International Journal of Aquatic Research and Education

Volume 1 | Number 1 Article 3

2-1-2007

# Certified Operators: Does Certification Provide Significant Results in Real-World Pool & Spa Chemistry?

Kevin Johnston
*University of Idaho*, kevinj@uidaho.edu

Michael Kinziger
*University of Idaho*

*International Journal of Aquatic Research and Education*, 2007, *1*, 18-33


# Certified Operators: Does Certification Provide Significant Results in Real-World Pool and Spa Chemistry?

**Kevin Johnston and Michael Kinziger**

This study statistically compared operators certified as YMCA pool operator on location (POOL) with noncertified operators managing YMCA aquatic facilities with respect to water chemistry (pH and Langelier Saturation Index [LSI]) and chlorine levels (free-available and combined-chlorine levels). The study used a convenience sample of 572 pools and spas located at approximately 250 YMCAs. Certification was used as the factor, and the responses included pH, compliance with pH, free chlorine, compliance with free chlorine, combined chlorine, compliance with combined chlorine, LSI, and compliance with LSI. The results indicate that the POOL certification program does provide some significant results related to the proper care of pools and spas at YMCAs. Significant differences ($p < .05$) were found between certified and noncertified operators in the level of pH, the level of combined chlorine, and compliance with combined-chlorine standards. The findings of this study underscore the need for increased training for pool and spa operators and greater responsibility on their behalf in maintaining safe chemical conditions in the water. This research supports the YMCA and the aquatic profession in that POOL-certified operators do make a difference in maintaining water quality and safer water-chemistry standards.

***Key Words**:* aquatic risk management, swimming pool maintenance, swimming pools, water clarity, water decontamination/filtration, water safety

Swimming is a popular leisure pursuit, second only to walking, with people swimming a total of approximately 360 million times annually (U.S. Bureau of Census, 1995). With such a high level of participation, the proper operation and care of a swimming pool or spa is critical to the health and safety of the bathers. The importance of maintaining a swimming pool is underscored by the fact that 48 states in the United States regulate swimming pools' operation by providing codes, guidelines, or recommendations. In addition, 15 states require that pool operators be trained or certified (Johnston, 1999).

Pool and spa operators must have a working knowledge of water chemistry and pool operations to comply with state standards (Williams, 2003). Water chemistry is one of the basic items that a pool operator needs to monitor (Johnson, 1994a),

The authors are with the Department of Health, Physical Education, Recreation, and Dance, University of Idaho, Moscow, ID 83844-2401.

**Table 1 Summary of National Pool-Operator Certifications**

| Course title | Agency | Course length |
|---|---|---|
| Pool Operator On Location | YMCA | 8.5 hr |
| Certified Pool Operator | National Swimming Pool Foundation | 12-16 hr |
| Aquatic Facility Operator | National Recreation and Park Association | 16-20 hr |

with hourly monitoring recommended by the YMCA of the USA (YMCA). There are three national certifications (Table 1) that provide a greater understanding of pool and spa operations (Griffiths, 1994). None of these certifying bodies has empirically shown that educating operators has reliable results.

The YMCA is the largest nonprofit community service organization in the country, with more than 2,400 associations providing health and social services to 17.9 million men, women, and children in 10,000 American communities (YMCA, 2003a). Most of these associations operate aquatic programs and facilities. Since the 1880s, swimming has been an integral part of the YMCA program. According to *Aquatics International* magazine (2003), by 1984 the YMCA was reported as the largest operator of pools in the world.

To date very little documentation exists to provide evidence that pool-operator certification courses make a difference in water-quality parameters. The latest swimming-pool-inspection study released in June of 2003 by the Centers for Disease Control (CDC) reinforces the need for training and increased vigilance to ensure that swimming-pool water is safe for the public to use (CDC, 2003). One of the final recommendations of the CDC study is for aquatic facilities to employ trained and certified operators. This recommendation indicates the need for a study that can provide statistically significant proof to the YMCA and the aquatic profession that operators certified as pool operator on location (POOL) do make a difference in maintaining pool-water quality.

This study compared POOL-certified operators with noncertified operators managing YMCA aquatic facilities with respect to water chemistry (pH and Langelier saturation index [LSI]) and chlorine levels (free available and combined chlorine levels). The study used a convenience sample of 572 pools and spas located at approximately 250 YMCAs. Twelve members of the Professional Aquatic Consultants International (PACI) collected and recorded the measures and data during the summer of 2001. The data set represented every YMCA assessed in 2001 by the PACI for Y-Services, an administrative component of the YMCA. The data coding and statistical analysis took place in the summer of 2003. Preliminary findings from this study were published in *Aquatics International* magazine in December 2003.

## Methods

Y-Services, a for-profit insurance corporation formed by the YMCA, retained the services of PACI to provide comprehensive assessment and risk-management

services for all YMCAs that have aquatic facilities and that are insured through Y-services. PACI used the YMCA's aquatic guidelines to develop administrative and other assessments to evaluate the compliance of member YMCAs using YMCA guidelines. These assessment tools form the Comprehensive Aquatic Facility Assessment Program. Assessment forms were developed over a period of a year by PACI consultants to collect vital risk information during the assessment of the 572 pools and spas at over 250 individual associations during the summer of 2001. The study used selected information that was collected by the 12 PACI consultants during the summer of 2001 from the completed Comprehensive Aquatic Facility Assessments Program (see Appendix A, Administrative Assessment, page 5; Appendix B, Chemical Assessment; Appendix C, Document Assessment).

These documents were used to identify the selected variables needed for this study. One of the required items was designed to assess whether or not the aquatic facilities in these YMCAs were being operated according to YMCA standards by verifying operator POOL certification. Also included in the assessment services by PACI's consultants were documentation of pool and spa chemistry, free available chlorine, and other important water-chemistry parameters.

The first instrument was developed from the first edition of the *Principles of YMCA Aquatics* (YMCA, 1997) and is titled the Administrative Assessment (PACI, 2000). The Administrative Assessment was used to assess compliance with YMCA aquatic guidelines. Specific to this study, Number 27e of the Administrative Assessment (Appendix A) was used to distinguish certified and noncertified operators. The standard reads, "YMCA professional director, who supervises the aquatic program, is on the official roster of employed staff and has achieved YMCA POOL certification" (YMCA, 1997).

Certification of the pool and spa operators was evaluated during a face-to-face interview between the individuals responsible for the aquatics facility and the PACI consultants. This variable was verified through both a verbal response and verification through the Document Assessment Form (Appendix C), in which the consultants verified the original certification card or a copy of the card. The PACI consultants documented this standard by checking the appropriate box as yes, no, or NA.

Assessment services provided by PACI's consultants also included documentation of pool and spa chemistry. Another instrument in this study was the form used to record the pool and spa chemistry. This instrument is the Chemical Assessment Form (Appendix B). The consultants personally conducted these tests and recorded them on the same day as the Administrative Assessment.

PACI provided chemical test kits to each of the consultants. Two types of Taylor test kits were used to collect the chemical information. The first kit was a Taylor Service Complete Test Kit K-205C, which measures DPD chorine (0.5–5 parts per million [ppm]), DPD bromine (1–10 ppm.), pH, total alkalinity, calcium hardness, and cyanuric acid. The second kit, a Taylor ferno ammonia sulfate diethyl-p-phenylenediamine (FAS-DPD) chlorine test kit K-1515-A (Lot #21131), was also used. Based on the *Standard Methods for the Examination of Water and Wastewater,* 20th ed., printed in 1998, these FAS-DPD test kits are considered the standard in the industry. The accuracy of an FAS-DPD test kit is far superior to DPD test kits (Ivusich, 2003). These test kits are accurate to 0.2 ppm and can measure chorine levels higher than 20 ppm.

Taylor test kits are used throughout the aquatics industry for pool- and spa-water testing. They easily and quickly provide precise and repeatable results test after test. Taylor says that they take pride in offering accurate, repeatable results (Taylor Technologies, Inc., 2000).

Chemical test kits were purchased from the same vendor at the same time, thus providing test reagents that had the same shelf life. Each consultant had identical testing equipment. This would provide a reasonable level of certainty that the test kits would be reliable and accurate and would provide identical readings between kits with water of identical properties.

Information from these tests was recorded on the Chemical Assessment Sheets (Appendix B). With the data gained from the tests, the consultants made calculations for the combined chlorine levels and the LSI.

During the spring of 2001, before the start of the summer assessments, individual YMCA executive directors and aquatic directors were contacted by phone to discuss the upcoming assessments, to schedule the date that the assessment would take place, and to answer any concerns or questions they might have. At least 30 days in advance of the assessment each executive director and each aquatic director received a priority-mailed package that included the complete aquatic assessment. The appointment was then reconfirmed at least a week in advance by the PACI consultant.

The total assessment process took each consultant 8–12 hr per site to collect the required information and to complete the assessment documents. Typically, the chemical assessment and administrative assessment took place early in the day.

The administrative assessment was completed with face-to-face interviews with the personnel responsible for overseeing the operation of the pool and spa, typically the aquatic director and the PACI consultant. Each consultant verbally asked these directors if they were POOL certified. The verbal response was then recorded. At the time of assessment, POOL-certified operators were certified for life.

The second instrument was a Chemical Assessment Sheet (PACI, 2000). This form was developed to assess various water-chemistry properties. The information from the Chemical Assessment Sheet used for this study includes the pH value, necessary readings to enable calculation of the LSI, temperature, free chlorine, and combined chlorine. A copy of the Chemical Assessment Sheet can be found in Appendix B of this article.

## Operationalizing the Chemical Variables and Testing Procedures

The recommended pH levels are a minimum of 7.2 and a maximum of 7.8 in the *YMCA Pool Operations Manual* (Johnson, 1994a). Given this recommended pH level, PACI consultants used a minimum pH of 7.2 and a maximum pH of 7.8 during the chemical assessment of the YMCA pools and spas to determine compliance.

The most frequently referenced required minimum level of free available chlorine in a pool is 1.0 ppm based on the 37 states that regulate disinfectants (Johnston, 1999). The American National Standards Institute's minimum level of free available chlorine is 1.0 ppm (National Spa and Pool Institute/American National Standards Institute, 1991). Adjusting the pool to 1.0 ppm is referenced

frequently in the *YMCA Pool Operations Manual* (Johnson, 1994a). Given this YMCA standard, this study used a minimum of 1.0 ppm free chlorine as the criterion for compliance.

The mean allowable level of combined chlorine across the state bathing codes is 0.3 ppm (Johnston, 1999). The *Aquatic Facility Operators Manual* (Williams, 2003) indicates that superchlorination to breakpoint is necessary if the combined chlorine level is at 0.4 or higher. The American National Standards Institute establishes a maximum of 0.2 for combined chlorine (National Spa and Pool Institute/American National Standards Institute, 1991). The *YMCA Pool Operations Manual* (Johnson, 1994a) recommends that breakpoint chlorination is needed when the combined chlorine is greater than 0.3. This variable was operationalized for this study at 0.4 ppm of combined chlorine or higher to be considered noncompliant.

The most commonly accepted range for the LSI is –0.5 to +0.5. The Aquatic Facility Operators course recommends even narrower constraints of –0.3 to +0.3, and the YMCA recommends the same. In the certified-pool-operators text, an index between –0.5 and +0.5 is considered balanced water. The *YMCA Pool Operations Manual* states, "extreme tolerance limits of plus or minus 0.5 are acceptable" (Johnson, 1994a, p. 22), so an LSI level outside this range was considered noncompliant.

Each of PACI's consultants participated in several meetings to develop the Comprehensive Aquatic Facility Assessment Program. Each of these consultants has a thorough level of knowledge of the assessment documents. Two training sessions were held by PACI and organized by Dr. Ralph Johnson, president and CEO of the company, over a 3-day period to thoroughly train the consultants on the assessment process and proper use of the testing equipment.

This training ensured that the 12 consultants performing the assessments were knowledgeable in the collection of the data and use of their test kits. A test run was performed to ensure that the information that was collected would be reliable between the test kits and the individuals performing the tests. For this purpose, the consultants tested two different pools at two different locations at the same time. The owners and operators of these aquatic facilities volunteered their pools for testing and were notified of our presence.

The manufacturer's specific instructions on water testing were followed and practiced. Water-chemistry tests during the training included pH, free available and combined chlorine (both colorimetric and titrimetric), total alkalinity, calcium hardness, total dissolved solids, and water temperature.

The water-testing results were compared kit to kit and individual to individual, and the results were indistinguishable. This procedure was important to establish the reliability of the information collected for this study. In addition, it ensured that there were no differences in testing results between the male and female consultants.

All of the members of PACI are "aquatic professionals." The 12 consultants had over 225 years of combined aquatic-operation experience. Many PACI consultants are certified instructors or trainers in pool operation.

Ten of the 12 consultants had advanced degrees (master's or higher) in physical education, recreation, or sport (the consultants' bibliographies can be found on the Web at www.aquaticweb.com). With this amount of training, education, and level of experience, there is a high likelihood of reliability of the information collected. These facts imply a very credible level of face validity.

**Table 2 Coding Data**

| Data | Complies | Does not comply |
|---|---|---|
| Whether or not the operator is currently POOL certified (pass or deficient/fail) | 0 | 1 |
| Whether or not the pool or spa has an appropriate level pH (7.2–7.8) | 0 | 1 |
| Whether or not the pool has an appropriate level of chlorine (1.0–5.0 ppm) | 0 | 1 |
| Whether or not the pool has an appropriate level of combined chlorine (>0.4 ppm) | 0 | 1 |
| Whether or not the pool is in balance related to the Langelier saturation index (±.5) | 0 | 1 |

The data from the two forms were transferred into an Excel® spreadsheet for coding by the lead researcher. This makes the data more pliable for applying statistical analysis. The data set was coded using Table 2.

*Pass* meant the standards were met. *Deficient* meant that the standards might have been partly met (i.e., a pool-operator certification from another certifying organization, an expired certification, or that another staff member besides the aquatic director was certified). *Fail* meant that the standards were not met.

The Excel file was transferred to Mini Tab, a software program used for formal statistical analysis. The following statistical methods were used to analyze the data: One-way ANOVAs using dot plots, box plots, and normal probability plots for each variable (specifically, Fischer's pairwise comparisons in Minitab version 12 for Windows®). A significance level of .05 for all statistical tests was established.

To protect individual YMCA identities, all data in the study remained anonymous. No association numbers of YMCAs or YMCA personnel were used in the reporting of the findings. The data were generalized as a whole. All information used to generate the data coding and analysis was destroyed at the study's conclusion.

## Results

The chemical assessments analyzed at the 572 pools and spas are descriptively and statistically summarized. The descriptive results are reported in Table 3 and Table 4 (these descriptive data were acquired through the data coded in Excel).

A one-way analysis of variance (ANOVA) using Fischer's pairwise comparisons in Mini Tab version 12 for Windows was applied to the variables. POOL-certified operators are compared with operators not certified in POOL in response to the four dependent variables: (a) pH (both the actual levels and compliance with the standards), (b) free chlorine (both the actual levels and compliance with the standards), (c) combined chlorine (both the actual levels and compliance with the standards), and (d) LSI (both the actual levels and compliance with the standards). In addition, the results of comparing POOL-certified operators with operators not certified in POOL in the frequency of complying with the four variables are

**Table 3 Pool and Spa Demographics by Certification**

| Group | *n* | % |
|---|---|---|
| Pools operated by POOL-certified operators | 209 | 46.9 |
| Pools operated by operators not certified in POOL | 237 | 53.1 |
| Spas operated by POOL-certified operators | 61 | 48.4 |
| Spas operated by operators not certified in POOL | 65 | 51.6 |

statistically summarized. These results were compared for significance at the $p = .05$ level. The tables allow for the comparison of both pools and spas, only pools, and only spas.

When combining pools and spas, certified operators maintained pH at a mean of 7.5612, and the noncertified operators maintained pH at a mean of 7.4923. This was a significant finding at the $p > .05$ level (Table 5). There was no significant difference, however, between the certified operators and the noncertified operators in regard to compliance with pH standards.

The certified operators maintained free available chlorine at a mean of 6.21, and the noncertified operators, at a mean of 3.83. This was not a statistically significant ($p = .26$) finding. There were no significant differences ($p < .05$) between the POOL-certified operators and the operators not certified in POOL in regard to compliance with free-chlorine standards.

The certified-operator group had the two most extreme outliers for free chlorine (one at 600 ppm and another at 50 ppm). The most experienced consultant in PACI took both of these readings. Because of this knowledge of how to reach an endpoint in high-chlorine environments, the readings were taken to the endpoints, which included two outliers in this data for free chlorine in the certified group. The other consultants with high levels of chlorine stopped at between 10 and 20 ppm, not reaching an endpoint if it exceeded one of these two levels.

Because these two outliers drastically affected the mean, the data were rerun without these two outliers to see if there would be any significant difference between the two groups. Without the outliers, there was still no significant difference ($p = .991$) between the POOL-certified operators and the operators not POOL certified in regard to free-chlorine standards. It should be noted that without the two extreme outliers, the mean free chlorine for the POOL-certified group was 3.836, and the mean for the group not certified in POOL was 3.832, nearly identical.

In both pools and spas, the certified operators maintained combined chlorine at a mean of 0.678, and the noncertified operators, at a mean of 1.025. This was a significant finding at the $p < .05$ level (Table 6), with a $p$ value of .009. There was a significant difference in spas ($p = .003$) related to compliance with combined-chlorine standards. There was no significant difference, however, at the .05 level between the POOL-certified operators and the operators not certified in POOL in regard to compliance with combined-chlorine standards (Table 7) when considering pools and spas together ($p = .099$).

LSI was maintained at a mean of 0.1575 by the certified operators and at a mean of 0.1305 by the noncertified operators. This finding was not significant ($p = .63$) by the analysis. There was no significant difference ($p = .56$) between

**Table 4 Descriptive Findings From the Water-Chemistry Data**

| | Noncertified | Range | Certified | Range |
|---|---|---|---|---|
| Level of pH, *M* | 5.92 | 3–10 | 5.99 | 5.6–9 |
| Did not meet standards for pH | 16.5% | | 18.6% | |
| Free-chlorine levels (ppm), *M* | 2.67 | 0–23 | 2.73 | 0–600[a] |
| Did not meet standards for free available chlorine | 20.5% | | 18.6% | |
| Total chlorine levels (ppm), *M* | 3.36 | 0–28.4 | 3.29 | 0–600 |
| Combined-chlorine levels (ppm), *M* | 0.69 | 0–28 | 0.56 | 0–5 |
| Did not meet standards for combined chorine | 48.2% | | 47.2% | |
| Langelier saturation standards (LSI), *M* | 0.13 | 2.6 to –5.7 | 0.14 | 2.2 to –4.3 |
| Did not meet standards for LSI | 22.1% | | 20.8% | |
| Operators, *n* | 237, 65 spas | | 270, 61 spas | |
| Times out of compliance, *M* | 1.07 | | 1.05 | |

[a]4.01 without 600 ppm, range 0–50.

**Table 5 ANOVA for Comparing POOL-Certified Operators With Operators Not Certified in POOL to pH Levels**

| pH Levels | *df* | Mean squares | *F* | *p* |
|---|---|---|---|---|
| Pools and spas | 1 | .671 | 3.76 | .053* |
| error | 566 | .179 | | |
| Pools | 1 | .317 | 2.99 | .084 |
| error | 444 | .106 | | |
| Spas | 1 | .459 | 1.02 | .313 |
| error | 120 | .448 | | |

*Note*. Significance increases because of increase in sample size when combining pools and spas.

*$p < .05$.

**Table 6 ANOVA for Comparing POOL-Certified Operators With Operators Not Certified in POOL to Combined Chlorine Levels**

| Combined chlorine levels | *df* | Mean squares | *F* | *p* |
|---|---|---|---|---|
| Pools and spas | 1 | 17.22 | 6.96 | .009* |
| error | 571 | 2.48 | | |
| Pools | 1 | 2.69 | 2.46 | .117 |
| error | 444 | 1.09 | | |
| Spas | 1 | 33.54 | 4.64 | .033* |
| error | 125 | 7.23 | | |

*$p < .05$.

**Table 7 ANOVA for Comparing POOL-Certified Operators With Operators Not Certified in POOL to Compliance With Combined-Chlorine Standards**

| Compliant to combined chlorine | *df* | Mean squares | *F* | *p* |
|---|---|---|---|---|
| Pools and spas | 1 | .656 | 2.73 | .099** |
| error | 571 | .241 | | |
| Pools | 1 | .019 | .08 | .777 |
| error | 444 | .239 | | |
| Spas | 1 | 2.091 | 8.88 | .003* |
| error | 125 | .235 | | |

*$p < .05$. **$p < .01$.

the POOL-certified operators and the operators not certified in POOL in regard to compliance with LSI standards for pools, spas, or pools and spas.

The frequency of complying with the standards shows no significant difference ($p = .395$) between the two groups when considering all four variables together for each pool and spa. There was only a slight difference in the means between the two groups: the POOL-certified mean was 1.563, and the non-POOL-certified mean was 1.640. The noncertified group had a higher likelihood of not complying, but again, not significantly ($p = .395$). There was a $p$ value of .078 for compliance with standards of spas being operated by POOL-certified operators when compared with operators not certified in POOL.

## Discussion

The sample included 270 pools and spas with POOL-certified operators and 302 pools and spas with operators not certified in POOL. Over half (53%) of the pools and spas were operated by non-POOL-certified operators, thus falling outside the YMCA's aquatic guidelines, which recommend using POOL-certified operators.

This study was specifically limited in scope to 572 pools and spas located at approximately 250 YMCAs in the United States that directly operated these pools

and spas in their associations. It was further limited to those operators certified or not certified in the POOL course offered by the YMCA. The study considered only the data from facilities assessed by PACI in the summer of 2001. Because the assessments were planned with the YMCA's knowledge at least a month before every assessment undertaken by PACI consultants, this could bias the results compared with a blind or unannounced assessment. The executive director and the aquatic director knew the date of the assessment and the hazard or risk parameters to be assessed at least 30 days in advance. Even with the knowledge of our arrival (certified or not), numerous facilities were not compliant with water chemical standards.

It is surprising that non-POOL-certified operators at YMCAs operated 53% of the pools and spas. Pools and spas are complicated facilities that require in-depth knowledge of codes, standards, filtration systems, chemical systems, water chemistry, and many other factors that can be learned in the POOL course. Don Thorne (1994), in his book *Swimming Pool Operator's P.R.O. Manual,* noted that nearly 90% of pool operators have little to no formal training to operate pools properly. It should and could be a rare exception for a YMCA.

Some of the most extreme outliers occurred at YMCAs with certified operators (free chlorine and LSI), and there was an average of over one and a half combined violations of national water-chemistry standards whether the operator was certified or not; these two problems should be a major concern.

The descriptive results do lead to the conclusion that whether a pool is operated by a POOL-certified operator or not, all pools and spas need to be operated better as a whole at YMCAs to ensure the safety of the users, comfort of bathers, and longevity of the facilities. All YMCA pools and spas need to improve their diligence in meeting aquatic standards.

When comparing combined-chlorine levels of certified and noncertified operators in spas ($p = .033$) and the compliance with combined-chlorine standards ($p = .003$), there was a significant difference between the two groups. Looking more closely at the detail of the statistical analysis, the mean combined-chlorine level was three times as high in spas operated by noncertified operators than in spas operated by certified operators. Combined chlorine is what causes skin and eye irritation in pools and spas and what creates the unpleasant chlorine smell. As a result of the findings in this study, it is probably a valid generalization that YMCA POOL-certified operators maintain spas at a significantly higher level of competence. Certainly, the POOL-certified-operator spas were less irritating in regard to smell and the eyes and skin of the bathers.

There is a lack of research in the area of pool and spa operations, pool-operator certifications, and water recreation related to operators and to maintenance of pool chemical standards. Future studies should include operators who are certified by the other national organizations to see if there are significant differences in water chemistry and chlorine standards between certified operators in their programs and those not certified.

The study did not consider additional training that an operator might have beyond the POOL certification, the years of experience that an operator might have, or whether the pool operator obtained other aquatic or management certifications. These aspects should be considered in a future effort.

Organizations other than the YMCAs were not considered; it is noted that pools in other organizations might be operated differently from YMCA pools. The

following facility constraints were not be specifically considered: surface area, volume of water, whether a facility uses automated chemical controllers, whether a pool or spa is indoor or outdoor, whether a facility has leisure features (fountains, slides, spray, flow channels, and other features), the number of pools and spas on site, what form of disinfection and pH control is used, how often chemical qualities were monitored, age of the pool and its equipment, and how many bathers per day use the pool.

The following variations among individual YMCA associations were not considered: the membership size of the association, the size of the aquatic budget of the association, and the number of pools and spas located in the association. The following administrative items were limited: how many full-time staff members were responsible for the aquatic operation, title of the pool operator, and scope of the job of the individual or individuals responsible for pool-water quality. Any of these considerations could have a direct or indirect influence on the chemical properties of the water. Generalizability should be limited to the sample frame and, at most, to YMCA of the USA.

## Summary

The results of this study have validated that the POOL certification does provide a number of significant results related to the proper care of pools and spas at YMCAs. Significant differences ($p < .05$) were found between certified and noncertified operators in the level of pH and the level of combined chlorine when combining pools and spas; significant differences were found in levels of combined chlorine and compliance with combined-chlorine standards in spas. These results reinforce the recommendation that YMCAs employ POOL-certified operators.

With one of the CDC's recent reports, it is paramount that more pool operators maintain better water quality (CDC, 2003). The findings of this study underscore the need for increased knowledge and training of pool and spa operators and greater responsibility on their behalf in maintaining safe chemical conditions in the water. Stronger adherence to the YMCA's aquatic guidelines and national water-chemistry standards is critical to keeping YMCA aquatic environments safe and their patrons healthy.

One of the final recommendations of the CDC study (2003) is for aquatic facilities to employ trained and certified operators. This study provides statistically significant proof to the YMCA and the aquatic profession that POOL-certified operators do make a difference in maintaining water quality and safer water-chemistry standards.

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## Appendix A: Administrative Assessment, p. 5

| Category | P Pass | D Deficient | F Fail | N/A Non/App. | Comments |
|---|---|---|---|---|---|
| 23. Members and participants are required to show proper identification when entering the facility or participating in programs or classes.<br>a. A checkout procedure is also in place. | | | | | |
| 24. The association has a comprehensive insurance plan that covers programs and the staff and volunteers involved in their delivery. It includes, where applicable, the following items:<br>a. Comprehensive general liability<br>b. Property coverage<br>c. Accident coverage<br>d. Employer's nonownership liability<br>e. Hired and leased vehicle coverage<br>f. Fire, theft, and catastrophe coverage<br>g. Motor-vehicle coverage<br>h. Worker's compensation<br>i. Director's and officer's liability coverage | | | | | |
| 25. A written agreement is obtained for the rental of any YMCA facilities and equipment including vehicles, by non-YMCA groups and for YMCA use of non-YMCA facilities and equipment.<br>a. The agreement shall include, but not be limited to, the following:<br>(1) The responsibilities of the parties<br>(2) Fees for use<br>(3) A "hold harmless" agreement | | | | | |

(4) A certificate of insurance showing that the YMCA is named as an "additional insured" under the general, auto, and umbrella policies
(5) Safety standards, pool rules, and safety equipment

C. LEADERSHIP STAFF/ VOLUNTEER

26. The following are used in the selection and hiring of staff and volunteer recruitment.
    a. Applications
    b. Personal interviews
    c. References (personal/ business)
    d. Previous work history
    e. Law-enforcement background record checks
    f. Performance observation and skill check
    g. A trial performance period (probation)
27. The YMCA professional director, who supervises the aquatic program, is on the official roster of employed staff and has achieved the following:
    a. Twenty-one years of age
    b. A bachelor's degree in a related field or commensurate experience
    c. YMCA aquatics-management certification
    d. Current CPR, first-aid, AED, blood-borne-pathogen, and $O_2$ certifications
    e. YMCA POOL certification

# Appendix B: Chemical Assessment

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YMCA Services Corporation

## Assessment Documents Sheet

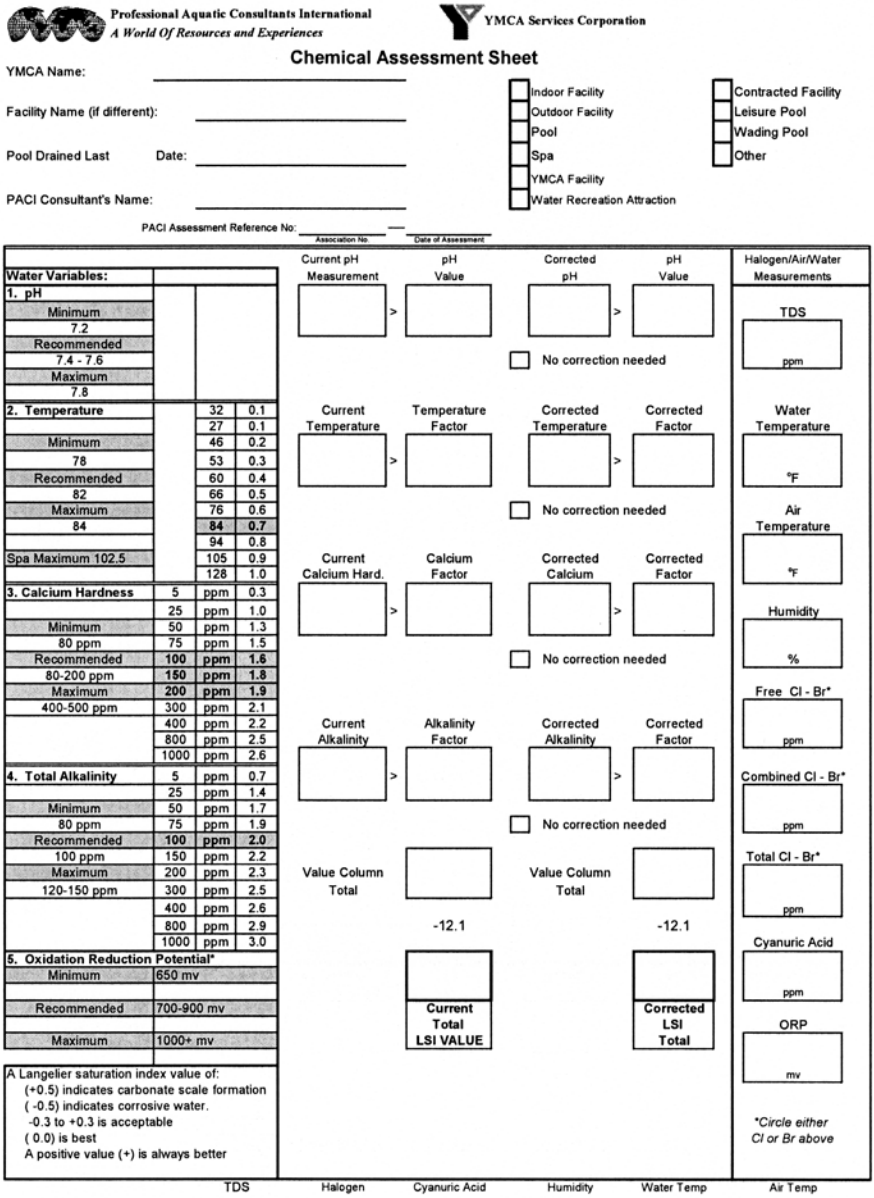
PACI Assessment Reference No: _____ — _____
(Association No.) (Date of Assessment)

Facility Name: _____ PACI Consultant's Name: _____

To facilitate the Assessment process please have the following list of documents ready for inspection.
It would also be helpful if all these documents were gathered in one location. All documents must be most current.

| Yes | No | N/A | | |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | 1 Permit for pools, spas, lakes etc. | _____ |
| ☐ | ☐ | ☐ | 2 Electrical inspection by a licensed electrician (most recent 3-5 year inspection, including certification of bonding per NEC Section 250 and for grounding per NEC Section 680 ). | _____ |
| ☐ | ☐ | ☐ | 3 Copies of state/county inspections (past year). | |
| ☐ | ☐ | ☐ | 4 Copy of State, County or Bathing Code | _____ |
| ☐ | ☐ | ☐ | 5 Current Bacteriological Reports (past year). | _____ |
| ☐ | ☐ | ☐ | 6 Pool Log (water chemistry, $Cl_2$, pH,) past year. | _____ |
| ☐ | ☐ | ☐ | 7 Lifeguard, Non-emergency Staff & Facilty Manuals | _____ |
| ☐ | ☐ | ☐ | 8 Copy of accident or emergency procedures | _____ |
| ☐ | ☐ | ☐ | 9 Copies of Certs (YMCA & Red Cross ) lifeguard, first aid, CPR, Y Aquatic Mgr., AED, $O_2$ and Blood borne (Verify Waterfront training) | _____ |
| ☐ | ☐ | ☐ | 10 Copies of YMCA & Red Cross Instructor, I.T. Trainer and Faculty Certifications. | _____ |
| ☐ | ☐ | ☐ | 11 Copies of Current Pool Operator Certifications for any staff member (P.O.O.L., A.F.O., C.P.O. or State Certification) | |
| ☐ | ☐ | ☐ | 12 Copies of accident reports for the past 10 years (only for those accidents that required transport via local EMS ambulance.) | _____ |
| | | | Number of Incidents: ☐ | |
| ☐ | ☐ | ☐ | 13 Copy of In-Service Training Log | _____ |

# Appendix C: Document Assessment



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YMCA Services Corporation

**Chemical Assessment Sheet**

YMCA Name: _____

Facility Name (if different): _____

Pool Drained Last Date: _____

PACI Consultant's Name: _____

PACI Assessment Reference No: ____ — ____
(Association No. / Date of Assessment)

☐ Indoor Facility
☐ Outdoor Facility
☐ Pool
☐ Spa
☐ YMCA Facility
☐ Water Recreation Attraction

☐ Contracted Facility
☐ Leisure Pool
☐ Wading Pool
☐ Other

| Water Variables: | | | |
|---|---|---|---|
| 1. pH | | | |
| Minimum | | | |
| 7.2 | | | |
| Recommended | | | |
| 7.4 - 7.6 | | | |
| Maximum | | | |
| 7.8 | | | |
| 2. Temperature | | 32 | 0.1 |
| | | 27 | 0.1 |
| Minimum | | 46 | 0.2 |
| 78 | | 53 | 0.3 |
| Recommended | | 60 | 0.4 |
| 82 | | 66 | 0.5 |
| Maximum | | 76 | 0.6 |
| 84 | | 84 | 0.7 |
| | | 94 | 0.8 |
| Spa Maximum 102.5 | | 105 | 0.9 |
| | | 128 | 1.0 |
| 3. Calcium Hardness | 5 | ppm | 0.3 |
| | 25 | ppm | 1.0 |
| Minimum | 50 | ppm | 1.3 |
| 80 ppm | 75 | ppm | 1.5 |
| Recommended | 100 | ppm | 1.6 |
| 80-200 ppm | 150 | ppm | 1.8 |
| Maximum | 200 | ppm | 1.9 |
| 400-500 ppm | 300 | ppm | 2.1 |
| | 400 | ppm | 2.2 |
| | 800 | ppm | 2.5 |
| | 1000 | ppm | 2.6 |
| 4. Total Alkalinity | 5 | ppm | 0.7 |
| | 25 | ppm | 1.4 |
| Minimum | 50 | ppm | 1.7 |
| 80 ppm | 75 | ppm | 1.9 |
| Recommended | 100 | ppm | 2.0 |
| 100 ppm | 150 | ppm | 2.2 |
| Maximum | 200 | ppm | 2.3 |
| 120-150 ppm | 300 | ppm | 2.5 |
| | 400 | ppm | 2.6 |
| | 800 | ppm | 2.9 |
| | 1000 | ppm | 3.0 |
| 5. Oxidation Reduction Potential* | | | |
| Minimum | 650 mv | | |
| | | | |
| Recommended | 700-900 mv | | |
| | | | |
| Maximum | 1000+ mv | | |

A Langelier saturation index value of:
(+0.5) indicates carbonate scale formation
( -0.5) indicates corrosive water.
-0.3 to +0.3 is acceptable
( 0.0) is best
A positive value (+) is always better

| Current pH Measurement | > | pH Value | Corrected pH | > | pH Value |
|---|---|---|---|---|---|
| | > | | | > | |

☐ No correction needed

| Current Temperature | > | Temperature Factor | Corrected Temperature | > | Corrected Factor |
|---|---|---|---|---|---|
| | > | | | > | |

☐ No correction needed

| Current Calcium Hard. | > | Calcium Factor | Corrected Calcium | > | Corrected Factor |
|---|---|---|---|---|---|
| | > | | | > | |

☐ No correction needed

| Current Alkalinity | > | Alkalinity Factor | Corrected Alkalinity | > | Corrected Factor |
|---|---|---|---|---|---|
| | > | | | > | |

☐ No correction needed

| Value Column Total | | Value Column Total | |
|---|---|---|---|
| | -12.1 | | -12.1 |
| | **Current Total LSI VALUE** | | **Corrected LSI Total** |

| Halogen/Air/Water Measurements |
|---|
| TDS ppm |
| Water Temperature °F |
| Air Temperature °F |
| Humidity % |
| Free Cl - Br* ppm |
| Combined Cl - Br* ppm |
| Total Cl - Br* ppm |
| Cyanuric Acid ppm |
| ORP mv |

**Circle either Cl or Br above*

TDS | Halogen | Cyanuric Acid | Humidity | Water Temp | Air Temp