Materials:
 - .1 Furnish following spare parts:
 - .1 Butterfly Valves: one per size installed.
 - .2 Ball Valves: One per size installed.
 - .3 Valve handles: two of each size.
 - .4 Gaskets for flanges: one for every ten flanges.

Part 2 Products

2.1 PIPING MATERIAL

- .1 Pool Piping and fittings (including hydro-air piping)
 - .1 Below Grade – Concrete Encased, PVC Schedule 40 to CSA-B137.3.
 - .2 Above Grade - PVC Schedule 40 to CSA-B137.3.
- .2 PVC Custom Fabricated Headers
 - .1 Custom factory constructed of Schedule 80 PVC materials by qualified fabrication facility.
 - .2 All spigots to be mitred, and set level and square to header body. Header ends to be capped with ½” PVC plate.
 - .3 All joints to be factory hot-gas welded (min 4 passes) and factory fibreglass wrapped using proper surface preparation, isophthalic resin, and a minimum 2 layers chop strand fibreglass and minimum 2 layers roving mat fibreglass.
 - .4 Provide final gelcoat finish.
- .3 Chemical Feed Piping up to 25mm Diameter:
 - .1 Suction Side of Pump Polyethylene to CSA B 137.1-M
 - .2 Discharge side of Pump – PVC Sch. 80 / PVC Sch. 80 Double Containment piping. To ASTM D2467 specifications for pressure piping.
 - .3 Bulk feed piping: PVC Schedule 80 to CSA-B137.3
 - .4 CO2 micro-bulk system piping: as per manufacturer requirements.
- .4 Pool Piping To / From Heat Exchanger and UV
 - .1 CPVC Schedule 80 to CSA-B137.3.
- .5 Pool Gravity Gutter Drain:
 - .1 PVC – Schedule 40 to CSA B137.3
- .6 Pool Fill Line: Downstream of Backflow Preventer
 - .1 PVC Schedule 80 to CSA-B137.3

2.2 JOINTS & FITTINGS

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.
- .3 Compression fitting for Polyethylene tubing
- .4 Galvanized Pipe - Teflon tape: for threaded joints.
- .5 Copper Pipe - Solder: 95/5 - tin copper alloy: lead free.
- .6 Flanged connections to all equipment or dissimilar materials
- .7 Saddle tees not to be use below or above grade.

2.3 VALVES

- .1 Ball Valves:
 - .1 Pool water up to 50 mm:
 - .1 All PVC ball valves are to be "Safe-Bloc" (or equal) with EPDM seal and cushioned Teflon ball seats.
 - .2 Carriers for Teflon seats will be screw-in type internally adjustable from both ends.
 - .3 PVC compound will be Type I, Grade 1, cell classification 12454-A, with minimum suffix "B" designation for chemical resistance as per ASTM D-1784.
 - .2 Chemical Injection:
 - .1 PVDF to 50 mm - All PVDF ball valves are to be "Safe-Bloc" (or equal) with Teflon seals and cushioned Teflon ball seats.
 - .2 Carriers for Teflon seats will be screw-in type internally adjustable from both ends.
 - .3 Acceptable Manufacturer:
 - .1 Chemline
 - .2 Hayward
- .2 Butterfly Valves:
 - .1 75 mm to 300 mm
 - .1 Wafer style bodies one piece molded, with a full set of ANSI class 150 flange locating bolt holes.
 - .2 Discs shall be solid PVC; complete have double EPDM O-ring seals at the top and bottom assuring that the shaft is non-wetted.
 - .3 Shaft shall be one piece high tensile stainless steel having and engagement over the full length of the disc with no disc screws.
 - .4 Seat shall be removable EPDM and shall provide 100% bubble tight closure all sizes, with two concentric convex molded rings on flanged face to function as a low torque gasket. Seal shall effectively isolate the body and shaft from the fluid media.
 - .5 75 mm to 150 mm shall have hand lever molded of polypropylene over a steel core and have a polycarbonate 13-position lock.
 - .6 200 mm to 600 mm are to be supplied with baked epoxy coated waterproof gear operator, with PVC covered handwheel shaft and O ring seal, SS fasteners, sealed visual position indicator and open/close travel stops which allows adjustment for seat wear.
 - .7 Provide chain-operator for frequent-use valves placed at high level.
 - .8 One piece molded PVC bodies, are to be made of Type 1, Grade 1, cell classification 12454-A, with minimum suffix "B" designation for chemical resistance as per ASTM D-1784.

- .9 PVC, compound and EPDM seals shall meet CSA Standard B-137.0
Para 5.2.1 environmental requirements for toxicity.
- .2 Acceptable Manufacturer:
 - .1 Chemline
 - .2 Hayward
- .3 Wafer Check Valves
 - .1 40mm to 600mm:
 - .1 Polypropylene wafer check valves 40 mm to 600 mm with 316SS disc springs and with EPDM O-ring disc seal.
 - .2 Valve will be wafer type designed to fit between ANSI Class 150 flanges
 - .3 Provide required companion spacer for installation of check valve.
 - .4 Provide flange gaskets between valve and flange and companion spacer and flange.
 - .5 Required flange gaskets will be full face Class 150, raised face low torque type of solid EPDM (or Teflon PTFE bonded EPDM).
 - .6 Polypropylene shall conform to ASTM D-4101 material requirements
 - .7 All valves shall be custom tagged with manufacturer's inspection number to provide traceability.
 - .2 Acceptable Manufacturer:
 - .1 Chemline
 - .2 Hayward
 - .3 Braukmann
- .4 Pressure Regulating Valves
 - .1 12mm to 50mm:
 - .1 All PVC pressure regulating valves, 12 mm to 50 mm are to be fully field adjustable for 100kPa to 900kPa pressure.
 - .2 Solvent-weld union ends 12 mm to 50 mm shall be Schedule 80 and conform to ASTM D-2464.
 - .3 65 mm to 100 mm
 - .1 All PVC, fully adjustable between 100kPa and 621kPa through the exchange or springs. Stem seal will be Teflon PTFE bellows to assure reliable operation. Static seals will be Viton.
 - .2 Flanged ends 65 mm to 100 mm shall be ANSI Class 150, All PVC flanged bodies will be one piece molded.
 - .4 Acceptable Manufacturer:
 - .1 Chemline
 - .2 Hayward
- .5 Air Release Valve
 - .1 12 mm ø air release valve. Static seals will be Viton.

- .2 Acceptable Manufacturer:
 - .1 Chemline
 - .2 Hayward
 - .3 Braukmann
- .6 Flow Control Valves:
 - .1 25mm polyethylene plate drilled with single orifice suitable to produce restricted flowrate in given system application.
 - .2 Plate to be installed between flanges and gaskets. Plate to be drilled to ANSI #150 bolt pattern suitable to diameter of pipeline installation.

2.4 ACTUATORS

- .1 Reversible rotary unit with output torques of 150 in-lb. Cycle time to be 5 seconds for 90° rotation.
- .2 Modulating via 0-10 vdc or 4-20mA signal
- .3 Actuator to include end limit switches for auxiliary control.
- .4 Actuator housing shall be Nema IV with glass fiber reinforced polypropylene and manual override.
- .5 Ball Valve Actuators Up to 50-mm ϕ
- .6 Butterfly valve actuator for valves 65- mm ϕ and greater.
- .7 Acceptable Manufacturer:
 - .1 Chemline
 - .2 Hayward
 - .3 Belimo

2.5 PIPE HANGERS & SUPPORTS

- .1 General Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts, and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework, or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
 - .6 Provide seismic restraints for all piping. Retain seismic engineer to approve

- restraint of pool piping systems. Refer to section 23 05 48 – Vibration and Seismic Control for Mechanical.
- .7 Restrain piping against water hammer as experienced under any operating conditions, using appropriate restraints.
 - .8 Hangers and restraints located in the aquatic area, aquatic storage rooms, and basement and main floor mechanical rooms shall be epoxy coated.
- .2 Finishes:
- .1 Provide epoxy marine grade coating on all supports located in aquatic area, aquatic storage rooms, basement and main floor mechanical rooms.
 - .2 Painting by qualified trade or factory supplied with cost incurred by this contract. Paint before installing hangers.
 - .3 Provide fiberglass unistrut-channel or PVC angle supports in pool surge tanks/submerged areas.
 - .4 All metal anchors in pool surge tanks/submerged areas to be 316L stainless steel.
 - .5 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
 - .6 All hangers, rod, and supports required for un-encased pool piping below grade to be stainless steel.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
- .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut, and carbon steel retaining clip, UL listed to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw clamp with hooked rod, spring washer, plain washer, and nut UL listed.
- .4 Upper attachment to concrete:
- .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin, and cotters with weldless forged steel eye nut. Ensure eye 6-mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .5 Shop and field-fabricated assemblies:
- .1 Trapeze hanger assemblies.
 - .2 Steel brackets:
- .6 Hanger rods: threaded rod material to MSS SP58:
- .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Provincial Plumbing Code and BC Health code. Contractor to make assessment of documents bearing in mind good industry practices for pool mechanical systems and requirements of a complete mechanical system. Contractor to note potential discrepancies or omissions plans and note at time of tender and prior to equipment installation.
- .2 Provide all required pipe fittings, straight pipe runs, and other connections required by controls contractor. Coordinate equipment types and locations prior to installation of pipelines.
- .3 Firestopping: provide firestopping at all penetrations between basement and main floor mechanical room, and main floor and upper mechanical rooms.
- .4 Identification: provide lamocoids for identification of all equipment. Adhere lamocoids to equipment. Where equipment does not present even surfaces to create a durable bond, use non-metal strapping to attach lamocoids to equipment.
- .5 Provide identification flow arrows and adhesive stencil labels using full-word descriptions of piping systems.
- .6 Identify all circulation piping and water feature piping by name as well as number. Provide labels system labels in all rooms.

3.2 POOL PIPING & CONNECTIONS

- .1 All piping shall be stored above grade and covered for protection from weather. Piping sitting on the ground will be marked & will not be allowed to be installed. Unprotected piping creates bacterial growth when the systems are filled and heated.
- .2 All gluing, welding or cementing of piping shall be done at temperatures exceeding 5°C. Temporary hording will not be considered as meeting the above requirement.
- .3 For graded piping and structural penetrations, verify inverts and pipe position allows maintaining a pipe run underground or through a mechanical room area, prior to setting sleeves or waterstop penetrations.
- .4 All buried pool piping shall be encased in concrete with a minimum of 75 mm of cover. Suitable reinforced concrete cover with re-bar @ 300 mm O.C. or as required by the Structural Engineer. Maintain hydrostatic pipe test when encasing pipe in concrete. (Coordinate this with structural).
- .5 Underslab piping to be left un-encased by explicit direction of Mechanical consultant only. Pipes to be braced against water hammer using rigid supports if necessary.
- .6 All acid and chlorine feed piping shall be double containment type to protect facility operator from potential leaks. IPEX Double containment piping or equal.
- .7 All piping that penetrates the pool, including piping encased monolithically with

- pool structure, large tanks, or gutter walls, shall be protected with a water stop flange. Minimum flange size shall be 75 mm minimum larger than pipe.
- .8 Support piping upon or against structure prior to encasement with mechanical supports as required. Restrain against movement prior to concrete pour.
 - .9 Mechanical room piping layout to allow ready access to critical/regularly used valves by operator. Verify status of particular with consultant prior to beginning installation if in question.
 - .10 Provide shop drawings for PVC header.
 - .11 Use custom PVC headers to ensure alignment of associated pipe penetrations of walls prior to concrete pour, where applicable.
 - .12 Provide Flange connections when connecting to equipment.
 - .13 Provide Flange connections when changing materials.
 - .14 All unions to be S-80 PVC, c/w EPDM O-rings. All unions to be by one manufacturer to ensure easy resupply of o-rings.
 - .15 Apply silicone grease to all system o-rings and union threads to ensure ease of assembly.
 - .16 Provide seismic restraints as per direction of seismic engineer, and provide additional restraints against water hammer in piping as may be required.
 - .17 All Flange bolts and washers shall be suitable for a corrosive environment acceptable materials are stainless steel or equal.
 - .18 Torque all flange bolts, observing flange torque requirements, prior to system start up to ensure long-term water tightness of system.
 - .19 Maintain clearance to allow flange bolt removal.
 - .20 Use spigot flanges where required to reduce equipment layout dimensions where necessary.
 - .21 It is the Pool contractor's responsibility to plumb the pool fill lines from the backflow preventer to the connection points. Refer to drawings for exact locations.
 - .22 Provide gear operated valves for all pool fill manual bypass piping to prevent water hammer.
 - .23 P.V.C. pipe shall not be threaded on site. Use tees and not saddles for large differential connections. Drill and tapping of pipe shall be used as a last resort under the following conditions:
 - .1 No drill and tapping whatsoever shall be used under slab. Drill and tap in mechanical room space on the mechanical room side of all isolation valves only.

- .2 Where possible, tap one size larger and required and install thread x thread reducing bushing to strengthen tapping installation.
 - .3 Only use Sch-80 pipe for tapping. Locate tapplings as required for equipment installation.
 - .4 In mechanical room only, drill and tap for equipment where reducing tees prevent proper device installation (i.e. flow switches and temperature sensors) and where:
 - .5 Threads \leq 25mm diameter are tapped into pipes \geq 150mm diameter. For larger tapplings or smaller pipes, use reducing tees. Do not tap pipes $<$ 150mm diameter EXCEPT in case of chemical injection points, which require exposure to centre of flow within pipeline.
 - .6 Tap, thread, glue, and epoxy all tapped connections except equipment/chemical injection points. Repair all leaks after pressure testing as required.
- .24 Pipe Fastening
- .1 P.V.C. hot air welding in strict accordance with manufacturers recommendations shall be allowed only for non-leak flanges or back welding of glued fittings, or by permission of the Engineer.
 - .2 Obtain manufacturers procedure literature before welding of pipe. Submit this literature to engineer as part of shop drawings. Have the procedures on site during installation of all piping.
 - .3 When welding is allowed, the contractor shall demonstrate to the engineer his ability to properly weld P.V.C. piping prior to welding finished products.
 - .4 All cementing shall be done at temperatures exceeding 5°C. Submit manufacturers written procedures if welding at colder temperatures.
 - .5 Piping must be cut square and all burrs removed from inside and outside of cut end of pipe.
 - .6 All piping shall be cleaned prior to cementing.
 - .7 Following manufacturers published literature for priming and gluing of pipe ensuring the use of correct size of brush and that fittings are twisted 90° prior to glue setting.
 - .8 For pipes over 300 mm, joints shall be clamped for specified curing time.

3.3 VALVES

- .1 Ball Valves:
 - .1 Socket weld ball valves. Maintain upstream/downstream pipe alignment and tension to prevent unequal or excessive compression of valve components.
 - .2 Locate valves (whenever possible) at easy accessible elevations.
 - .3 Lubricate o-rings and threads with minimal silicone-grade grease.
- .2 Butterfly Valves:

- .1 Connect butterfly valves with flanges. Maintain upstream/downstream pipe alignment and tension to prevent unequal or excessive compression of valve components.
- .2 Provide chain operators for regularly-used butterfly valves located at high level.
- .3 Check Valves:
 - .1 Install check valves on parallel pump systems.
 - .2 Install check valves to protect flow from reversing. Refer to drawings.
 - .3 Align check valves to ensure proper operation and to prevent valve jamming in open position.
 - .4 Install a check valve at the tee of the chemical feed injector and main filtration pipe.
- .4 Pressure Regulating Valves:
 - .1 Pressure regulating valves are to be used to protect pumps from dead heading. Install regulator on a by-pass line to re-circulate flow into the suction side of the pump.
- .5 Air Release Valves:
 - .1 Install air release valves @ all high points in the system.
- .6 Flow Control Valves:
 - .1 Install flow control valves on water feature systems to assure constant flow to the feature regardless of pump flow or pressure.
- .7 Foot Valves:
 - .1 Install foot valves in chemical mixing tanks to assure pump is always primed.

3.4 SUPPORTS & HANGERS

- .1 Refer to Section 23 05 29 – Hangers & Supports for Mechanical Piping & Equipment for additional information.
- .2 Hangers to be epoxy coated in all mechanical rooms.
- .3 Provide all required reinforcing bar, blocking, straps for proper support and concrete coverage when concrete encasing piping.

PVC Pipe Supports										
Maximum Spacing (mm) Pipe Size	25 mm	30 mm	40 mm	50 mm	65 mm	75 mm	100 mm	150 mm	200 mm	250-300mm
Temp Range										
Up to 27c	0.9 m	1.5 m	1.5 m	1.5 m	1.8 m	1.8 m	2.1 m	2.4 m	2.7 m	2.1
Between 27c – 37c	0.9 m	1.2 m	1.2 m	1.2 m	1.5 m	1.8 m	1.8 m	2.1 m	2.4 m	2.1

Over 37c	0.9 m	0.9 m	1.2 m	1.2 m	1.2 m	1.5 m	1.5 m	1.8 m	2.1 m	2.1
Hanger Rod Diameter	10mm	10mm	10mm	10mm	10mm	10mm	10mm	12mm	12mm	15mm

- .4 Minimum one hanger per section of pipe.
- .5 Install hangers a maximum 300mm away from an elbow. Support on both sides of elbows.
- .6 Provide seismic restraints as per direction of seismic engineer.
- .7 Provide restraints against water hammer in particular piping locations as required and determined at time of equipment startup.

3.5 FIRESTOPPING

- .1 Shop drawings to show:
 - .1 Material specification including CSA or ULC reference numbers.
 - .2 Installation details for various types of piping materials.
 - .3 Operating and maintenance requirements.
- .2 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .3 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- .4 Firestop System installation must meet requirements of CAN4-S115-M or ULC S 115-M tested assemblies that provide a fire rating.

3.6 TESTING

- .1 Pressure test buried systems before concrete encasing. Maintain under reduced pressure during concrete encasing.
- .2 Allow for all required pressure test caps at various transitions in construction phases.
- .3 Pressure test above grade piping, including all equipment, as a whole prior to system startup.
- .4 All pool related piping shall be tested to a minimum of 1.5 times system dead head pressure, or 517 kPa, whichever is greater, for a period of eight hours.

- .5 Test equipment with lesser pressure ratings at lower test pressure. Isolate prior to testing remainder of equipment and piping at higher pressure if applicable.
- .6 Complete two Cycle pressure tests for mechanical room piping. Test is intended to ensure all mechanical connections endure pressure changes.
- .7 All PVC pipe pressure tests shall be with water or glycol. Air pressure tests are not permitted.
- .8 All underground pool piping shall be tested and passed prior to encasing piping in concrete. Maintain test during pipe encasement and piping will be tested again four days after concrete encasement.
- .9 Pool filters shall be tested to 344 kPa for a period of eight hours. Test filters prior to introduction of sand media.
- .10 All piping or equipment that fails tests will be replaced at no cost to the owner
- .11 All pressure tests to be documented and placed into maintenance manuals. Document to indicate what is being tested, start/finish times of test, pressure start pressure, finish pressure and witness.
- .12 The pool mechanical Consultant will be unable to inspect all underground pool piping. Photos must be taken of piping roughed in, reinforcement in place and during the encasement concrete pour. The following procedure concerning remote inspection of pipe installation will be followed:
 - .1 Below slab piping:
 - .1 Prior to encasement, submit photos of piping sections to be covered. Include description of portion of systems to be tested.
 - .2 Submit pressure test report, including start/end pressures and independent witness verification. Report to include brief explanation of piping to be encased, referencing line types and gridlines.
 - .3 Pictures and pressure test report to be submitted to Consultants minimum 36 hours prior to covering piping to allow proper consultant verification of installation. RECEIPT OF PRESSURE TEST REPORTS AND SUPPLEMENTAL PICTURES OF INSTALLATION PRIOR TO ENCASEMENT IS MANDATORY.

3.7 FLUSHING & CLEANING

- .1 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations used.
 - .3 Specific requirements for completion of work.

- .4 Special precautions for protecting piping system materials and components.
- .5 Complete analysis of water used to ensure water will not damage systems or equipment.
- .2 Conditions at time of cleaning of systems:
 - .1 Systems: free from construction debris, dirt and other foreign material.
 - .2 Strainers: clean prior to initial fill.
- .3 Report on Completion of Cleaning:
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

3.8 FILLING & TREATING

- .1 The structural engineer and Architect shall outline the allowable temperature rise and fill time to protect the structure and tile work from shrinkage and cracking.
- .2 Fill pool high enough to maintain pump circulation assuring no air will enter into the suction of the system. Remove all air in system. Run water through filter and heat exchanger.
- .3 Once pool is filled and water is clear, commence into super chlorination to remove any bacteria that may have gathered in the system.
 - .1 Raise the chlorine level to 25mg/L free chlorine. While circulating the pool
 - .2 With all by-pass systems online. Test minimum 8 areas of the pool to assure that the entire pool will not have less than 25mg/L of chlorine. Test shall run for a minimum of 24 hours.
 - .3 Reduce chlorine levels to 10mg/L and run test for another 24 hours.
 - .4 Reduce chlorine levels to 3mg/L and balance pools to Langlier Index.

3.9 BALANCING

- .1 Obtain from the pool fitting supplier, balancing information for all inlet and adjustable fittings and set fitting as required to specified flow rates.
- .2 Balance all equipment when the filter is fully loaded. All by-pass lines to be balanced per equipment selections. Re-check bypass flow rates when filter is cleaned confirming if system is within design range. Provide all data to consultants for review.
- .3 Submit Balance reports per section 13 40 05 – Swimming Pool Commissioning.

3.10 PERFORMANCE VERIFICATION

- .1 Dye Testing:
 - .1 Once the specified temperature has been achieved contractor shall set up A system dye “test” for the Leisure & Lap pools. The purpose of the dye test

is to confirm the effectiveness of water distribution.

- .2 Eriochrome black T (0.2 g/m³ of circulation) dye is recommended. Before purchasing dye, verify that the dye does not stain or attack the pool tank, fittings, tiles, and grout.
- .3 De-chlorinate the pool water using sodium thiosulphate or equal. Do not expose chemical controller probes to sodium thiosulphate.
- .4 Close off the by-pass to the treatment systems and filters. Assure that the flow rate matches whether entire system is online.
- .5 Turn circulation system off and add dye. Dye maybe added through the bulk feed pump. Resume normal circulation rate.
- .6 Time how long it takes for the pool water to become evenly covered. If the pool is entirely covered in ½ the turnover rate then test is passed. If it takes longer than ½ the turnover period, rebalance system to assure proper flow distribution.
- .7 Remove dye by turning chlorine dosing systems to 5ppm. Verify that it takes the same time for the dye to remove as a second test.
- .8 Take photos of any problem areas.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of pool aquatic pumps. Pumps for current project are existing, so the following section is to be followed for reinstallation and recommissioning/balancing of these pumps.
- .2 Related sections
 - .1 Read in conjunction with all front-end documents. Note any discrepancies at time of bid.
 - .2 13 40 00 – Swimming Pool – General Conditions
 - .3 13 40 01 – Swimming Pool Piping
 - .4 13 40 04 - Swimming Pool Equipment
 - .5 13 40 05 – Swimming Pool Commissioning
 - .6 Division 26 – Electrical
 - .7 Architectural Documents
 - .8 Structural Documents

1.2 REFERENCES

- .1 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .2 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA MG 1-[2003], Motors and Generators.
- .3 National Sanitation Foundation
 - .1 Standard 50 – Swimming Pool Pumps
- .4 Canadian Standards Association.
 - .1 UL-1081: Standard for Safety: Swimming Pool Pumps

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 13 40 00 – General Conditions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data
- .3 Shop Drawings.
 - .1 Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies, and wiring and schematic diagrams.
 - .2 Dimensions and recommended installation.
 - .3 Pump performance and efficiency curves. Supply parallel pump
 - .4 Specify maximum turndown for VFD-duty applications.

- .5 When alternate equipment is supplied, it is the contractor's responsibility to match pump curves and flowrates to suit hydraulic characteristics. Provide notice to consultant at time of tender and again during shop drawing review. Additional costs due to alternate equipment including power shall be this contractor's responsibility.
 - .6 Provide information on seal corrosion resistance for verification that it matches the specified application.
 - .7 All pumps to carry CSA or NSF certificate for swimming pool safety.
- .4 Instructions: Submit manufacturer's installation instructions.
 - .5 Closeout submittals: Submit maintenance and engineering data for incorporation into manual specified in Section 13 40 00 – Closeout submittals include
 - .1 Manufacturers name, type, model year, capacity, and serial number.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list with names and addresses

Part 2 Products

2.1 EQUIPMENT

- .1 Existing equipment.

Part 3 Execution

3.1 INSTALLATION

- .1 In line circulators: Install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
- .2 Cast iron close-coupled: Install pumps as required for alignment to associated equipment. Anchor to concrete floor slab and set level and plumb. Housekeeping pads to be poured after pump installation. Ensure that pads do not interfere with pump removal or servicing.
- .3 Maintain a length of straight pipe, equivalent to 4-5 times the diameter of the pump suction flange diameter, at the suction side of each pump, except where specifically noted in the drawings.
- .4 Several system pumps require VFD control. Refer to drawing schedule for VFD control.
- .5 Thermoplastic close-coupled: install as per cast-iron close coupled pump where possible, excepting requirement for straight pipe diameters at suction side of pump. Set upon and bolt to cast concrete pads where necessary and while observing seismic restraint requirements. Provide reducing bushings as required to suit pump suction flange sizes.
- .6 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

- .7 Pipe drain tapping to floor drain if required by seal type.
- .8 Install volute venting pet cock in accessible location.
- .9 Check rotation prior to start-up. Do not bump motors prior to filling with water. Repair all damage due to premature motor rotation check at contractor's expense
- .10 Install pressure gauge test cocks.
- .11 Pump Basket strainers shall be set on minimum 100 mm high concrete
- .12 Reducers between strainer and pump to be standard long eccentric type reducer.

3.2 START-UP

.1 General

- .1 In accordance with Section 13 40 05 – Swimming Pool Commissioning: General Requirements, supplemented as specified herein.
- .2 In accordance with manufacturer's recommendations.

.2 Procedures:

- .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
- .2 After starting pump, check for proper, safe operation.
- .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
- .4 Check base for free-floating, no obstructions under base.
- .5 Run-in pumps for 12 continuous hours.
- .6 Co-ordinate with electrical trade: set thermal overloads at time of pump start-up. Recheck thermal overloads during commissioning process.
- .7 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
- .8 Eliminate air from scroll casing.
- .9 Adjust water flow rate through water-cooled bearings where applicable.
- .10 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
- .11 Adjust alignment of piping and conduit to ensure true flexibility at all times.
- .12 Eliminate cavitation, flashing and air entrainment.
- .13 Adjust pump shaft seals, stuffing boxes, glands where applicable.
- .14 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .15 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .16 Verify lubricating oil levels.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General

- .2 In accordance with Section 13 40 05 – Swimming Pool Commissioning: General Requirements, supplemented as specified herein.
- .3 Exclusions:
 - .1 This paragraph does not apply to small in-line circulators.
- .4 Assumptions: These PV procedures assume that:
 - .1 Manufacturer's performance curves are accurate.
 - .2 Valves on pump suction and discharge provide tight shut-off.
- .5 Net Positive Suction Head (NPSH):
 - .1 Application: Measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed in the Standard.
- .6 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .7 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .8 Commissioning Reports: In accordance with Section 13 40 05 – Swimming Pool Commissioning: reports supplemented as specified herein. Reports to include:
 - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
 - .2 Report forms as specified Section 13 40 05 – Swimming Pool Commissioning: Report Forms and Schematics.
 - .3 Pump performance curves (family of curves).
 - .4 Pump Data
 - .1 Design Data:
 - .1 Fluid flow rate;
 - .2 Total head;
 - .3 kW (Hp), r/min, amps, volts, phase.
 - .2 Installation Data:
 - .1 Manufacturer and model;
 - .2 Size;
 - .3 Type drive;
 - .4 Motor type, kW (Hp), r/min, voltage, phase, and full load amperage.
 - .3 Recorded Data:
 - .1 Discharge and suction pressures (full flow and no flow);
 - .2 Operating head;
 - .3 Operating water flow rate (from pump curves if metering not provided);

.4 Motor operating amps (full flow and no flow); R/min.

3.4 EQUIPMENT PERFORMANCE

.1 Refer to schedule on drawings for equipment performance.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes:
 - .1 The installation of Pool Equipment forming part of complete pool mechanical systems.
- .2 Related Sections
 - .1 Read in conjunction with all front-end documents. Note any discrepancies at time of bid.
 - .2 13 40 00 – Swimming Pool – General Conditions
 - .3 13 40 01 – Swimming Pool Piping
 - .4 13 40 02 - Swimming Pool Pumps
 - .5 13 40 05 – Swimming Pool Commissioning
 - .6 Division 26 – Electrical
 - .7 Architectural Documents
 - .8 Structural Documents

1.2 REFERENCES

- .1 Alberta Health Services, Swimming Pool Regulations
- .2 National Sanitation Foundation (NSF) Standard 50
- .3 Canadian Standards Association (CSA)

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 13 40 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheet for fixtures and equipment.
- .3 Shop Drawings.
 - .1 Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies, and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Provide equipment from specified equipment lists. When proposing alternate equipment with electrical/hydraulic characteristics different from those of specified equipment, contractor is responsible for ensuring compatibility of associated equipment intended to complete a single mechanical system – i.e. pumps, chemical treatment equipment. Note alternates at time of tender.
- .4 Instructions: Submit manufacturer's installation instructions.

- .5 Closeout submittals: Submit maintenance and engineering data for incorporation into manual specified in Section 13 40 00 - Closeout Submittals, include:
 - .1 Manufacturers name, type, model year, capacity, and serial number.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list with names and addresses

1.4 QUALITY ASSURANCE

- .1 All work to be of the highest quality according to best trade practice and in strict accordance with manufacturers printed specifications.
- .2 Provide warranties with shop drawings as requested in the following pool sections.
- .3 Supply only equipment, design features, and materials approved by the Canadian Standards Association or the National Sanitation Foundation. If equipment supplied does not conform to the above, it is the manufacturer's responsibility to get Health Authority approval.

Part 2 Products

2.1 FILTER TANK LEVEL CONTROL

- .1 All existing components, systems and controls for filter tank level control and pool fill are to be retained and recommissioned for operation after remediation work.

2.2 PUMP BASKET STRAINER:

- .1 Strainer shall be constructed completely of non-corrodible materials.
 - .1 Body shall be all fibreglass construction incorporating a .100" corrosion liner on all interior surfaces and flange faces.
 - .2 Liner shall be constructed of one layer of resin-rich "C" veil, followed by two layers of 1½ oz. fibreglass mat.
 - .3 Structure to be four layers of 1½ oz. glass mat, vinylester resin impregnated.
 - .4 Provide factory-installed gauge tappings on influent and effluent sides to allow gauge installation.
 - .5 Strainers to be provided with extra factory-installed tapping at influent connection to allow gauge installation.
- .2 Inlet and outlet to be flanged connections, flange to be 20mm thick drilled to 150# ANSI standard drilling pattern.
- .3 Lid to be manufactured of clear acrylic to allow unobstructed visual inspection of basket. Stainless steel toggle bolts with galvanized carbon steel knobs to be built into the top of the strainer body to clamp down acrylic cover tightly. Three bolts are immovable while one bolt drops away after loosening knob. The clear lid shall be grooved to allow it to swing open after dropping one toggle. Lid shall be sealed with an ethylene propylene "O" ring.
- .4 Supply a Stainless Steel strainer basket with 1/4" holes on 3/16" staggered centres. Minimum open area to be four times the incoming pipe open area.

2.3 **INLINE PVC Y-STRAINERS**

- .1 Strainer to be composed of clear PVC, Y-configuration, c/w union connections.
- .2 Strainer element to be PVC c/w 1/32" perforations.
- .3 Strainer seals to be EPDM.
- .4 Acceptable manufacturers:
 - .1 Hayward
 - .2 Chemline

2.4 **FLOW METERS:**

- .1 Type - FM-1:
 - .1 Flow Meter:
 - .1 Insertion style magnetic flow sensor with no moving parts.
 - .2 Provide corrosion resistant material suited for 25 PPM of chlorine content.
 - .3 The output signal may be transmitted up to 100 metres without the need for conditioning.
 - .4 Pipes sizes 12mm to 900mm
 - .5 The microprocessor based sensor shall include Empty Pipe Detection, LED-assisted troubleshooting, and Bi-Directional span capability (in 4-20 mA models).
 - .6 Supply voltage: 5 to 24 VDC +/- 10% 15 mA max.
 - .7 Accuracy: + 1% over flow rate range
 - .8 Repeatability: + 0.5%
 - .9 Linearity: +1%
 - .10 G+F Signet 2551 Magmeter or equal
 - .2 Remote Instrument Readout Panel:
 - .1 Panel Mounting Instrumentation,
 - .2 Supply Voltage, 110 VAC: 60 Hz
 - .3 All data input for preset and calibration by push button control
 - .4 The data from totalizer will not be lost in case of power failure
 - .5 Provide one Remote Panel Readout for 2 pools.
 - .6 4-20 mA signal output to DDC for flow monitoring.
 - .7 Product – G+F 9900
 - .3 Acceptable Manufacturers:
 - .1 G+F
 - .2 Blue-White
 - .3 Hayward
 - .4 Hays
 - .5 Seametrics
 - .6 Chemline
- .2 Type: FM-2

- .1 Flow meter with inline readout with CPVC Praher valve body, ABS Indicator arm, viton seal, polycarbonate scale and lid
 - .2 Provide vertical or horizontal installation flowmeters as required by installation.
 - .3 All flowmeters come complete with installation instructions and gasket seal
 - .4 The flow meter to be NSF approved for swimming pool applications
 - .5 Flow meter to provide accurate flow with the ability to be installed next to fittings such as tees.
 - .6 The maximum temperature the flowmeter should be exposed to is 91°C.
 - .7 Acceptable Manufacturers:
 - .1 FlowVis by H2Flow Controls
- .3 Type: FM-3
- .1 Flow meter with inline and digital readout with CPVC Praher valve body, ABS Indicator arm, viton seal, polycarbonate scale and lid
 - .2 Provide vertical or horizontal installation flowmeters as required by installation.
 - .3 All flowmeters come complete with installation instructions and gasket seal
 - .4 The flow meter to be NSF approved for swimming pool applications
 - .5 Flow meter to provide accurate flow with the ability to be installed next to fittings such as tees.
 - .6 The maximum temperature the flowmeter should be exposed to is 91°C.
 - .7 Acceptable Manufacturers:
 - .1 FlowVis Digital by H2Flow Controls

2.5 PRESSURE GAUGES

- .1 Gauges shall be 70 mm diameter 1% accuracy cast aluminum case, aluminum ring, phosphor bronze bourdon tube, brass movement, front re-calibrator, and glass window. Gauges to be liquid filled.
- .2 Dials shall read metric units kPa as well as imperial units PSI.
- .3 For gauges on liquid service, provide a bronze pulsation damper and needle valve. Provide snubbers against liquid and debris infiltration into gauge.
- .4 Supply compound vacuum/pressure gauges on suction side of all circulation pumps and pressure gauges on discharge sides of all pumps and at equipment as shown on schematic. Provide pressure gauges only at all bypass pumps. Gauges are not required on chemical feed pumps with exception of bulk feed pump.
- .5 Ensure a ball type isolation valve is installed for each pressure gauge

2.6 THERMOMETERS

- .1 Thermometers shall be 225 mm scale adjustable angle, cast aluminum case or ABS plastic case, red reading mercury, glass front and complete with 18 mm NPT brass separable well, Celsius scale AND Fahrenheit scale.

2.7 POOL FITTINGS

- .1 Refer to plans and schedules.

Part 3 Execution

3.1 INSTALLATION

- .1 In accordance with Section 13 40 01 – Swimming Pool Piping.
- .2 Install in accordance with Provincial Plumbing Code.

3.2 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.
- .3 Provide all pressure test caps/devices required to test piping connected to water features.
- .4 Do not install test caps until all piping connections are complete, to minimize chance of welding caps to fittings and damaging fittings.
- .5 Manufacturers to provide all start-up and training requirements

3.3 MAKE UP WATER CONTROLS

- .1 Refer to section 13 40 01 for materials required for makeup water piping.
- .2 The Level control System shall be capable of performing the following functions:
 - .1 Send a 4-20mA signal to the DDC system to indicate tank water level to monitor LWL (Low Water Level), NWL (normal water level) and HWL (high water level).
 - .2 Refer to sequence of operations for setup of valve components.
 - .3 Refer to Manufacturers data for installation of Level sensor. Mount sensor above fluid level protected by overflow drain.
 - .4 Refer to drawing details for installation of system.
 - .5 Provide water stop flanges on all new or remediated pipe penetrations through surge tank.

3.4 PUMP BASKET STRAINER

- .1 Basket strainers shall be line size not pump size.
- .2 Provide eccentric reducers between strainer and pump to assure laminar flow.
- .3 Install pressure gauges across strainer to monitor cleaning.

3.5 FLOW METERS

- .1 Mount FM-1 read out panels in an accessible location. Coordinate with controls contractor for EMCS control point connections.
- .2 Install flow meters (FM-1, FM-2 & FM-3) per manufacturer's instructions. In this is unavailable assure 8 pipe diameters before and 2 pipe diameters after the meter.

3.6 POOL FITTINGS

- .1 Obtain from the pool fitting supplier, balancing information for all inlet and adjustable fittings and set fitting as required to specified flow rates.

3.7 SPARE PARTS

- .1 Supply one spare basket for each strainer size.

3.8 PERFORMANCE VERIFICATION

- .1 General:
 - .1 Co-ordinate with pool commissioning agent prior to start-up of pool equipment. Refer to section 13 40 05.
 - .2 Render all assistance necessary as part of commissioning of pool equipment.
 - .3 Provide information to pool commissioning agent as required for composition of operating manuals.
- .2 Pool Fill:
 - .1 Ensure pool fill line is located at sufficient distance from level control standpipe to not influence level reading.
 - .2 Test auto-fill devices. Drop pool level below set point and monitor control.
 - .3 Drop water level low enough to verify shut down of equipment on low level.
- .3 Heat Exchanger
 - .1 Design Data:
 - .1 Fluid flow rates (heated media, heating media);
 - .2 Fluid type;
 - .3 Inlet and outlet temperatures.
 - .4 Amount of time required to bring pool from cold to operational temperature state.
 - .2 Installation Data:
 - .1 Manufacturer, model, type;
 - .2 Fluid flow rates (heated media and heating media);
 - .3 Inlet and outlet temperatures;
 - .4 Pressure relief valve setting.
 - .3 Recorded Data:
 - .1 Heating media entering flow rate;
 - .2 Heated media leaving flow rate;
 - .3 Entering and leaving temperatures (for varying outdoor temperatures) and pressures;
- .4 Filter Tank Level Control
 - .1 Refer to section 13 40 06 Sequence of Operations for design intent of valve operation.
 - .2 Drop water level in Filter Tank:
 - .1 Confirm Make Up Water Valve opens

- .5 Flow Meters:
 - .1 Measure flow in the system using the pump curve to verify accuracy of meter.
 - .2 Confirm BMS & Pool Controller are receiving signal.
- .6 Pool Fittings:
 - .1 Assure that a minimum back pressure is on the inlet fittings to assure sufficient velocity across the pool floor. Minimum setting is 3-psi at filters. Adjust inlet fittings underwater as required. Refer to dye testing outlined in section 13 40 01 Swimming Pool Piping.
 - .2 Test main drains for suction.
 - .1 Cover one main drain and go around and check others for suction.
 - .2 Repeat performance until all drains have been covered at least once.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

- .2 Related Sections:

- .1 Read in conjunction with all front-end documents. Note any discrepancies at time of bid.
- .2 13 40 00 – Swimming Pool – General Conditions
- .3 13 40 01 – Swimming Pool Piping
- .4 13 40 02 – Swimming Pool Pumps
- .5 13 40 04 - Swimming Pool Equipment
- .6 Division 26 – Electrical
- .7 Architectural Documents
- .8 Structural Documents

- .3 Acronyms:

- .1 AFD - Alternate Forms of Delivery, service provider.
- .2 BMM - Building Management Manual.
- .3 Cx - Commissioning.
- .4 PCx – Pool Commissioning Agent
- .5 EMCS - Energy Monitoring and Control Systems.
- .6 O&M - Operation and Maintenance.
- .7 PI - Product Information.
- .8 PV - Performance Verification.
- .9 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

- .1 The PCx cannot be done by the installing contractor.
- .2 The PCx must have successfully commissioned five aquatic centres of similar size in the past 5 years.
- .3 The PCx can be the building Cx agent provided he meets the two items above. If this is a different agent, the PCx agent shall report to the overall building Cx agent.
- .4 Refer to commissioning sections for items that may not be covered within the section.

- .5 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O&M staff.
- .6 The pool Contractor assists in PCx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .7 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 PCx to be a line item of the Pool Contractor's cost breakdown.
- .2 PCx activities supplement field quality and testing procedures described in relevant technical sections.
- .3 PCx is conducted in concert with activities performed during Construction and PCx stages to ensure the built facility is constructed and proven to operate satisfactorily under various occupancy conditions to meet functional and operational requirements. PCx activities includes transfer of critical knowledge to facility operational personnel.
- .4 The Consultant will issue Interim Acceptance Certificate when:
 - .1 Completed PCx documentation has been received, reviewed for suitability and approved by Consultant.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during PCx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by the Consultant, to ensure effective performance.

- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

- .1 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .2 Before start of PCx:
 - .1 Have completed PCx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to Consultant.
 - .7 Have PCx schedules up-to-date and submitted to the building Cx agent. Project schedule shall include flushing, filling, heating then the detailed commissioning process.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Verify completion of TAB procedures on systems, submit TAB reports to Consultant for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
- .3 Inform Consultant in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Consultant before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 COMMISSIONING DOCUMENTATION

- .1 Refer to sections 13 40 ## for documentation requirements supporting results of verification tasks described therein.
- .2 Provide documentation of results in different system operational states (ie. Clean filters, loaded filters, etc.)

1.8 COMMISSIONING SCHEDULE

- .1 Co-ordinate with overall mechanical and building commissioning schedule and commissioning agents.
- .2 Commissioning schedule to include equipment installation inspection during construction.

- .3 Commissioning schedule to include pre-startup, pool fill, and equipment startup and adjustment, and testing. Make allowance for equipment adjustment and troubleshooting such that all equipment is operational at end of commissioning process.
- .4 Submit commissioning schedule to consultant min 1 month prior to start of commissioning.
- .5 Pool commissioning involves manufacturer representatives for startup of some equipment. Pool commissioning agent to co-ordinate all site activities of manufacturer representatives.
- .6 Pool commissioning to be scheduled in coordination with commissioning of water features that are owner supplied or supplied by other scopes. Schedule commissioning in conjunction with commissioning of these water features.
- .7 Pool commissioning requires supporting mechanical systems (i.e. plumbing, drainage, HVAC) to be operational prior to final pool commissioning.
- .8 Pool commissioning to include commissioning of water features that are owner-supplied or supplied by other scopes. Participate in commissioning of these water features and render support necessary.
- .9 Pool commissioning to include all required staff training. Schedule training to ensure staff availability. Maintain all training requirements in spite of delays incurred during equipment startup/commissioning.
- .10 Owner is required to sign off on all staff training prior to commissioning being considered complete.
- .11 Owner to assume control of pool mechanical systems once staff training has been completed.
- .12 Have Pool Cx schedules up-to-date and submitted to the building Cx agent. Project schedule shall include flushing, filling, heating then the detailed commissioning process

1.9 COMMISSIONING MEETINGS

- .1 Convene PCx meetings following project meetings and / or building Cx meetings:
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to PCx.
- .3 Continue PCx meetings on regular basis until commissioning deliverables have been addressed.
- .4 A Mandatory Milestone meetings above the normal are required to discuss the following. The intent is to flush out any issues that may occur based on past experience.

- .1 Shop drawings completed and equipment on site. A meeting shall be arranged to discuss the philosophy of the design and bring out any concerns before piping has started.
- .2 Aquatic interface with BMS and pool design requirements. Discuss all of the pool processes and problems faced in past projects.
- .5 At 60% construction completion stage. Cx contractor to call a separate PCx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .6 Thereafter PCx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .7 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .8 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent PCx meetings and as required.

1.10 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.11 MANUFACTURER'S INVOLVEMENT

- .1 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with consultant.
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .2 Ultra-Aqua will be providing the Gas Stripper for this Project. They will also provide the design verification and assist the pool commissioning agent. Contractor to coordinate when the representative will/should arrive on site.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.

- .3 To report results in clear, concise, logical manner.

1.12 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from consultant or owner's representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by consultant or owner's representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by Consultant.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Consultant.
 - .3 If evaluation report concludes that major damage has occurred, shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.13 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to consultant or owner's representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment
 - .1 UV System
 - .2 Gas Stripper
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,

- .5 Step-by-step description of complete start-up procedures, to permit owner's maintenance staff to repeat start-up at any time.

1.14 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit consultant or owner's representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.15 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.16 START OF COMMISSIONING

- .1 Notify consultant or owner's representative at least 14 days prior to start of PCx.
- .2 Start PCx after elements of building affecting start-up and performance verification of systems have been completed.

1.17 EXTENT OF PCX

- .1 Commission pool systems and associated equipment:
 - .1 Aquatic Systems:
 - .1 Pool pumps and control
 - .2 Pool inlets, gutters and main drains and entire system balance
 - .3 Water feature control & emergency control
 - .4 Pool heat exchanger control and interface with heating water system
 - .5 Filter control and backwash procedure
 - .6 Pool level control, make up water systems
 - .7 Chemical controller operation and interface
 - .1 Free & Total Chlorine Control with UV
 - .8 Chlorine treatment including fill safety controls
 - .9 pH control
 - .10 UV systems
 - .11 Additional requirements as described in sections 22 51 ##

- .12 Interlock and safety systems to ensure no catastrophic failures.

1.18 INSTRUMENTS / EQUIPMENT

- .1 Submit to consultant or owner's representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.
 - .4 Pool Dye.
 - .5 Scuba equipment should rebalancing of inlet fitting be required.
 - .6 Ultrasonic flow meter to verify pump and systems flow rates.

1.19 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out PCx:
 - .1 Under accepted simulated operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 PCx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.20 WITNESSING COMMISSIONING

- .1 Consultant or owner's representative to witness activities and verify results.

1.21 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.22 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and PCx to satisfaction of consultant or owner's representative.
- .2 Report problems, faults or defects affecting PCx to consultant or owner's representative in writing. Stop PCx until problems are rectified.

1.23 COMPLETION OF COMMISSIONING

- .1 Upon completion of PCx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in PCx specifications, complete PCx prior to issuance of Certificate of Completion.
- .3 PCx to be considered complete when contract PCx deliverables have been submitted and accepted by consultant or owner's representative.

1.24 TRAINING

- .1 Provide staff training to allow operator takeover, troubleshooting, maintenance, and operation of installed pool mechanical systems.
- .2 Provide draft manuals and operating instructions as described under tab 1.2, 1.3, 1.4, section 21 05 01, prior to start of staff training. Instructions to be revised and supplemented based on results of commissioning.
- .3 Manufacturer-supplied staff training is to be separate from overall Ensure manufacturer-supplied staff training is coordinated with overall staff training.
- .4 Provide training outline and list of tasks for consultant review prior to beginning of commissioning process.
- .5 Ensure equipment is operational and in proper adjustment prior to start of staff training. Consultant will not consider training complete if owner is not trained on operating equipment and such equipment is not left in operational conditions.
- .6 Provide minimum 2 days training covering information described under tab 1.2, 1.3, 1.4 section 21 05 01. Provide additional half-day of training as required. Training to be in addition to equipment specific manufacturer representative training.
- .7 Demonstrate both proper and improper operational conditions to staff such that staff can identify improper conditions and rectify them.
- .8 Provide an additional 1-day follow-up training at one month, 6months & 12 months into facility operation on site, to verify operations. This should be coordinated so it falls on the same day as the control training follow up.
- .9 Provide follow-up support in answering operator questions as required.
- .10 Staff training is not intended to provide comprehensive training in pool mechanical operation. Owner to ensure qualified staff are available to perform maintenance and follow training provided.
- .11 Identify potential shortcomings in staff understanding of system operation.

1.25 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:

- .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 5 % of recorded values.

1.26 OWNER'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by consultant or owner's representative will not relieve Contractor from compliance with specified start-up and testing procedures.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION