ABET Accreditation: What Is It and Why Does It Matter?

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This article reviews the purpose of ABET accreditation, the associated criteria, the volunteers that provide the accreditation reviews, and the role of AIChE in the accreditation process.

Most chemical engineers reading this article will have graduated from an ABET-accredited chemical engineering program, yet few know much about the accreditation process. Unless they were students during a review, many industry practitioners may not have even heard of ABET accreditation. While some academics see ABET as a way to improve their programs, others experience accreditation through a visit by an accreditor every six years, along with the rubrics and the student data they provide their program's ABET coordinator between reviews.

Accreditation ensures that a program meets minimum standards (as outlined in a set of criteria) so that employers, parents, students, graduate schools, and the public can have confidence in the quality of the education graduates receive from an ABET-accredited program. In addition, a degree from a program accredited by the Engineering Accreditation Commission (EAC) of ABET meets the education component specified in the National Council of Examiners for Engineering and Surveying (NCEES) Engineering Education Standard for engineering registration *(1)*. In most states and territories, this means that those graduates can pursue engineering registration (P.E. license) with four years of supervised experience rather than 8–10 years (unless their educational credentials are evaluated by NCEES or the state board and determined to meet the academic requirements).

This article reviews ABET accreditation criteria, discusses the accreditation review timeline, and examines the role of AIChE in the accreditation process. This article also describes the various volunteer opportunities for AIChE members from industry, government, and academia to serve as accreditation evaluators.

Review of chemical engineering accreditation and ABET

Chemical engineering has its roots in the industrial revolution, with courses beginning in the 1880s and degree programs in 1895 *(2, 3)*. AIChE was founded in 1908 and began efforts to standardize the body of knowledge. In 1925, AIChE led an initiative to better standardize the curriculum across the 78 chemical engineering programs in the U.S. and to create standards that could be used to evaluate program quality.

In 1932, seven societies, including AIChE, joined together to form the Engineer's Council for Professional Development (ECPD) and began to focus on the evaluation and accreditation of engineering programs. Other engineering societies began joining the council, and in 1946, engineering technology programs were added, eventually followed by applied science in 1983 and computer science in 1985. In 1980, ECPD changed its name to the Accreditation Board for Engineering and Technology, or ABET. By 1995, there were approximately 150 accredited chemical engineering programs in the U.S. ABET is currently composed of 35 member societies representing more than 1.5 million professionals. Delegates from each society help set policy and develop strategies for ABET.

While ABET started as a national accreditation organization in the U.S., ABET is part of many mutual recognition agreements (MRAs) and memoranda of understanding (MOUs) with accrediting organizations around the world. ABET began accrediting programs outside the U.S. in 2008, and currently 4,564 programs at 897 institutions in 40 countries are accredited.

The face of ABET is the more than 2,200 volunteers who serve as program evaluators (PEVs) and team chairs. AIChE currently has more than 80 PEVs and team chairs that serve ABET. Currently, ABET accredits 230 chemical, biochemical, biomolecular, and similarly named engineering programs, as well as four paper-related engineering programs and five other related engineering programs. In addition, nine chemical/refinery/process engineering technology and six chemistry-related programs are accredited. Of all these programs, 71 are outside the U.S. For further information, see www.abet.org.

ABET accreditation criteria

Program accreditation criteria ensure that processes and procedures for student success are practiced systematically to help graduates achieve the program's stated educational objectives. ABET accreditation criteria incorporate generally accepted practices to maintain and improve educational programs in engineering, engineering technology, computing, and applied and natural sciences. Within ABET, there are four accreditation commissions. The EAC is responsible for accrediting engineering programs and approving any updates to the engineering program criteria as outlined in a document entitled Criteria for Accrediting Engineering Programs *(4)*. Other commissions include the Engineering Technology Accreditation Commission (ETAC), the Computing Accreditation Commission (CAC), and the Applied and Natural Sciences Accreditation Commission (ANSAC). The Accreditation Policy and Procedure Manual (APPM) is shared among all four commissions, which provides procedures on how reviews are conducted *(5)*. The APPM also includes requirements related to public information and lab safety.

The criteria document for each commission is updated annually, and it includes definitions, criteria, and proposed changes. Definitions for engineering criteria include program educational objectives, student outcomes, assessment, evaluation, basic science, college-level mathematics, complex engineering problems, engineering design, engineering science, and teams. Proposed criteria changes are included to allow for public input and modifications to the proposed changes before any approval by ABET. Most proposed changes incorporate small changes, but periodically more significant changes are proposed. For example, the EAC is piloting the addition of diversity, equity, and inclusion components to the curriculum and faculty criteria, as well as evaluating reviews of certificate programs.

Evolution of accreditation

As the evaluation and accreditation process evolved, the criteria became increasingly detailed and prescriptive, focusing on specific curricular content, faculty qualifications, and adequate facilities. In 2000, the accreditation criteria underwent significant changes to encourage self-defined program educational objectives and the creation of a set of learning outcomes, including professional skills like communication, teamwork, ethics, and life-long learning. In addition, ABET also updated the assessment and evaluation process to better demonstrate the attainment of those outcomes, along with actions to address any gaps. The curricular requirements no longer specify specific courses but rather the broad areas (with minimum credit-hours) that need to be in the curriculum. Additionally, the curriculum needs to be consistent with the program's educational objectives and outcomes. An evaluation of faculty, facilities, and institutional support remained. There was also an allowance for additional discipline-specific curricular and faculty requirements.

This easing of rigid requirements means that programs have the flexibility to do what makes sense for them and the stakeholders they serve. As a result, there is much variety in how programs meet the requirements.

The engineering criteria are published each year, following the update process. The 2023–24 Criteria for Accrediting Engineering Programs includes:

Criterion 1: Students. This criterion requires evaluating student performance, monitoring student progress, advising students, and enforcing graduation requirements and policies related to admissions and course credit. Many of these processes are routine for universities and are already in place. Transcript reviews are part of determining whether the university is following its own rules.

Criterion 2: Program educational objectives. This criterion requires the publication and periodic review of program educational objectives, which are broad statements describing what graduates are expected to accomplish within a few years following graduation. A program's educational objectives, often written by faculty members of the program, must be consistent with the mission of the institution and the needs of the program's constituencies. Statements that address graduates' success in careers or advanced degrees are also common.

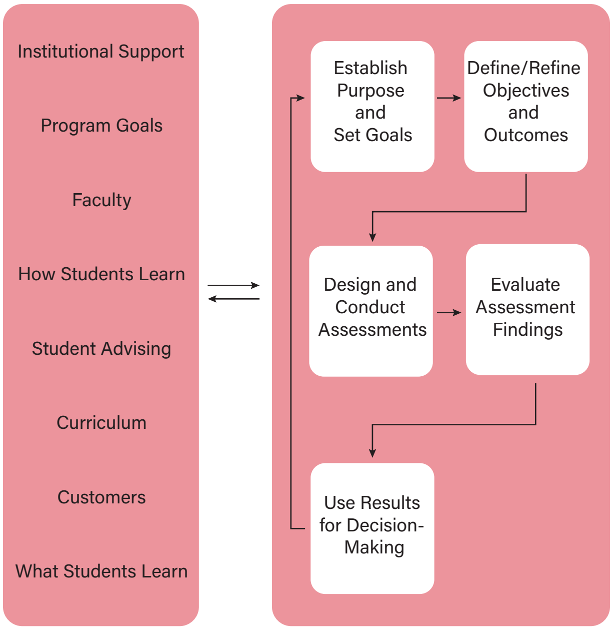
Criterion 3: Student outcomes. This criterion defines seven student outcomes that each program must include for assessment and evaluation to support the program's educational objectives. The student outcomes required for all engineering disciplines, as defined by the EAC, are:

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Criterion 4: Continuous improvement. This criterion requires a documented process for assessing and evaluating the extent to which student outcomes are attained, as well as a method for continuous improvement associated with the evaluations. Examples of continuous improvement have included increased instruction to address weaknesses in a given content area, improved assessment techniques, addition or removal of courses to address educational trends, and restructuring of advising.

Most of the "extra work" for programs pursuing ABET accreditation is spent developing and implementing continuous improvement processes. The program's faculty must develop and put into practice processes for evaluation, assessment, and continuous improvement. In particular, the program must demonstrate to ABET that a systematic and appropriate process is used to assess and evaluate students' performance before graduation. They must also demonstrate how this information is used to determine the actions a program will take to improve students' performance.

Many programs directly assess each of the seven student outcomes in two or more required courses annually using rubrics and reviewing student work, including exams, homework problems, lab reports, and projects. This information is aggregated and used to decide what needs improvement and how a program should proceed. A typical continuous improvement process is shown in Figure 1. With institutional support and program goals in mind, combined with knowledge of how students learn, faculty develop the continuous improvement process and participate in student advising. These elements help ensure that what students learn meets the needs of the stakeholders of the



▲ **Figure 1.** A commitment to continuous improvement is a crucial component of a program's accreditation, and there are many forms that this improvement can take. This figure visualizes how actions, like building institutional support and quality student advising, as well as parts of the program's institutional structure like the curriculum and its stated goals, are all factors that can be molded and adapted to attain positive student outcomes.

program: students, employers, graduate schools, and the communities where the graduates live and work.

Criterion 5: Curriculum. This criterion specifies the necessary curriculum content, including 30 semester credits of college-level mathematics and basic science, 45 semester credits of engineering topics appropriate to the program, a culminating major design experience incorporating engineering standards and multiple constraints, and a complementary broad education.

Criterion 6: Faculty. This criterion requires that faculty members are qualified and competent, and that there are a sufficient number of them to cover the curriculum. Additionally, professional development and faculty interactions with students and industrial practitioners is also required. Although there is no checklist, the criterion states that the overall competence of a faculty member may be based on several factors such as education, diversity of background, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and professional licensure. Faculty members also need the authority to run the program. There are no requirements regarding the faculty/student ratios or the minimum number of full-time faculty members. While many faculty members have advanced degrees, some programs use experienced design engineers to teach the major design course.

Criterion 7: Facilities. This criterion requires the appropriateness and safety of all facilities to support the attainment of the student outcomes and to provide an atmosphere conducive to learning. Facilities include equipment, computing resources, classrooms, faculty offices, and laboratories. Appropriate support to maintain the facilities is also required. Instructional labs get a lot of attention and need to be sufficient to allow students to work in small groups. Labs must be functional, related to the discipline, and equipped with modern tools.

Criterion 8: Institutional support. This criterion requires institutional leadership and the support of resources to create an environment where student outcomes can be attained. Resources include institutional services, financial support, and adequate staff. The resources should be sufficient to attract and retain qualified faculty members.

Chemical engineering program criteria

Many programs, including chemical engineering, have additional program-specific criteria limited to areas of curricular topics and faculty qualifications. The current program criteria for chemical engineering programs state that the curriculum must include:

- applications of mathematics, including differential equations and statistics, to engineering problems
- college-level chemistry and physics courses, with some at an advanced level, as appropriate to the objectives of the program
- engineering application of these sciences to the design, analysis, and control of processes, including the hazards associated with these processes.

Programs with biochemical, biomolecular, or similar modifiers in their titles must also include biologically based engineering applications in their curriculum as appropriate to the program's name and educational objectives.

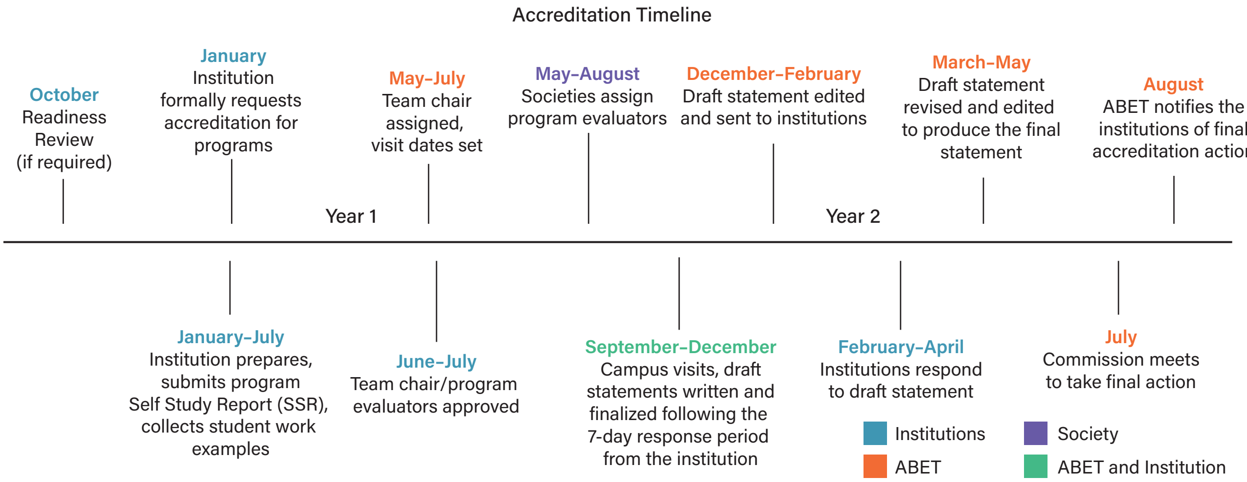
Chemical, refinery, process engineering technology, and similarly named programs have program criteria defining the curricular requirements for associate- and baccalaureate-level programs.

ABET accreditation timeline

Programs that are currently accredited renew their accreditation every six years. Programs send a request for review to ABET in January and submit a Self Study Report (SSR) by July 1. The reviews occur during a three-day onsite visit in the September to December time period. The SSR report is based on an ABET-provided template that is the same for all engineering programs. New programs can start any year and begin by submitting a Readiness Review SSR, which is due October 1 of the year before the planned visit. However, if there is already an ABET accredited program in the same commission at that institution, the new program reaccredits at the same time. Thus, after a new program is reviewed and accreditation is achieved, the next accreditation review for that program must coincide with the review cycle of existing ABET-accredited programs within that commission.

Shortly after the visit, a draft statement for all programs undergoing review is sent to the institution following a rigorous editing process. The editing process provides consistency among the statements sent to each institution. If a shortcoming in any of the criteria is included in the draft statement, the institution can submit additional information during a 30-day due process period. Shortcomings, from least severe to most severe, are denoted as a "concern," "weakness," or "deficiency." If additional information is submitted, the draft statement is then revised after a rigorous editing process. If needed, and with the approval of the team chair leading the accreditation visit, the institution may send additional information before the July commission meeting where a final accreditation action is determined and voted upon for each program.

Institutions receive the final accreditation decision of the commission in August. If a weakness or deficiency is not properly addressed, programs must undergo an additional review two years later to clear any shortcomings. This review may either be through a report or an onsite visit. The



▲ **Figure 2.** This figure demonstrates the timeline for the ABET accreditation of any engineering program. Throughout this process, the different parties involved — including ABET, the applicable trade society, and the program itself — must all meet their individual deadlines for accreditation to be granted.

only exception is that a new program will not be accredited if a deficiency remains unaddressed. Figure 2 shows a typical accreditation timeline.

The face of ABET: Program evaluators and team chairs

PEVs are assigned to review a specific program, and a typical review will involve one or more PEVs. A team chair is a seasoned PEV that is asked to serve on an ABET commission and to lead an ABET visit to an institution.

Why do professionals volunteer to become part of the ABET process as PEVs or team chairs? To answer the question, it is important to understand their roles. PEVs and team chairs do not receive any stipends, but they do get to travel to other universities in both the U.S. and across the world (all travel costs are covered). A PEV reviewing chemical engineering and related programs needs to be a member of AIChE. Applicants seeking to become a PEV need to apply on the ABET website and choose which of the four commissions (EAC, ETAC, CAC, or ANSAC) is a good fit for their background.

The AIChE Education and Accreditation (E&A) Committee, discussed in the following section, reviews the PEV applications in November. Selected prospective PEVs complete seven online training modules, then receive a mock self-study report and set of transcripts from a fictitious program. The prospective PEV is asked to read and evaluate the materials and then write a report with the preliminary findings and potential questions they would ask during a site visit. All of this pre-work is discussed with a mentor prior to the prospective PEV attending a two-day in-person training workshop at ABET headquarters. The in-person training costs are covered by ABET. All training is completed by July, which is the start of the next accreditation cycle.

Some engineering societies, including AIChE, require that the newly trained PEVs observe an experienced PEV during an actual site visit in the fall. The observation visit costs are often covered by the societies. After this, the training is complete, and the PEV is assigned during the following accreditation cycle to evaluate a program. Refresher training is provided every year, and the PEVs are evaluated by the programs they visit and the rest of the ABET team.

After a PEV is assigned a program to evaluate, the PEV will receive the SSR from the program they will be assessing. A best practice is to skim the report immediately to see if there are any potential shortcomings that the program can take action on prior to the visit or that will need to be investigated further. If more information is required, the PEV will confer with the team chair and begin a dialogue with the program. The goal is to resolve as many shortcomings as possible before the site visit. The PEV also analyzes transcripts to determine the number of basic science, math, and engineering credits and to assess alignment with the curriculum provided in the SSR. Additionally, the transcripts allow the PEV to determine whether the program is following its own rules on topics such as graduation, course substitutions, and pre-requisite requirements. The PEV typically participates in one to three Zoom meetings with the entire ABET visit team before the visit to discuss all of the programs, identify any common shortcomings, discuss any inconsistencies, and plan for the visit. The PEV also drafts an exit statement or at least the introductory portion of the exit statement prior to arrival.

PEVs often find that the site visit is the fun part of their experience. Visits typically occur Sunday through Tuesday. Therefore, PEVs usually arrive on Saturday. After arriving on campus, the first day (Sunday) includes touring facilities and reviewing documents. The second day (Monday) includes interviews with faculty members, students, staff, administrators, and advisory board members. The third day (Tuesday) is spent writing the exit statement and sharing the initial findings with the institution.

Each visit allows a PEV to learn something new. Site visits help academic PEVs improve their own programs. For industrial PEVs, visits provide a glimpse of new engineering education trends. The site visit time is intense and requires long days and evenings. It also includes going out to excellent restaurants and getting the opportunity to work with great people. PEVs generally complete their work after the site visit. The team chair handles editing reports following the visit, although the team chair may consult the PEV during the editing process or when more information is received from a program.

AIChE Education and Accreditation Committee

AIChE is the leading society for chemical, biochemical, biomolecular, and similarly named engineering programs. The AIChE E&A Committee works with ABET to identify the aforementioned program criteria. The committee is also responsible for recruiting and assigning PEVs for ABET reviews. The E&A Committee assigns PEVs for chemical engineering, chemical engineering technology, and chemistry programs, as well as related programs like paper engineering. The committee also "loans" PEVs to other societies for reviewing biomedical, materials, environmental, and other related programs.

After numerous ABET accreditation visits as a PEV, an individual may be asked to join the AIChE E&A Committee. The committee selects individuals to represent AIChE on the ABET commissions and serve as team chairs. Currently, AIChE has nine EAC commissioners, one ETAC commissioner, and one ANSAC commissioner. In the 2022–23 review cycle, there were 309 ABET team chairs, of which 11 were from AIChE. The commissioners serve as team chairs and work with the commissioners from other engineering societies to assure consistency, approve criteria changes, and improve the evaluation process. Commissioners also review all the visit statements and vote as a body on the final accreditation actions during the Commis-

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sioner Meeting in July. The team chair position requires a larger time commitment than being a PEV because the team chair usually completes two ABET visits per year. Additionally, the team chair manages the visit and continues to communicate with the programs during the post-visit period if programs want to submit information prior to the July meeting.

Additional important roles of the AIChE E&A Committee include:

- providing program-specific training to the PEVs
- reviewing the consistency of all chemical engineering and related programs under review during a given ABET cycle
- addressing any ABET or AIChE educational or accreditation needs.

Program-specific training and other information can be found at https://www.aiche.org/community/committees/education-accreditation-committee.

Volunteer opportunities

Although everyone has their own reason for volunteering as a PEV, common reasons include the opportunity to travel to new places, learn about other programs (and improve their own programs if they are an academician), stay on top of changing technology and ABET requirements, and contribute to the future of the profession. PEVs tend to be very dedicated to the profession and want to ensure that what is taught to students across the world meets the needs of the industries that hire graduates. They seek to ensure that chemical engineering curriculums are consistent about what it means to have a BS degree in chemical engineering.

PEVs are asked to participate in at least five visits, usually one per year or every other year, but many serve much longer. AIChE usually adds five new PEVs each year. Most current PEVs and team chairs are faculty members at universities in the U.S., but there are also a few volunteers from industry and non-U.S. institutions.

The AIChE E&A Committee is seeking to diversify the pool of PEVs by including more people from industry, other countries, and broader gender and underrepresented minority groups.

Whether this year or in the future, consider volunteering to be a PEV. You may apply at https://www.abet.org/program-evaluators/become-a-program-evaluator. CEP

Additional Accreditation Needs: Process Safety and Chemical Reactivity

The AIChE E&A Committee was involved in addressing process safety and hazards as part of the accreditation process. In 2007, a major explosion (equivalent to 1,400 lb of TNT) occurred at T2 Laboratories in Jacksonville, FL, resulting in the deaths of four employees, the injury of 32 others, and the destruction of multiple nearby businesses.

The U.S. Chemical Safety and Hazard Investigation Board (CSB) report on the incident concluded that the company owners (a BS-level chemist and a BS-level chemical engineer) were unaware of the potential for a runaway exothermic reaction and thus under-designed the cooling and relief systems. The report stated that the root cause of the accident was a lack of training by the process owners and recommended (among other things) that ABET work with AIChE to add reactive hazard awareness to the ABET program-specific chemical engineering criteria.

A task force from the AIChE E&A Committee proposed a change to the ABET program criteria, including a curricular requirement of hazards associated with chemical, physical, and/or biological processes. These changes were implemented in 2012. The effort was recognized by the 2011 AIChE Gary Leach Award "for significant accomplishments toward the Institute's mission and objectives" *(6)*.

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