Phased Array Training in Olympus NDT

Michael Moles
Olympus NDT, 48 Woerd Avenue, Waltham, Massachusetts, USA 02453
Tel: +1 416 831 4428, E-mail: Michael.moles@olympusndt.com

Abstract
Like other ultrasonic equipment manufacturers, Olympus NDT organizes phased array training courses. These courses are comprehensive, but are primarily aimed at the lower end of the market, i.e. portables and related instruments. The logic behind this decision is that higher end instruments (e.g. Focus, Focus LT, TomoScan III) have required specialized, well trained operators, while limited application instruments (e.g. QuickScan) have required “go-no go” type interpretation. This leaves a large market for portable phased array instruments (OmniScan MX, OmniScan manual and EPOCH 1000i) requiring training and certification.

One of the main limitations of training is the requirement to have “certifications”. Not surprisingly, “certification” means different things in different countries. While Europe and Asia are working on harmonizing EN 473 and ISO 9712, North America is working on a different approach. With the USA dominant in North and South America for NDE training and certification, ASNT has chosen to modify their ISO qualifications accordingly. The ASNT-modified ISO 9712 document leaves a lot to be desired and the differences between the ASNT ISO version and the global ISO 9712 will be shown. ASNT is also looking at a new phased array approval process, which would use standard headings, formats and questions for training, but it is unclear when this will be approved.

Hopefully, this last step will introduce North America to global certifications for NDT training. This would synchronize global training and effort, and allow free transfer of operators across the planet. Ultimately, this would resolve one of the major issues facing Olympus NDT and other manufacturers – a globally accepted phased array certification program.

Keywords: Phased array training, global courses, certification, ISO 9712, ASNT (American Society for NonDestructive Testing)

1. Introduction

Olympus NDT started phased array training courses some years ago with the introduction of the OmniScan portable phased array unit [1]. Initially, courses were run by a single operator out of Houston, Texas; then we evolved (rapidly) to the Training Academy [2]. The training courses were originally quite restrictive, and only six companies were invited to join the Training Academy. The Academy has since been expanded, with around twenty companies now Members. These companies now run in excess of two hundred courses per year in all continents, which excludes private courses. In addition, the courses have expanded in content from the initial two-day Introduction to Phased Array course up to single and double week courses. The courses also include TomoView versions (Olympus’s advanced software program), Phased Array Level III, and training in multiple languages.
Also, other instruments have been added to the list for training: besides the OmniScan MX (encoded OmniScan), we have the OmniScan M (manual) and EPOCH 1000i (see Figure 1). Olympus makes a full range of phased array equipment, including Focus LT, Focus and TomoScan III (see Figure 2). However, these latter instruments tend to be specialized, so do not involve training in the conventional sense.

Figure 1: Photos of (left) OmniScan MX and M; (right) EPOCH 1000i. Note that the OmniScan MX and OmniScan M look identical; the only change is the module at rear.

Figure 2: Photos of (top left) Focus LT; (top right) Focus; (bottom) QuickScan PA.

With several thousand OmniScans on the more popular end of the market, the overall training prospects are good.
2. Objective

As stated in the **Abstract**, the main objective of this paper is to demonstrate that Certification is a key to the Olympus NDT training academy. Specifically, Olympus looks at two main factors for training, though as a viewer, not as a regulator:

1. Classroom hours, and
2. Certification.

As a global manufacturer, ONDT wants to ensure that all operators have globally recognized certification. This works reasonably well in Europe, Asia, Australasia and maybe Africa, where ISO 9712 [3] and its related codes - EN 473 [4], PCN and CSWIP are functioning. However, this leaves us with a major deficiency in North America, where ASNT (American Society for NonDestructive Testing) is dominant.

3. North American Certifications

ASNT has two types of certifications: one is the well-known company certifications, which have their uses [5]. To quote, “Employers are responsible for administering the visual acuity, practical and any job-specific examinations required by their written practice to complete the certification process.” This type of certification is “company-specific”, and cannot be transferred by the operator on changing jobs.

The other is the ASNT Central Certification Program [6] or ACCP, which is exam-based and transferrable. Neither certification includes advanced techniques like phased arrays and Time-Of-Flight Diffraction (TOFD). Thus there is a gaping hole in North America’s advanced NDT certifications. According to the ASNT website, the ACCP Level II UT meets the ISO requirements (though which version of ISO is not clear – see below).

ASNT is developing a **Body Of Knowledge** (BOK) for phased arrays, supplied by one of our Olympus NDT Training Academy Members. This work is in progress.

ASNT has also developed their own version of ISO 9712 [7], with local adaptations – as permitted by the World Trade Organization. Here, we have some interesting modifications, for example, reducing the required hours for Level II Phased Array training from 80 to 40 (see Figure 3, compared with Figure 4). In reality, these changes may not be globally acceptable, as Non Tariff Barriers (NTBs) may be erected to eliminate non-nuclear North American products in export markets.
Table 1: Minimum Training Requirements

<table>
<thead>
<tr>
<th>NDT Method</th>
<th>Level I (hours)</th>
<th>Level II (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>MT</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>PT</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>RT</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>UT</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>VT</td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

**National Explanatory Note:**
The Training hours in Table 1 have been modified to reflect current national NDT certification requirements used by the majority of U.S. industry. Arbitrarily increasing these hours to reflect the ISO 9712 training hours, without technical justification, would result in an excessive burden on industry.

The additional training hours for Level III personnel shown in ISO 9712:2005 has been removed here as current national practice accepts the time in grade as a Level II as being sufficient for eligibility to sit for Level III examinations.

Figure 3: Extract from ASNT ISO 9712-2008 [7].

<table>
<thead>
<tr>
<th>NDT Method</th>
<th>Level 1 hours</th>
<th>Level 2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT</td>
<td>40 c</td>
<td>64 c</td>
</tr>
<tr>
<td>ET</td>
<td>40 c</td>
<td>40 c</td>
</tr>
<tr>
<td>IT</td>
<td>40 c</td>
<td>80 c</td>
</tr>
<tr>
<td>LT</td>
<td>A - Basic knowledge</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>B - Pressure method</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>C - Tracer gas method</td>
<td>18</td>
</tr>
<tr>
<td>MT</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>PT</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>RT</td>
<td>40 c</td>
<td>80 c</td>
</tr>
<tr>
<td>ST</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>UT</td>
<td>40 c</td>
<td>80 c</td>
</tr>
<tr>
<td>VT</td>
<td>16</td>
<td>24</td>
</tr>
</tbody>
</table>

- Training hours include both practical and theory courses.
- Direct access to Level 2 examination requires the total hours shown for Level 1 and Level 2.
- In case of national regulations concerning the duration of a week of work, the 40 hours are equivalent to the legal duration of a week of work.
- Training duration may be reduced by up to 50% when the certification sought is limited in application or technique.
- A reduction of up to 50% in the total required number of training hours may be accepted by the certification body for candidates who have graduated from technical college or university, or have completed at least two years of engineering or science study at college or university.

Figure 4: Extract from ISO 9712 [3].
4. Nuclear Certifications

There are also nuclear-specific qualifications, in both Europe and North America. In Europe, we have the ENIQ (European Network for Inspection Qualification) [8]. This is more of a general framework, with each country having qualification rights to regulate NDE procedures and techniques. ENIQ allows judgement in assessing the need for and extent of physical trials in demonstrating adequate performance.

In the USA, ASME has recently permitted another type of qualification, through ANDE (American Society of Mechanical Engineers - NonDestructive Examination). This does not use ASNT as a certification body, but uses the ASME certification instead from Section XI Article VII 4000 on Qualification Requirements [9]. The summary of classroom hours is shown in Figure 5. Thus, for a direct-to-Level II candidate, 80 hours of classroom training would be needed.

<table>
<thead>
<tr>
<th>TABLE VII-4220-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>INITIAL TRAINING HOURS</td>
</tr>
<tr>
<td>(CLASSROOM/LABORATORY)</td>
</tr>
<tr>
<td>Level I</td>
</tr>
<tr>
<td>40/40</td>
</tr>
</tbody>
</table>

GENERAL NOTES:
(a) To certify a candidate directly to Level II with no time at Level I, the total hours of training required for Level I plus Level II shall apply.
(b) To certify a candidate directly to Level III with no time at Level I or Level II, the total hours of training required for Level I plus Level II plus Level III shall apply.
(c) Industrial or academic training courses covering the topics listed in 9.0 of Supplement I may be credited toward the training required for Level III personnel.
(d) The hours of instruction devoted to each subject in Supplement 1 shall be determined by the NDE Instructor.

Figure 5: Extract from ASME certification rules [9].

ANDE will develop a Body Of Knowledge, which ultimately will be turned over to ASME’s certification body. This BOK will cover all techniques, e.g. UT, EC, MT, PT, and hopefully PA as well. However, ANDE’s development has only recently started, and previous experience with EPRI’s qualification requirements has shown that they fragment quickly. For example, it appears that for full qualification in EPRI, around 55 test areas (read: qualifications) are required. Perhaps the main question for ANDE certifications is:
Will they be acceptable outside the North American nuclear industry? Based on hours in classroom, the answer is uncertain.

In contrast, Figure 6 shows the qualification requirements for (non-nuclear) ASME Section V Article 4 for AUT inspections [10]. For Section V, the assumption is that ASNT will perform the certification.

VI-423 Personnel Qualifications

Only qualified UT personnel trained in the use of the equipment and who have demonstrated the ability to properly acquire examination data, shall conduct production scans. Personnel who analyze and interpret the collected data shall be a Level II or III who have documented training in the use of the equipment and software used. The training and demonstration requirements shall be addressed in the employer's written practice.

Figure 6: Extract from ASME Section V Article 4 Mandatory Appendix VI [10]

There are differences between ENIQ and ANDE. Specifically with ENIQ, there is no qualification of equipment and probes by themselves. As each inspection procedure is case-by-case, a manufacturing company like Olympus NDT cannot develop a general inspection process to get their equipment qualified. Only service companies can run qualification of their NDT system that includes procedure, manpower, instrument, probe etc.

With ANDE, there is the possibility/probability of getting equipment approved by EPRI to go onto their acceptance list. As such, the direct involvement of an inspection company per se is not essential.

5. Other North American Options

With the major absence of acceptable phased array certifications of any form, North America has developed other qualifications. One of these is the Performance Demonstration Qualification (PDQ), currently limited to an oil company or two in Alberta. This is a hybrid between a single phased array qualification (e.g. ISO 9712) and the EPRI qualification. Specifically, instead of a single or focused certification, multiple certifications are required – and their portability is questionable. The main problem with the PDQ and other certifications is cost: they rapidly become a major financial burden on inspection companies.

6. And Where Now?

So, where does Olympus NDT stand with certification in North America? Reading this paper, it sounds like North America in particular is in a major rut, but in practice life is not that bad. Specifically, Olympus NDT has been promoting the introduction of ISO-
related phased array training courses into North America, with some success. Lavender International is introducing PCN courses for phased arrays and for TOFD; Davis NDE is introducing ISO-related courses, as is Eclipse Scientific. As these are three of the original six training members, we are reasonably happy with progress. In addition, Global School of NDT and Jubail Industrial College are developing ISO courses.

Given that it has taken years to get EN 473 and ISO 9712 to settle their minor differences, our progress can be considered as reasonably brisk [11].

However, Olympus NDT will be happier when all training course can effectively offer globally-acceptable phased array certifications, most likely based on the ISO model. Not surprisingly, there are issues with the ISO approach as well. For example, ISO breaks down components into several sectors, as shown in Figure 7.

A.2 Product sectors

a) Castings (ferrous and nonferrous materials) [c].

b) Forgings (all types of forgings: ferrous and nonferrous materials) [f].

c) Welds (all types of welds, including soldering, for ferrous and nonferrous materials) [w].

d) Tube and pipe (seamless, welded, ferrous and nonferrous materials, including flat products for the manufacture of welded pipes) [t].

e) Wrought products, except forgings (plates, bar, rods) [wp].

Figure 7: Extract from ISO 9712 on different product sectors [3]

The other issue, from an Olympus perspective, is the number of hours appropriate for training. When Olympus started training, we ran a two day course only – called “Introduction to Phased Arrays”. Naturally, this course was not planned for qualifications, but proved woefully inadequate in terms of certification. This course was really only useful for engineers and managers, to get an idea of what phased arrays could do. The courses have now expanded to 40, then 80, hours – many in keeping with ISO, PCN and other certifications. In fact, some training companies are even running (private) courses of three or more weeks.

7. Conclusions

1. The Olympus NDT phased array training courses have been very successful, with over 200 (public) courses per year.
2. These courses have evolved from a two-day overview to two week (or more), some with certifications.
3. Ideally, Olympus NDT would like to see all courses using the same certification, but this is unlikely to happen in the near future.
4. There is a significant difference between ISO-controlled certifications and ASNT-company certifications – for both global acceptance and for content.
5. In other words, there is a mish-mash of certifications, but we are slowly iterating towards acceptable, transportable certifications – specifically ISO 9712.
References

10. ASME Section V Article 4 Mandatory Appendix VI, “Ultrasonic Examination Requirements for Workmanship Based Acceptance Criteria”, 2010.
11. http://www.nordicinnovation.net/article.cfm?id=1-834-685