



Bioprocessing Piping and Equipment Design

A Companion Guide for the ASME BPE Standard

William M. (Bill) Huitt

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**BIOPROCESSING
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BIOPROCESSING PIPING AND EQUIPMENT DESIGN

A COMPANION GUIDE FOR THE ASME BPE STANDARD

William M. (Bill) Huitt

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ASME BPE 2014

Its Organization and Roster of Members

Organization

The ASME Bioprocessing Equipment (BPE) Standards Committee membership in 2014 was made up, in whole, of 195 members holding membership to anywhere from one to five committee/subcommittee memberships. The ASME BPE Standards Committee is, as self-described, considered a “committee,” referring to itself as the ASME BPE Standards Committee, or simply Standards Committee. As indicated in Figure 1, organizational chart, the ASME BPE Standards Committee reports to the ASME Board on Pressure Technology Codes and Standards (BPTCS). Aside from the BPE Standards Committee, reporting also to the BPTCS are the Boiler and Pressure Vessel Code (BPVC) Committees, the B16 and B31 Committees, and other committees related to pressure containing subject matter.

The ASME BPE Committee is divided into a set of subtier groups of interest referred to as subcommittees. In other Standards Committees these subtier groups are referred to as “subgroups,” not so with the BPE Standards Committee. Among this group of subcommittees there is no hierarchy. They are simply divided by and focused on the various subject matter interests of the BPE Standard and report directly to the BPE Standards Committee. These subject matter interests are referred to as Parts with the following identifiers as referenced in Table 1.

Referring to Figure 2, it is apparent that each of the subcommittee groups reports to the BPE Standards Committee. The work these subcommittees do, whether it’s maintaining an existing part in the standard, respective of the subcommittee’s part title, or in developing a new part for the standard, there is an ongoing liaison effort that takes place between all of the subcommittees. This helps in diverting conflicts among the various subcommittees and in improving content of the standard as a whole.

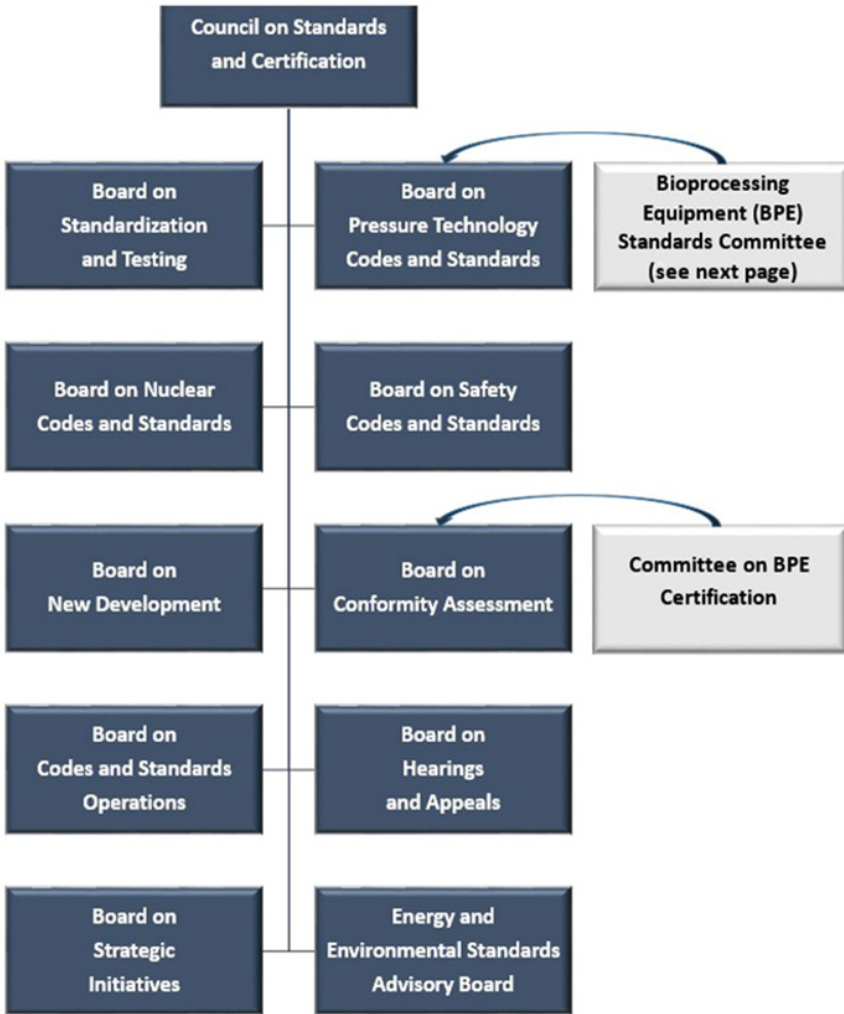


Figure 1 ASME boards and governing groups

Table 1 Subcommittee subject matter part identifiers

| Part | Title | Part | Title |
|------|---------------------------|------|-------------------------|
| GR | General requirements | SG | Sealing components |
| SD | Systems design | PM | Polymeric materials |
| DT | Dimensions and tolerances | CR | Certification |
| MJ | Materials joining | MM | Metallic materials |
| SF | Surface finishes | PI | Process instrumentation |

Each of the subcommittees is made up of a balanced membership wherein each member is assigned an interest category as follows:

- Designer/constructor (AC)—An organization performing design or design-related services, fabrication or erection, or both
- General interest (AF)—Consultants, educators, research and development organization personnel, and public interest persons
- Manufacturer (AK)—An organization producing components or assemblies
- Material manufacturer (AM)—An organization producing materials or ancillary material-related accessories or component parts
- User (AW)—An organization utilizing processes and/or facilities covered by the applicable standards

No one classification shall be represented by more than one-third of the subcommittee membership. By maintaining this balanced membership, no single interest group, whether it be a manufacturer or end user, or any other group, can monopolize the decisions made and the topics discussed in the subcommittee meetings.

Heading up the committees and subcommittees are elected officers of those groups. Each committee, subcommittee, and task group will have a chair and vice-chair. And depending on the size and complexity of any subcommittee, they may also have multiple vice-chairs and a secretary. The secretary for the BPE Standards Committee is an ASME staff secretary that not only provides a direct in-house link to ASME but also helps the entire membership maneuver through the procedural maze now and then when such procedural questions arise.

A subtier of groups under that of the subcommittees are the task groups. These are ad hoc groups that are assembled for a specific task and report to a particular subcommittee. These groups are where the majority of work gets done in standards development and maintenance. Some projects these groups are tasked to do are relatively small. But rather than take up time trying to resolve an issue during a subcommittee meeting, the issue or task will be assigned a temporary number, and volunteers are asked to work on resolving such issues offline or outside the confines of the subcommittee meeting.

Other task group issues are much more complex and involved. These tasks may take years to resolve and prepare for the balloting process. The balloting process itself is rigorous in that a proposal has to obtain consensus approval at multiple stages of the balloting process. That is, a proposal is balloted at the subcommittee level, then at the standards committee level, then to the board level, and finally to ANSI for procedural approval.

At each step of the process, a consensus has to be reached and each negative response has to be responded to with an attempt made to resolve all objections. But a consensus does not require unanimous approval. It does require approval by a simple majority of all of those voting. And to document all of this, ASME uses a system titled C&S Connect, the C&S standing for Codes and Standards. The basis for these procedures is consistent with the principles established for the World Trade Organization's Technical Barriers to Trade Committee.

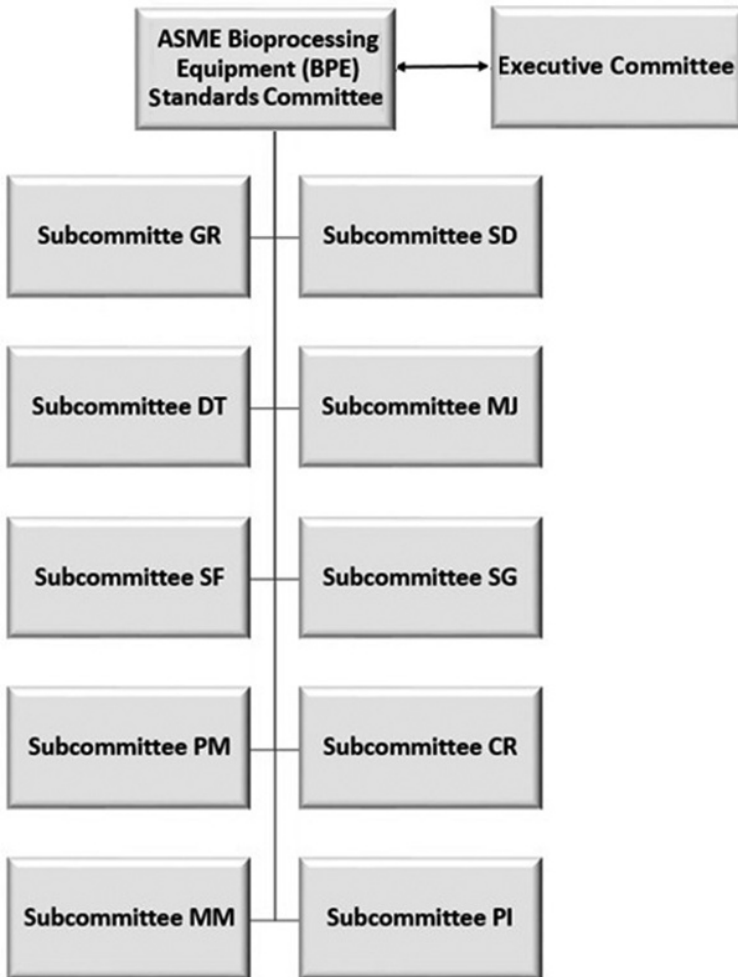


Figure 2 ASME BPE Standards Committee

The BPE Executive Committee, as seen in Figure 2, is a direct subset of the Standards Committee. This group is responsible for recommending approval or discharge of personnel and the governing of administrative items or actions as they relate to ASME policy and procedures. The vice-chair of the Standards Committee automatically serves as chair of the Executive Committee, and the chair of the Standards Committee automatically serves as vice-chair of the Executive Committee. Subcommittee chairs automatically hold membership to the Executive Committee, but membership on the Executive Committee beyond that does not require being a member of the Standards Committee.

In referring to Figure 1, there is an adjunct committee that is closely related to the Part CR subcommittee with the title of “Committee on BPE Certification” (CBPEC). This is a committee on its own and reports, as shown, to the Board on Conformity

Assessment (BCA). I will refer you to Section 1.2 of this book for a very brief synopsis of the scope of Part CR and all of the other subcommittees. But to clarify here how these two groups, Part CR and the CBPEC, work together is relatively simple.

The Part CR subcommittee is the group that developed and maintains Part CR in the standard, which intrinsically defines what BPE Certification is and how it interacts with the standard. It defines what the requirements are for BPE Certification and provides guidance on how to become a BPE Certificate Holder.

The CBPEC is the assessment and enforcement arm of the certification process. This is the group that, in working with the BCA, performs audits of those applying for BPE Certification; they review the subsequent auditor's assessment report and then make a determination, based on the auditor's report and deliberation, whether or not to recommend approval of the applicant. The final decision on that point is made by the BCA.

BPE Standards Committee Meetings

All committee and subcommittee meetings of the BPE Standard are open to the public. The only meetings not open to the public are those meetings in which discussions and decisions regarding personnel are held. The CBPEC meetings are closed, but these are conformity assessment meetings that typically follow the meetings of the CR subcommittee and are not BPE meetings.

The BPE Standards meetings follow an evolved schedule that runs for four days, Monday through Thursday. The Monday meetings typically include subcommittees CR and GR and task group meetings for any active task groups that need to discuss and finalize any outstanding issue relating to a task group's work.

Most task group activity takes place between the three committee meetings each year via conference calls and e-mail communication. Depending on the complexity and scope of a task group, some discussions and resolution need to take place in a face-to-face setting. These are the meetings that are scheduled for the Monday task group meetings. Tuesday and Wednesday are the two days in which the balance of subcommittees will meet. Thursday is the Standards Committee meeting at which the Standards Committee reports and all subcommittees report on what transpired at each of their meetings during the week.

As mentioned, all meetings are generally open to the public. New attendees should know that they are free to visit any meeting at any time except as explained previously. Only members are permitted to vote on subcommittee business. But any visitor is free to voice an opinion or make a point during a tabled discussion. It should also be known that visitors to these meetings are eligible to participate in task group work. If a visitor is considering membership, their work on task groups elevates their possibility of being approved.

Up until 2016 the BPE Standards Committee met three times each year. These meetings were held each year in January, May/June, and September/October. As a trial run it was voted on and planned that the committee hold only two meetings in 2016, one meeting in January and a second meeting in September. This was to test the waters to see if the committee could maintain the same level of efficiency and production of work on the standard with only two meetings per year.

A decision as to whether or not to remain with a two meeting per year format would not be decided upon until possibly the January 2017 meeting. That decision, I suspect, will be based largely on what is accomplished during 2016 and to what extent, good or bad, did the missing third meeting play a part.

Roster of Members

The following is a listing of all members of the ASME BPE Standards Committee and members of subcommittees reporting to the Standards Committee. The names are in alphabetical order and indicate if that person is a chair, vice-chair, or secretary of a committee or subcommittee and which subcommittees they are members of:

| BPE STANDARDS COMMITTEE AND SUBCOMMITTEE MEMBERS | | | | | | | | | |
|--|----------------------------------|-------------------------|----------|--|-----------------|-----------------|-----------------|-----------------|----|
| Abbreviations and Terminology used below: | | | | Notes: | | | | | |
| EC = Executive Committee | | SD = Systems Design | | 1. Contributing Member: an individual non-voting member whose contribution to a committee is through reviews and comments on proposals. Contributing members shall possess the technical qualifications necessary for individual voting members. 2. This individual is considered a "Delegate," which implies that they are an individual selected by the Standards committee to represent a group of experts outside of the U.S. and Canada. Each group represented has provided a clearly defined interest in participating on BPE subcommittees. | | | | | |
| DT = Dimensions and Tolerances | | SF = Surface Finishes | | | | | | | |
| GR = General Requirements | | SG = Sealing Components | | | | | | | |
| MJ = Materials Joining | | | | | | | | | |
| MM = Metallic Materials | | | | | | | | | |
| PI = Process Instrumentation | | | | | | | | | |
| PM = Polymeric Materials | | | | | | | | | |
| SC = Standards Committee | | | | | | | | | |
| NAME | AFFILIATION | CHAIR | V. CHAIR | SECRETARY | SUBCOMMITTEES | | | | |
| Allard, Michael | NewAge Industries | | | | PM | | | | |
| Anant, Janmeet | EMD Millipore | | | | PM | | | | |
| Anderson, Paul | Northland Stainless Inc. | | | | MM | | | | |
| Andrews, Jacob | Zenpure Americas, Inc. | | | | PM | | | | |
| Andrews, Todd | Colder Products Company | | | | PM | | | | |
| Ankers, Jay | Ocean Alloys LLC | SC | EC | | SD | PI ¹ | | | |
| Anton, George | Qualtech Inc. | | | | PI | | | | |
| Avery, Richard E. | Nickel Institute | | | | MM | SF | | | |
| Balmer, Melissa L. | Sanofi Pasteur | | | SD | SC | | | | |
| Banes, Patrick H. | Astro Pak Corp. | | | SF | | | | | |
| Baram, David | Clifton Enterprises | | | | SC ³ | SG ³ | | | |
| Benway, Ernest A. | Ironwood Specialist Inc. | | | | SC ³ | GR ¹ | MJ ¹ | | |
| Bhaila, Kadeem | ITT Engineered Valves, LLC | | | MJ | | | | | |
| Bickel, Neill | Genentech | | | | MJ | SF | | | |
| Billmyer, Bryan A. | Central States Industrial Equip. | | | | SC | CR | DT | SD | |
| Blumenthal, Joel | Perceptual Focus LLC | | | | PI | SG | | | |
| Bond, Richard | Anderson Instrument Co. | | | | PI | | | | |
| Bradley, Jeffrey L. | Eli Lilly and Co. | | | | SD ³ | GR ¹ | MJ ¹ | | |
| Bragg, Chuck J. | Burns Engineering, Inc. | | | | PI | | | | |
| Brockmann, Dan | Alfa Laval Inc. | | | | CR | DT | SF | | |
| Burg, William P. | DECCO Inc. | | | | GR | MJ | | | |
| Cagne, William H. | JSG, LLC | | | | SC | EC | GR | | |
| Campbell, Dr. Richard D., PE | Bechtel | MJ | | | SC | EC | GR | CR | MM |
| Canty, Thomas | J M Canty Inc. | | PI | | SD ³ | | | | |
| Carl A. Johnson | Genentech Inc. | | | | SD | | | | |
| Chapman, Chuck | Gemu Valves | | | | DT | SD | | | |
| Chih-Feng, Kuo | King Lai International | | | | SF | | | | |
| Cirillo, Anthony P. | Cirillo Consulting Services LLC | | | | SC ³ | EC ³ | GR ¹ | | |
| Cohen, Donald K. | Michigan Metrology, LLC | | | | SF ³ | | | | |
| Conley, Indumathi | DPS Engineering | | | | SD | | | | |
| Conn, Carlyle C. | Top Line Process Equipment Co. | | | | SF | | | | |
| Cook, Todd J. | T & C Stainless, Inc. | | | | MJ | SF | | | |
| Cooper, Mark | United Stainless | | | | SF | | | | |
| Cosentino, Rodolfo | Giltec Ltda | | | | DT | PI | | | |
| Cotter, Randolph A. | Cotter Brothers Corporation | | | | SC | MJ | SD | | |
| Crawley, Jere | Jacobs Engineering Group, Inc. | | | | SD | | | | |
| Daly, James | BSI Engineering | | | | SD | | | | |
| Daniels, James R., PE | ITT Engineered Valves, LLC | | | | SG | SF | | | |
| Davis, Kenneth R. | Nordson Medical | | | | DT | PM | | | |
| Defeo, John W. | Hoffer Flow Controls Inc. | | | | PI | | | | |
| Defusco, Sean J. | Integra Companies Inc. | | | | PM | SG | | | |
| Dubiel, Robert J. | Parker Hannifin | | | | SG | | | | |
| Dunbar, Peter M. | VNE Corporation | | | | CR | DT | | | |
| Dvorsek, James | Abbott Laboratories | MJ | | | SC | EC | CR | SD ¹ | |
| Dymess, Albert D., PE | Advent Engineering Inc. | | SD | | SD | | | | |
| Elbich, Robert | Exigo Manufacturing | | | | CR | DT | | | |

(Continued)

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|-------------------------------|----------------------------------|----|-----|--|-----------------|-----------------|-----------------|----|--|
| Elkins, Curtis W. | Central States Industrial Equip. | | | | MJ | SF | | | |
| Embury, Mark | ASEPCO | GR | | | EC | EC | SD | | |
| Esbensen, Preben | Alfa Laval Kolding A/S | | | | SG | | | | |
| Evans, Greg | Ace Sanitary | | | | PM | | | | |
| Featherston, Jan-Marc | Weed Instrument Co. | | | | PI | | | | |
| Feldman, Jason | Yula Corporation | | | | SD | | | | |
| Fisher, E. Burrell | Fisher Engineering | | | | SC | SD | | | |
| Fitts, Robert B. | Spraying Systems Co | | | | DT | GR | | | |
| Foley, Gerard P. | PBM, Inc. | | | | SG | SD | | | |
| Foley, Raymond F. | DPS Engineering | | | | DT | SD | | | |
| Fortin, Jonathan | Lonza Group | | | | SD | | | | |
| Franks, John W. | Electrol Specialties Company | | | | MM | SD | | | |
| Fridman Tamara | Vanasyll LLC. | PM | GR | | | | | | |
| Fritz, James | TMR Stainless | | | | MJ | MM | | | |
| Gallagher, Eoghan | Alkermes Pharma Ireland Ltd | | | | ES | | | | |
| Galvin, Paul G. | GF Piping Systems LLC | | PM | | PM | | | | |
| Gayer, Ms. Evelyn L. | Holloway America | | | | CR | MJ | SF | | |
| George, Daryl | Hallam ICS | | | | SD | | | | |
| Gerra, Ronn | Shire Pharmaceuticals | | | | SD | | | | |
| Giffen, Jay | PBM Inc. | | | | SG | SF | | | |
| Gillespie, David A. | BMW Constructors | | | | CR | MJ | MM | | |
| Gleeson, John | Hamilton Company | | | | PI | | | | |
| Gonzalez, Michelle M., PE | Engineering Consultant | | | | SC ¹ | CR ¹ | SF ¹ | | |
| Gorbis, Vladimir | Genentech / Roche | | CPI | | | | | | |
| Govaert, Roger | Mettler Toledo Process Anal. | | | | PI | | | | |
| Gregg, Bradley D. | Top Line Process Equipment | | | | SG | | | | |
| Gu, Mr. Zhenghui ² | Shanghai Morimatsu Pharma | | | | SC | SD | | | |
| Gutzeit, Maik | GEA Lyophil GmbH | | | | SD | | | | |
| Haman, Scott | Fristam Pumps | | | | SG | | | | |
| Hamilton, Jody | RathGibson | | SF | | | | | | |
| Hanselka, Reinhard, PhD, PE | CRB Engineers | | | | SC | MJ | SD | | |
| Harper, Larry | Wika Instruments, Ltd | | | | GR | SG | | | |
| Harrison, S. Tom | Harrison Electropolishing, LP | | | | MM | SF | | | |
| Hartner, Scott M., PE | Baxalta US, Inc. | | | | SD | | | | |
| Harvey, Tom | Gemu Valves, Inc. | | | | SG | | | | |
| Helmke, Dennis R. | Flow Products LLC | | | | CR | SG | | | |
| Henon, Dr. Barbara K. | Magnatech LLC | | | | SC ¹ | MJ ¹ | SF ¹ | | |
| Hobick, Troy L. | Holland Applied Technologies | | CR | | SD | | | | |
| Hogenson Dr. David | Amgen | | | | SD | | | | |
| Hohmann, Michael A. | Quality Coalescence | | | | SC | CR | GR | MJ | |
| Huitt William M. | W. M. Huitt Company | | | | GR | CR | MJ | MM | |
| Hutton, L. T. | Arkema Inc. | | PM | | SC | CR | MJ | | |
| Inoue, Mikio | Fujikin Inc. | | | | SG | SD | | | |
| Irish, Declan | Carten-Fujikin | | | | SG | | | | |
| Jain, Mukesh K. | W.L. Gore & Associates | | | | PM | | | | |
| Janousek, John | Abbott | | | | SD | | | | |
| Jensen, Bo B. B. | Alfa Laval | | SD | | SD | | | | |
| Johnson, Carl A. | Genentech Inc. | | | | SC | SG | | | |
| Johnson, Michael W. | Entegris | | | | PM | | | | |
| Juntsch, Daniel | Zeta Biopharma GmbH | | | | MJ | | | | |
| Kelleher, Ciaran | Janssen Supply Chain | | | | SG | SD | | | |
| Kettermann, Carl | RathGibson | | CR | | SC | EC | MJ | MM | |
| Kimbrel, Kenneth D. | Ultraclean Electropolish Inc. | | SF | | SC | EC | CR | | |
| Klees, Daniel T. | Magnetrol International, Inc. | | PI | | SC | EC | | | |
| Klitgaard, Lars Beck | NNE Pharmaplan | | | | SD | | | | |
| Knox, Marianne | W. L. Gore & Associates | | | | PM | | | | |
| Kollar, Csilla | Dow Corning Corporation | | | | PM | | | | |
| Kranzpiller, Johann | GEA Tuchenhagen GmbH | | | | ES | | | | |
| Kresge, Ms. Denise | CRB Consulting Engineers | | | | PI | | | | |
| Kroehnert, Gerhard | Neumo | | | | DT | DT | SF | | |
| Kubera, Paul M. | ABEC, Inc. | | | | SG | SD | | | |
| Kwilosz, David | Elanco Global Engineering | | PI | | GR | PI | | | |
| Lamore, Andrew | Burkert Fluid Control Systems | | | | PI | | | | |
| Larkin, Thomas Jr. | Amgen | | | | PM | | | | |
| Larson, John D. | DCL, Inc. | | | | SD | | | | |
| Lisboa, Ivan ³ | RathGibson | | | | SC | DT | | | |
| Mahar Jeffrey T. | 3M Purification | | | | SC | SD | PM | | |
| Manfredi, Marcello | ZDL Componentes De Proc. | | | | DT | | | | |
| Manring, Frank | VNE Corp | | DT | | SC | SF ¹ | | | |
| Manser, Rolf | DCL, Inc. | | | | SD | | | | |
| Marks, David M., PE | DME | | SD | | SC | EC | | | |
| Marshall, Jeff | Perrigo-Inc. | | | | SG | | | | |
| Matheis, Kenneth J. Sr. | Complete Automation Inc. | | | | CR | MJ | MM | | |

(Continued)

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|-----------------------------|-----------------------------------|----|----|----|---|-----------------|-----------------|----|----|
| Mathien, Daniel J. | Behringer Corp. | | DT | | | SC | EC | | |
| McCauley Nicholas S. | A&B Process Systems | | | | | MJ | | | |
| McClune, Paul L., Jr. | ITT Pure-Flo | | | | | DT | | | |
| McCune, Daniel P. | Allegheny Bradford Corp | | | | | MM | SD | | |
| McFeeters, Milena | Steridose | SG | | | | SC | PM | | |
| McGonigle, Robert | Active Chemical Corp. | | | | | SF ¹ | | | |
| Michalak, Ryan A. | Eli Lilly and Co. | | | SD | S | SG | SD | | |
| Minor, John W., PE | Paul Mueller Co | | | | | GR | SD | | |
| Mogul, Rehan | Crane Flow Technologies Ltd | | | | | PM | SG | | |
| Monachello, John F. | SP INDUSTRIES | | | | | SD | | | |
| Mondello, Matthew | MECO | | | | | SF | | | |
| Montgomery, Gabe | Tank Components Industries | | | | | DT | | | |
| Mortensen, Michael | NNE Pharmaplan A/S | | | | | SD | | | |
| Muller, Scott R. | GE Healthcare Bio-Sciences | | | | | SD | | | |
| Murakami, Sei ² | Hitachi, Ltd. | | | | | S | | | |
| Nerstad, Joseph Richard | SOR, Inc. | | | | | PI | | | |
| Norton, Vickie L. | T&C Stainless | | | | | GR | | | |
| Obertane, Andrew R. | Clark-Reliance Corporation | | | | | CR | SG | SD | |
| O'Connor, Tom | Central States Industrial Equip | | | | | MJ | MM | | |
| Ortiz, William | Eli Lilly and Co. | | | | | GR ¹ | SD ¹ | | |
| Pacheco, Christopher N., PE | Amgen | | | | | SC | SG | SD | |
| Page, George W. Jr. | Page Solutions | | | | | SG | SD | | |
| Parker, Alton K. Jr | W. L. Gore and Associates Inc. | | | | | SG | | | |
| Pelletier, Marc PHD | CRB Engineers | EC | SC | | | GR | SD | | |
| Peterman, Lloyd J. | United Industries Inc. | | | | | SC | DT | SF | |
| Petrillo, Peter A. | Millennium Facilities Resources | | | | | PI | SF | | |
| Pierre, Philippe R. | Pierre Guerin SAS | | | | | ES | | | |
| Pitchford, Ernie | Parker Hannifin Corp. | | | | | PM | | | |
| Pitolaj, Steve | Garlock Sealing Technologies | | | | | SG | | | |
| Placide, Gilbert | Crosspoint Engineering | | | | | PI | | | |
| Pouliot, Jeffrey | Amgen | | | | | SG | | | |
| Powell, Alan L. | Merck & Co, Retired | | | | | SG | SD | | |
| Priebe, Paul | Sartorius Stedim Biotech | | | | | PM | | | |
| Raney, Robert K. | Ultraclean Electropolish Inc. | | | | | SF | | | |
| Rau, Dr. Jan | Dockweiler AG | | MM | | | SF | | | |
| Reinhold, Herman | AM Technical Solutions | | | | | MJ | | | |
| Rieger, Robert | John Crane Inc. | | | | | SG | | | |
| Roll, Daryl L., PE | Astro Pak Corporation | | | | | MM | | | |
| Roth, William L., PE | Procter & Gamble Company | | MJ | | | SC | CR | MM | |
| Sams, William R. | Richards Industries | | | | | SG | | | |
| Schmidt, Neil A., PE | Boccard Life Sciences | | | MM | | MM | | | |
| Schnell, Russell W. | DuPont Company | | | | | PM | SG | | |
| Schroder, Richard | Newman Gasket | | | | | PM | SG | | |
| Sedivy, Paul D. | RathGibson | | | | | SF | | | |
| Seibert, Kathy | Abee Inc. | | | | | | | | |
| Seiler, David A. | Arkema Inc. | | | | | PM | | | |
| Shankar, Ravi | Endress + Hauser USA | | | | | PI | | | |
| Sharon, Steven | Genentech, Inc. | | | | | PI | SD | | |
| Sisto, David P. | Purity Systems Inc. | | | | | MJ | | | |
| Smith, Robert A. | Flowsolve Corp. | | | | | SG | | | |
| Snow, Robert A. | Sanofi Global | | | | | SC | PM | SD | |
| Solomon, Michael S. | Feldmeier Equipment Inc. | | | | | MJ | SF | | |
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| Tischler, Gregory | VEGA Americas | | | | | PI | | | |
| Trumbull, Christopher A. | Paul Mueller Company | | | | | S | MJ | SF | |
| Van Der Lans, Albert | Janssen Biologics BV | | | | | ES | | | |
| Villela, Fernando Garcia | Stockval Tecno Comercial Ltda | | | | | DT | | | |
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| Vogel, James D. | The BioProcess Institute | | SG | | | PM | | | |
| Wagner, Paul | Anderson Instrument | | | | | PI | | | |
| Warn, Robert A. | Commissioning Agents Inc. | | | | | SD | | | |
| Watson-Davies, Stuart J. | PBM Inc. | | | | | ES | | | |
| Weeks, Cullen | CRB Builders, LLC | | | | | MJ | | | |
| Westin, Karl-johan | Roplan Sales Inc. | | | SG | | SD | | | |
| Wilson, Thomas G. | Consultant | | | | | DT ¹ | | | |
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| Wise, Daniel | Genentech, Inc. | | | | | SG | | | |
| Woods, Gary | Cross Point Engineering Grp. | | | | | PI | | | |
| Wu, Nanping | Fristam Pumps | | | | | SG | | | |
| Zinkowski, Richard J. | RJZ Alliances, LLC | | | | | S | EC | SG | SD |
| Zuehlke, Dr. Simon | Endress & Hauser CmbH Co. KG | | | | | PI | | | |
| Zumbrun, Michael A. | Maztech, Inc. | PM | | | | SC | EC | SG | |

Table 1 – Subcommittee Subject Matter Part Identifiers

| Part | Title | Part | Title |
|------|---------------------------|------|-------------------------|
| GR | General Requirements | SG | Sealing Components |
| SD | Systems Design | PM | Polymetric Materials |
| DT | Dimensions and Tolerances | CR | Certification |
| MJ | Materials Joining | MM | Metallic Materials |
| SF | Surface Finishes | PI | Process Instrumentation |

To my wife

Doris

My children and their spouses

Monique and Michael

Robert and Daryl

And my grandchildren

Connor, Shayfer, and Willamina

*I thank each and every one of you. Having your
faith and trust inspires me to do more.*

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