Accredited Standards Committee Z136 for the Safe Use of Lasers

Standards Consolidation Evaluation Sub-Group Report

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SCE Members:
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1. Scope

The SCE sub-group was established at the 2019 ASC annual meeting [1], following a presentation [2] with associated motion to form this sub-group. SCE is tasked with evaluating the pros and cons for consolidating some or all of: the vertical laser safety standards Z136.2, Z136.5, Z136.8, Z136.9; as well as the planned Z136.10 (not yet published) and possible new Z136.X (for LIP or other new application; not yet published) vertical laser safety standards. This document is SCE's report to ADCOM and the ASC of their findings.

The first discussion on considering consolidation for some of the vertical standards was at the 2018 ASC annual meeting [3] in the presentation [4] by Bob Thomas on "Future Roadmap for Vertical Standards." Bob noted several issues and concerns regarding Z136 committee work and the Z136 publications, including:

- limited sales of vertical standards
- quality of standards
- review time
- redundant information
- inconsistent requirements

He presented three potential courses of action:

i. continue status quo with potential for additional vertical standards
ii. reduce rewrite frequency (e.g., if content is stable, reaffirm a standard)
iii. consolidation of standards

For consolidation, he noted that could include Z136.2, Z136.5, Z136.8, Z136.9 and (a future) Z136.10 while leaving Z136.3 and Z136.6 as separate standards. In the discussion that followed, a straw poll was taken which favored further examining the plausibility of consolidation. This led to the subsequent presentation and discussion at the 2019 ASC meeting and formation of the SCE sub-group.

2. Z136 Horizontal and Vertical Standards

Z136.1 is a horizontal standard with applicability for all laser applications, while each vertical standard provides laser safety guidance for a particular application. A summary of the Z136 horizontal and vertical standards is presented in Table 2-1. In addition to these standards, there are two other Z136 publications: Z136.4, *Recommended Practice for Laser Safety Measurements for Hazard Evaluation* and Z136.7, *Testing and Labeling of Laser Protective Equipment*.

Table 2-1: Summary of Z136 Horizontal and Vertical Standards

Z136 Standard	Title	Current Publication Date	Previous Editions
Z136.1	Safe Use of Lasers	2014	1973, 1976, 1980, 1986, 1993, 2000, 2007
Z136.2	Safe Use of Optical Communication Systems using Laser Diodes and LED Sources	2012	1977, 1988, 1997
Z136.3	Safe Use of Lasers in Health Care	2018	1988, 1996, 2005, 2011
Z136.5	Safe Use of Lasers in Educational Institutions	*Withdrawn*[1] (10yr limit)	2000, 2009
Z136.6	Safe Use of Lasers Outdoors	2015	2000, 2005
Z136.8	Safe Use of Lasers in Research, Development & Testing	2012	-
Z136.9	Safe Use of Lasers in Manufacturing Environments	2013	-

2.1. Z136 Procedures, Z136 Conventions and Z136 Website Information

2.1.1. Z136 Procedures

The *Z136 Procedures* document [5] gives the title for each SSC and TSC but does not describe their scope, nor does it describe the scope for each Z136 Standard. This document does not define "horizontal" or "vertical" and these terms are not used. Section 6 in the document, *Subgroups Created by the Committee*, describes that:

- "The scope and duties delegated to the subgroup shall be approved at the time it is formed."
- "Subsequent changes in scope or duties, or the merger of two subgroups, or the disbandment of the subgroup shall also require approval by the Committee."

[1] The ASC is currently doing a recirculation ballot on a CDV2 revision for Z136.5. The next edition should be published in 2020.

2.1.2. Z136 Conventions

The *Z136 Conventions* document [6] Section 8 is titled *Horizontal vs Vertical Standard*. It gives the following description and scope information for these:

- Horizontal Standard:
  - Ideally, a horizontal standard would contain primarily general principles, concepts, definitions, terminology and similar general information applicable over the subject area of the standard.
  - The Z136.1 standard serves as a horizontal standard, and supplies the following information for all other standards in the series:
    1) exposure limit definitions and tables,
    2) hazard classification scheme,
    3) broadly-applicable control measures which are general to laser safety,
    4) glossary of terminology applicable in all Z136 standards,
    5) general guidance on education and medical surveillance, and
    6) examples which are applicable to items (1) - (3).
  - In order to address new applications and products, many horizontal standards also contain application-specific information.
  - Development of appropriate vertical standards allows the removal of application-specific information from the Z136.1 horizontal standard resulting in a standard more in line with the concept of a horizontal standard, i.e., containing only fundamental principles, concepts, definitions, terminology and other general information.
- Vertical Standard:
  - Application-specific areas should be addressed by vertical standards.
  - Vertical standards contain only information specific to particular applications or products in that subject area. While vertical standards are based on the horizontal standard, they expand upon the information in that standard for specific application areas. Each vertical standard should not include information extraneous to its intended application.
  - Application-specific vertical standards will refer to the Z136.1 horizontal standard for exposure limits, definitions and other items enumerated above. This will maintain standardization as the Z136.1 exposure limits, definitions and/or standard classification schemes evolve.
  - In order to maintain a hierarchy in exposure limit definitions and other information, any duplication of information (such as MPE table excerpts) from the Z136.1 should be placed in a non-normative appendix within a vertical standard.

2.1.3. Z136 Website

The Z136 website gives information for the scope of the SSCs and TSCs, which should correspond to what was approved for them. This is shown in Table 2-2 for some of the SSCs.

Table 2-2: Z136 Website Descriptions of SSC Scope

SSC	Scope
SSC-1	Develop a standard that provides guidance for the safe use of lasers and laser systems by defining laser hazard classes, control measures, requirements for a laser safety program, discussion of medical surveillance, defining important considerations of non-beam hazards. Some technical information on measurements, calculations and biological effects is provided within the standard and its appendices.
SSC-2	Develop standards that provide guidance for the safe use of LED and laser fiber optic and free-space systems that are specifically designed for use in telecommunications applications.
SSC-5	Develop a standard that provides guidance for the safe use of lasers and laser systems in the educational environment, specifically elementary through high schools, and institutions of higher education.
SSC-8	This standard provides recommendations for the safe use of lasers and laser systems in research, development and testing that operate at wavelengths between 0.18 micron and 1 millimeter.
SSC-9	This standard provides recommendations for the safe use of lasers and laser systems in manufacturing that operate at wavelengths between 0.18 micron and 1 millimeter.
SSC-10	This standard provides recommendations for the safe use of lasers and laser systems in entertainment, display and exhibitions that operate at wavelengths between 0.18 micron and 1 millimeter.

2.2. ASC 2015 Annual Meeting Discussion and Motion on Scope of Horizontal and Vertical Standards

The SSC-1 Chair's report [9, 10] noted that to develop the next Z136.1 revision, clarification was needed on whether vertical standards were to be "standalone" documents and made a motion for a vote on that. This prompted extensive discussion and the motion was modified. The modified motion was voted on and passed unanimously. It gives some guidance on the scope of Z136.1 and the vertical standards, but it does not directly address whether the vertical standards should be standalone documents. The motion states [11]:

"It is moved that:

- The Z136.1 shall direct that vertical standards shall reference the Z136.1 MPEs and shall not defer to the vertical standards guidance for exposure limits and related hazard evaluation
- If MPE definitions are included in vertical standards, they shall be contained in non-normative sections
- Vertical Standards shall reference MPE and hazard classification specifications from the Z136.1
- The Z136.1 shall contain at a minimum:
    - Exposure limit (MPE) definitions and guidance for their calculation
    - Hazard Evaluation and Classification
    - Broadly applicable Control Measures and Areas which are not covered by existing vertical standards
    - General guidance on education and medical surveillance
    - Broadly-used definitions applicable to all standards
- This shall apply to vertical standards at the time of approval of the CDV1 of the Z136.1"

2.3. Formation of SSC-8, SSC-9 and SSC-10 to Develop Z136.8, Z136.9, Z136.10

An ad-hoc committee formed at the 2005 ASC Annual Meeting [7] considered the need for additional vertical standards for laser applications, such as industrial processes, that may not be well addressed in the existing standards. The ad-hoc committee Chair presented the group's evaluation and recommendations at the 2006 ASC Annual Meeting [8]. That presentation described:

- Z136.1 has become too complex in an attempt to cover all applications, which leads to the lack of specific guidance in some applications and the resulting overly conservative requirements in other applications. A smaller Z136.1 and added vertical standards would alleviate the problem.
- A need for vertical standards was found to exist for laser applications in:
    - R&D and Testing
    - Manufacturing environment
    - Entertainment, display and exhibition
- New vertical standards would address user controls in the context of the application.
- After the new vertical standards were published, Z136.1 should be simplified but would include the following material, focusing on aspects that are universally applicable:
    - Definitions
    - Hazard evaluation and classification
    - Fundamental concepts of control measures, which include product safety standard requirements
    - MPEs
    - LSO and responsibilities
    - Applications that may not be covered in a vertical standard
- Advantages listed for the new vertical standards and simplified Z136.1 were:
    - Natural evolution for a mature technology
    - Greater flexibility to update and respond to new technologies
    - Greater speed in revision process by eliminating contentious debates over where a control is reasonable/unreasonable
    - Easier for a user who normally works in one technology application area
- Questions to resolve were:
    - Should Appendix B (calculation examples) be a new recommended practice or be folded into Z136.4? Do vertical standards include application-related examples?
    - Which appendices for general information should be retained in each standard?
    - Non-beam hazards: mostly industrial and medical, but are there general points? How should References be addressed?
    - What is reasonable timetable?

Following the 2006 ASC Annual Meeting, ballots were approved in August 2006 to establish SSC-8, SSC-9 and SSC-10 and to appoint the Chairs for these SSCs.

3. SCE Work Plan and Document References

The SCE work plan tasks and dates they were completed are summarized in Table 3-1. Document references provided to SCE Members are described in Sections 3.1, 3.2 and 3.3.

A Comment Matrix was used to gather input from SCE Members with each comment input including the following data fields:

- Submitter's name
- Relevant Standards
- Comment Type:
  - Eval: criteria to evaluate that affects whether consolidation would have a positive or negative impact
  - Pro: positive expected result from consolidating the identified standards
  - Con: negative expected result from consolidating the identified standards
- Comment with Rationale

Table 3-1: SCE Work Plan Tasks

	Task Description	Duration	Completion Date
1	Web meeting to discuss work plan		June 12
2	Post published or SCDV/CDV versions of Z136.1, .2, .5, .8, .9		June 21
3	Post info on sales of standards		June 25
4	Post working draft of Z136.10 (March 2019 version)		June 27
5	Collect input via comment matrix on pros/cons for consolidation	3 weeks	July 10
6	Tabulate comments and distribute/post.	3 weeks	July 27
7	Collect input, using a response comment form, so people can respond to the pros/cons that were submitted	3 weeks	August 23
8	Hold 2nd web meeting to discuss Eval items received		August 7
9	Post following documents to SCE website: • Planned revision work for Z136.9 (for current revision underway) • Planned revision work for Z136.5 (for subsequent revision beyond 2019 revision in progress) • ASC records for establishing .8, .9, .10 w/ associated SSCs + 2015 motion on scope for horizontal/vertical standards • Section Titles/Page Counts for different standards		August 7
10	Collect input from SSC Chairs on their views concerning issue of how vertical application standards use Z136.1 and whether a vertical standard can be a "standalone" document independent of Z136.1	2 weeks	August 22
11	Update/post tabulation of input comments to include "response comments" + input from SSC Chairs.	2 weeks	Sept 9
12	3rd web meeting to discuss input received and how to write report that will summarize and evaluate the pros/cons identified		Sept 26
13	Write draft report and distribute with a comment matrix	9 weeks	Dec 2
14	Collect comments on draft report	3 weeks	Dec 23
15	Address comments, update draft report + circulate comment matrix with responses	3 weeks	Dec 30
16	3rd web meeting to discuss finalizing report		Jan 10
17	Finalize draft report and submit to ADCOM	1 day	Jan 10
18	Address any ADCOM comments and submit final report to ASC	3 weeks	

Following an initial comment period, the comments were coalesced into a summary table. SCE Members were then given an opportunity to review the comments and respond to them. The comment matrix, including responses, is given in Appendix 1.

Input from SSC Chairs was requested on the following questions:

1. For the SSC-1 Chair,
    - Z136.1 (minimum) content is specified in the 2015 ASC motion given in the attachment (*see Section 2.2 in this document*). Regarding the vertical application standards, do you believe they should use the Z136.1 as a companion document where it would be referenced for its material as described in the 2015 ASC motion and so avoid unnecessary duplication of that material in their standard? Or do you believe the vertical standards can choose to be standalone documents where Z136.1 is not needed?
2. For the other SSC Chairs,
    - Z136.1 (minimum) content is specified in the 2015 ASC motion given in the attachment. Do you believe the vertical application standard your SSC is responsible for should use the Z136.1 as a companion document where it is referenced for its content, as described in the 2015 ASC motion, and avoid unnecessary duplication of that material? Or do you believe your SSC's associated vertical standard is a standalone document where Z136.1 is not needed?
    - Does the standard for which your SSC is responsible reference Z136.1 or another vertical application (and so avoid unnecessary duplication of that material) for the following topics:
        i. Hazard evaluation
        ii. Laser classification
        iii. MPEs and MPE criteria for exposures of eye and skin
        iv. Measurements
        v. Non-beam hazards
        vi. Outdoor laser applications

The SSC Chair comments were summarized (see Appendix 2) and distributed to all SCE Members and SSC Chairs.

3.1. Sales Data

It is not appropriate to consider pricing of standards as a consolidation criteria, but it is appropriate to consider sales volume for a goal of distributing standards to all users who would benefit from them. Table 3-2 presents sales data for each of the Z136 publications. The table shows that Z136.1 and Z136.3 have much larger sales than the other standards. For the published vertical standards considered by SCE (Z136.2, Z136.5, Z136.8 and Z136.9), their combined sales correspond to approximately 1/3 of the Z136.1 sales.

Table 3-2: Sales of Z136 Publications

Title	# Sold since publication	Years in circulation
ANSI Z136.1 (2014)	3873	5
ANSI Z136.2 (2012)	115	7
ANSI Z136.3 (2011)	2811	8
ANSI Z136.3 (2018)	288	1
ANSI Z136.4 (2010)	347	9
ANSI Z136.5 (2009)	307	10
ANSI Z136.6 (2015)	133	4
ANSI Z136.7 (2008)	197	10
ANSI Z136.8 (2011)	542	8
ANSI Z136.9 (2013)	373	6

3.2. Section Organization and Page Counts for Z136 Standards

Table 3-3: Comparing Section Organization and Title ('same' indicates same as Z136.1)

Z136.1 Section Title	Z136.2	Z136.5	Z136.8	Z136.9	Z136.10*
1. General	same	same	same	same	same
2. Acronyms and Definitions	Definitions	Definitions	same	Definitions	same
3. Hazard Evaluation and Classification	Hazard Classification	Laser and Laser System Hazard Classification	Hazard Evaluation	same	Hazard Evaluation and Risk Assessment
4. Control Measures	same	same	same	same	same
5. Education and Training	Safety and Training Programs	Laser Safety Programs and Student Training	same	same	same
6. Medical Examinations	Med Exams and Medical Surveillance	same	same	same	same
7. Non-Beam Hazards	same	Same	same	same	same
8. MPE Criteria for Exposures of Eye and Skin	Criteria for Exposure of the Eye and Skin	Criteria for Exposure of Eye and Skin	Not in standard	Criteria for Exposures of Eye and Skin	Criteria for Exposures of Eye and Skin
9. Measurements and Calculations	Measurements	Not in standard	Not in standard	Measurements	Measurements
10. Appendix A, Supplement to Section 1 – Laser Safety Programs	Not in standard	Not in standard	same	same	Not in standard
11. Appendix B, Calculations for Hazard Evaluation and Classification	Examples of Applications + Calculations	Not in standard	Not in standard	same	Not in standard

Table 3-4: Number of Pages in Normative Sections (Sections 1-9 + Appendix A, where applicable)

	Z136.1	Z136.2	Z136.5	Z136.8	Z136.9	Z136.10*
Sect 1-9 + App A	71	59	34	57	71	79
Section 4, Controls	25	20	12	28	29	37

*Z136.10 working draft

3.3. Other Reference Documents

The following documents were posted to the SCE website for SCE Members to consider when giving input via the Comment Matrix:

- Standards Roadmap Discussion at 2018 ASC Annual Meeting
- SCE motion at 2019 ASC Annual Meeting
- Z136.1 SCDV2, 2019
- Z136.2 CDV3, 2012
- Z136.5, CDV1, 2019
- Z136.8, SCDV3, 2018
- Z136.9, CDV3, 2013
- Z136.10 Working Draft, March 2019
- Z136.5 Planned Revision Work (for implementation in subsequent revision following expected publication of the next revision in 2020)
- Z136.9 Planned Revision Work
- D. Sliney memo with his views on consolidating vertical standards
- Standards' sales data (see Section 3.1)
- Standards' section organization and page counts (see Section 3.2)
- Summary of ASC document info on forming SSC-8, SSC-9 and SSC-10 (see Section 2.3)
- 2015 ASC motion on horizontal and vertical standards (see Section 2.2)

4. Summary of Input Comments from SCE Members and SSC Chairs

4.1. Summary of SCE Member Comments

The process for gathering this input is described in Section 3 and the complete set of comments is provided in Appendix 1. The input comments were organized into three categories:

- Eval: criteria to evaluate that affects whether consolidation would have a positive or negative impact
- Pro: positive expected result from consolidating the identified standards
- Con: negative expected result from consolidating the identified standards

Important issues identified for Eval, Pro and Con comments are listed below, where three additional sub-categories are also noted:

- Administrative
- Technical
- User

Administrative and technical issues affect the creators of the standards (ASC and its sub-committees), while technical and user issues affect the users of the standards. The "Pro" comments lean more towards technical issues, while "Con" comments lean more towards administrative issues.

1. Eval
    i. Administrative
        - How a consolidation process would work
        - Logistics of combining some standards; if doing this, may want to first combine just two standards and learn from that process
        - Limited sales of vertical standards
        - Efficiencies in standards development process should be improved; consolidation and additional or alternate steps can be considered

ii. Technical
- Goal of appropriate scope for horizontal and vertical standards (see Section 2 and Z136 Conventions [6]) has not been realized
- Scope descriptions for the standards and associated SSCs should be reviewed for possible updates
- Standalone versus companion documents.
  - when can a vertical standard be used as a standalone document without needing Z136.1?
  - when can a vertical standard be used with Z136.1 as a companion document?
  - when can Z136.1 be used without the need for a vertical standard?
- Extent of unique material in a vertical application standard and extent of material common with other standards
- Extent of material in Z136.1 that is not broadly applicable
- Use of lasers for current or emerging applications that may not be adequately described in the current standards

iii. User
- Identifying customers and being responsive to their needs
- Would consolidation positively or negatively impact ANSI's mission "to enhance both the global competitiveness of U.S. business and the U.S. quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems, and safeguarding their integrity"?

2. Pro

i. Administrative
- Reduce time and effort for creating, updating and reviewing standards
  - Z136 Members volunteer their time for standards work, so it is important to make that effort efficient and productive.
  - It takes too much time and effort to create a standard for a new application.
- Engage and cooperate across user communities

ii. Technical
- Reduce and improve a vertical standard's scope to better match description given in the Z136 Conventions (see Section 2.1.2).
  - Reduce duplication of content with Z136.1 and with other vertical standards
  - Some vertical standards contain information that is not application-specific, and that can be found in Z136.1 or in other vertical standards.
  - Encourage each user community to identify safety aspects unique to their application
- Reduce and improve the scope of Z136.1 to better match the description given in the Z136 Conventions (see Section 2.1.2).
- Z136.1 contains information that does not apply to all applications
- Normative sections in vertical standards are currently well-aligned with Z136.1 and with each other (see Section 3.2), facilitating a consolidation process
- Improve quality of vertical standards and Z136.1, in part by enabling more thorough reviews in SCDV and CDV process
- Improve consistency of definitions, terminology and requirements.
  - Some inconsistency is appropriate for different applications.
  - Inconsistency because of inadequate review or knowledge of other standards is not appropriate.

iii. User
- Single source of information covering multiple applications
- A combined application standard would get broader distribution and use, potentially reaching a sales volume comparable to Z136.1 or Z136.3

3. Con
   i. Administrative
   - Logistics of having a large subcommittee which has many sub-subcommittees responsible for the existing vertical standard user communities
   - Inputs from many application areas could make consensus more difficult, thus delaying the entire standard
   - Possibility of one sub-subcommittee for a particular application not being ready, thus delaying the entire standard
   - Reverting to the pre-vertical standard era
   - Process of eliminating the existing subcommittee structure and starting a new one
   - Loss of involvement by existing sub-committee members and/or more difficult to attract new members

   ii. Technical
   - Role and content of vertical standards still an unsettled question
   - Lack of specificity for each application and user community

   iii. User
   - Long length of a combined application standard can make it more difficult to find information relevant to a specific application

4.2. Summary of SSC Chair Comments

The process for gathering this input is described in Section 3 and the complete set of comments is provided in Appendix 2. The SSC Chairs were asked to provide input on:

i. whether and how a vertical application standard should be used as standalone document where Z136.1 is not needed, and
ii. how a vertical application standard should use and reference Z136.1 as a companion document

A short summary of the SSC Chair input is provided in Table 4-1.

Table 4-1: SSC Chair Input to SCE (Summary)

SSC	SSC Chair Comments

1	• MPEs, classification, and hazard evaluation belong in Z136.1
	  o If users don't perform related calculations, they may not need Z136.1
	  o If users perform calculations requiring this, they should use Z136.1
	• Duplication of material
	  o should be minimized to avoid conflict
	  o where duplication exists, need clarity for which standard takes precedence

2	• Z136.1 is a needed reference for MPEs and quite possibly on classification • Should not need multiple references to Z136.1 within Z136.2 • Z136.2 tries to use consistent meanings for access and controlled area concepts • Important to use consistent language where possible
3	• Little logic in a "one size fits all concept"; there is a user audience that would prefer to have one document • Z136.1 should serve as base; Z136.3 is somewhere in middle as to when it can be used as a standalone document • Some duplication of content with Z136.1 is reasonable. Taking out content in Z136.2 to force procurement of Z136.1 can reduce value of Z136.2
5	• 2020 revision of Z136.5 is designed to be standalone for most situations • Z136.1 is referred to for some areas, but Z136.5 also provides other references

6	• Z136.6 has a wide variety of potential users
	  o many may find value in having both Z136.1 and Z136.6
	  o strive to minimize number of people who need both
	  o for users with certain specific applications, Z136.6 can suffice
	  o users doing a complete hazard evaluation, probably need both
	• Duplication ok if clear which document takes precedence

8	• Z136.1 is needed for MPEs. SSC-8 believes its community needs Z136.1 for this, though people who use commercial calculation software may not use Z136.1. • SSC-8 has a split opinion on duplicating material in Z136.1 • Users of Z136.8 would not use Z136.1 except when needed for the required references • Z136.1 is needed for the classification process, MPEs and qualitative hazard calculation methods.
9	• Z136.9 should use Z136.1 as a "companion document" where Z136.1 is referenced appropriately. Users should not need Z136.1 unless it needs to be used for the specific references • Unnecessary duplication should be avoided

10	• Z136.x references in the working draft for Z136.10:
	  o Unclassified lasers: user is first referred to the laser product standards CDRH 1040.10 & IEC 60825-1, and second to Z136.1 and Z136.4
	  o For MPEs, measurements or calculation methods Z136.1 and Z136.4 are referenced.
	  o For outdoor laser use, Z136.6 is needed.
	• Many laser light show operators and people exhibiting a laser at a trade show should be able to use Z136.10 without need for Z136.1

5. Summary and Recommendations

The SCE sub-group evaluated a possible consolidation for some or all of the vertical standards Z136.2, Z136.5, Z136.8, Z136.9 and the planned Z136.10 (not yet published). The evaluation criteria considered and the pros and cons for consolidation identified by SCE Members were presented. Input from SSC Chairs was also presented for their views on whether a vertical standard can be a standalone document and on how a vertical standard should use and reference Z136.1.

A summary of the input from SCE Members and SSC Chairs is given in Section 4, while their detailed comments can be found in Appendix 1 and Appendix 2.

Many issues were discussed as part of the evaluation effort, and we have the following four recommendations for ASC to help improve the standards and their development process:

1. Review and clarify appropriate scopes for each horizontal and vertical standard and their associated SSCs.
2. Clarify whether and under what circumstances verticals can be standalone and how they should use and reference Z136.1 and other vertical standards.
3. Emphasize the need for each horizontal and vertical standard to achieve appropriate scope as described in the Z136 Conventions.
4. Identify opportunities for improving the efficiency and effectiveness of the standards development process, which aims to produce high quality laser safety standards for many different laser applications. Requirements in the standards should be clear, concise and effective – and they should be consistent, where applicable, between the different applications.

The SCE sub-group offers this evaluation report to ASC for their consideration on the merits for or against any consolidation.

6. References

1. ASC 2019 Annual Meeting draft Minutes, March 2019.
2. ASC 2019 Annual Meeting presentation slides, March 2019.
3. ASC 2018 Annual Meeting Minutes, March 2019.
4. ASC 2018 Annual Meeting presentation slides, March 2018.
5. Z136 Procedures, February 2018.
6. Z136 Conventions, August 2019
7. ASC 2005 Annual Meeting Minutes, March 2005.
8. ASC 2006 Annual Meeting Minutes and Presentation Slides, March 2006.
9. ASC 2015 Annual Meeting presentation slides, March 2015.
10. ASC 2015 Annual Meeting minutes, March 2015.
11. ASC 2015 Motion on Horizontal and Vertical Standards, March 2015.

Appendix 1: Comment Matrix from SCE Members

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
1	M. Woods	All listed	Eval	Possible concept for implementing the consolidation: • Title, "Safe Use of Lasers for Specific Applications" or "Safe Use of Lasers for Specific Applications, including Optical System Communications, Educational Facilities, R&D and Testing, Manufacturing and Entertainment" (or if just some of the standards get combined, could be for example "Safe Use of Lasers for Specific Applications, including Educational Facilities, R&D and Manufacturing") • Current SSCs for a vertical application standard would become TSCs, each responsible for their application's content in the new standard • A new SSC would need to be formed with overall responsibility for the standard. • ASC ballot needed for the new standard and associated changes to affected SSCs. • Have a similar table-of-contents structure as for Z136.1, but have additional sections for each application. Then application sections have sub-sections noting application-specific content in each of the areas (hazard eval, control measures, education and training etc.) • Start by picking 2-3 applications to consolidate and evaluate later whether to further consolidate. (Would likely want to delay consideration for Z136.10 consolidation until it's completed its first publication.) • Goal to revise standard every 5-7 years (rather than every 7-10 years). Don't need revised content for all applications covered, just those that are ready.
	R. Paura Response			*Response to Comment 1:* • Stated here, is the revision time of a standard. If it is a matter of vertical standard development time, would ask that SCE first consider ANSI recommendations for SDO efficiency. To neglect this considered advice, researched and based upon best practices within ANSI and other SDOs indicates to the Z136 membership that something else is driving this SCE effort. If so, members should be informed. • One element for improving our efficiency, not noted in the ANSI recommendations, but practiced by other SDOs, is use of affirmation process and the use of a FASTT track team. FASTT tracking is essentially a content "brush up" to quickly update a standard within short time frame. Reference ANSI and notes provided. • End customer needs are not included in this comment for implementing consolidation. Does consolidation fulfill the ANSI purpose and mission statement? o Purpose: "...empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment."

				○ Mission: "To enhance both the global competitiveness of U.S. business and the U.S. quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems, and safeguarding their integrity."
	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
2	LIA: Lily	All	Eval	It appears to me that to combine standards procedurally, there would have to be approval by the majority of the full Committee for the dissolution of certain subgroups and creation of a new subgroup with a new scope. From ANSI's side, I believe we'd submit the same paperwork as usual, with the PINS and BSR-8 indicating that the project intent is to 'revise, redesignate, and consolidate' standards. The purpose of these two actions is to initiate a public review period for the project; typically, we have not received comments from the public; however, I would not be surprised if we did receive public comments about consolidation. Comments received during the public review period must be addressed like we would if we received comments during a ballot.
3	J. Casson	All	Eval	I skimmed through all the standards listed above to see what information was duplicated and how much of the standard was specific information on the special topic. I found that the .2 and .10 contained considerable amount of information on OFCS and Entertainment, respectively. The .5, .8, and .9 were mostly information that was duplicated, if not taken verbatim, from .1. Only a small amount was specific to the topic.
4	T. Early	All	Eval	Given the existing duplication of the vertical standards with Z136.1, consolidation ultimately depends upon progress on making the identified standards truly vertical. Once general information is removed, only issues specific to the scope should remain.
5	T. Early	All	Eval	Recommend vertical standards be revised based on Z136.1, then evaluate consolidation. Recommend SSCs then concentrate on issues specific to their application.
6	T. Early	All	Eval	Control Measures seems to be an obvious section to differentiate between vertical standards. The traditional discussion of these measures, in Z136.1, expresses them in terms of the hierarchy of engineering, administrative, and personal protective equipment. Tables 10 and 11 in Z136.1 are excellent for summarizing the relationship between laser Class and control measure. However, the vertical standards, for example Z136.5 and Z136.10, also discuss control measures in terms of the category of person potentially exposed. For example, grade school students are a much different category than technicians in an R&D environment. I think another hierarchy, or flow chart, in terms of category of person would be very helpful to highlight unique aspects of each vertical standard.
7	B. Edwards	All listed	Eval	Review content of each vertical standard's key sections and determine how much is duplication of the corresponding dot 1 section, and how much is unique or original to each vertical dot. This would give an estimate of the volume of unique material in each vertical dot, which in turn could inform a discussion on the merits of consolidating (if there wasn't much original material) or leaving the verticals as separate (if there was a lot of really unique material).

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
8	LIA: Gus & Lily	Z136.5 & Z136.8	Eval	These standards might go well together. High schools aren't buying the dot 5, colleges are, and there's R&D happening at colleges. Of course, dot 5 wouldn't apply to R&D environments that are not in educational institutions. Both standards will have revisions published soon and when those revisions have been published these SSCs will both be seeking new chairs. If combined, we would only need one chair. Both standards would be restarting the revision process around the same time anyway.
9	LIA: Gus	Z136.1 & Z136.4	Eval	There are some calculations and topics explained well in dot 4 that would complement dot 1, if combined.
	M. Woods Response			*Response Comment* Possible consolidation of Z136.4 with another standard is outside the scope of the charge to SCE.
10	LIA: Gus	Z136.2, Z136.3, Z136.6, Z136.7	Eval	The following vertical standards would not make sense to consolidate and are better as standalone standards: Z136.2, Z136.3, Z136.6, Z136.7
	M. Woods Response			*Response Comment* Possible consolidation of Z136.3, Z136.6 and Z136.7 with another standard is outside the scope of the charge to SCE. Also, Z136.7 is not a vertical application standard but rather is a best practice document.
11	LIA: Lily, Gus, Nat	All	Eval	With the challenge of developing consensus among subgroups that may not be able to agree, it might be more prudent to experiment with combining just two standards and learning from the experience; for example, combining Z136.5 with Z136.8.
12	R. McHatton	Z136.2	Eval	Need more information to comment. Inclined to recommend we combine if sub-committee members are shared – thus complying to joint working group recommendation
13	R. McHatton	Z136.9	Eval	Need more information to comment. Inclined to recommend we combine if sub-committee members are shared – thus complying to joint working group recommendation
14	R. McHatton	All	Eval	Success would rely on active strong leadership between chairpersons who communicate clearly to each other and to their sub-committee members on shared responsibilities

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**

15	R. Paura	All	Eval	Would recommend that this SCE directive be reframed for a more constructive objective that benefits all:
				• Identification by respective SSCs of their hindrances and roadblocks to efficiently producing a document – actually charted through the Z136 development process, including TSCs and EWG
				  ○ No different than a project gap analysis at an organization and resource loading
				• Clear identification of the mission for each SSC in addressing the needs and wants of their market segment to fulfill Z136 and ANSI mission statements
				• Identification/proposal of the desired final product (a table of contents) by each SSC
				• Gap analysis and suggestions to the Secretariat regarding meeting market segment and customer needs by each SSC. A collaborative approach, not dictatorial.
				• A public forum for market segment feedback on each vertical. This raises awareness and garners valuable input from the stakeholders themselves, directly.
				  ○ E.g. Respective State Departments of Labor on Z136.9

	M. Woods Response			*Response Comment* What's described is not within scope of SCE's charge and would need to be addressed separately.
16	R. Paura	All	Eval	ANSI has addressed the matter of effort requirements versus results produced for its SDOs. See attached documents regarding ANSI recommendations and drafted matrix for efficiency improvements with Z136 activities.
17	R. Paura	All	Eval	See www.standardslearn.org Core skills of key personnel needs to be developed within Z136
18	R. Paura	All	Eval	This is a volunteer effort. If our Z136 process is over-burdened, then additional contributing members need to be cultivated and retained (with less free loaders) or those that feel they are over-worked need to be coached back down from over-volunteering.
19	D. Sliney	Z136.2	Eval	ANSI Z136.2 was the first vertical standard issued as I recall in the early 1980s, since OFCS are Class 1, but there was a need for many highly specialized requirements for servicing, etc. The hazard is always highly localized where an open fiber exists. Free-space transmission has highly specific environmental requirements, installation, etc. and a number of figures are used to illustrate them. It took too many paragraphs in dot one before it was split out. Since it is the only standard that has to focus on Class 1 systems it is highly specialized and few controls are the same as other applications. It should be retained as a separate standard, despite the fact that it has not had traditionally a large number of sales. Most telecommunications companies have one, but they are not a dime-a-dozen. It is currently being reviewed for update, although the reviewers see little need for changing hardly anything other than a reference to some IEC and ITU standards. Summary – Highly specialized.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
20	D. Sliney	Z136.3	Eval.	This has a powerful lobby in the Z136 ASC and are too powerful to confront.
	M. Woods Response			*Response Comment* Possible consolidation of Z136.3 with another standard is not in scope of the charge to SCE.
21	D. Sliney	Z136.5	Eval.	ANSI Z136.5 exists because of a very specific set of users – teachers in vocational schools, junior colleges and training institutes and possibly high-school physics teachers. It deserves to be cheaper than past pricing because of this customer base. It almost uniquely deals with a largely untrained users or observers who must be under the control of a teacher. So its philosophy and approach needs to be different from other applications, where for example we require all users to be trained, etc. etc. It should be retained as an independent standard and made more readily available.
22	D. Sliney	Z136.6	Eval.	As a standard used for outdoor environments it approach, rationale and clientele are different from other vertical standards. It needs to be retained as a separate standard since outdoor range controls and the like must differ from indoor controls. That has always stood as a general rule in the Z136 Community.
	M. Woods Response			*Response Comment* Possible consolidation of Z136.6 with another standard is not in scope of the charge to SCE.
23	D. Sliney	Z136.7	Eval.	This is a unique standard since it really has no control measures and is not application specific at all, but is needed for the Z136 user community to give USER technical requirements for wearers, LSOs and eveen manufacturers that differ from EN standards that were created by test houses and European manufacturers without consultation (and often disagreeing with) the laser user community. We need a US-centric standard.
	M. Woods Response			*Response Comment* Possible consolidation of Z136.7 with another standard is not in scope of the charge to SCE.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
24	D. Sliney	Z136.8	Eval.	This standard was intended to take most of the control measures and ancillary hazards information that have been in the earliest Z136.1 editions of the 1970s, when almost all applications were in the laboratory research settings. It deserves to be separate, because this is where accidents occur because of open-beams that are infrequent in manufacturing and some other areas. The users have to be diplomatically approached to have an effective program because they are convinced they know more than the LSO. University environments are quite different, and aside from a few government labs with substantial safety budgets, the LSO in most labs has to reason with the user. My only concern is that added forms and the like are increasing page costs; and to keep costs down such potentially useful items should be in books and the like since they really cannot be standardized. It should not be combined!
	M. Woods Response			*Response Comment* Not appropriate for Z136 to consider cost. But is appropriate to consider what relevant content is and relative importance of informative appendices for inclusion in the standard.
25	D. Sliney	Z136.9	Eval.	This is the one standard that deals with high-power units that are most frequently in special enclosures and part of other installed equipment. It is a needed interface with some manufacturer standards (e.g., IEC, ISO and other ANSI standards) and where the primary aim is to establish Class 1 conditions. It has to deal with adequate shielding, special servicing and a changing labor force that is not encountered with the other standards. It should not be combined with others; it is the belle of the laser material-processing community.
26	D. Sliney	Z136.10	Eval.	This standard – by its very nature of taking longer than any application-specific standard in history – must remain independent. It has its own clientele; its own special CDRH requirements not found for any other applications and it deals with potential public exposures. Few controls can be expressed in the same manner as with other applications.
20-26	*R. Paura Response*	All	Eval	*Response to Comments 20-26:* • Concur
27	R. J. Thomas	Z136.5	Eval	Consider addressing broader educational environments
28	R. J. Thomas	Z136.2, .6	Eval	Is this common with industrial application environment in scope, further consolidation with Z136.9 and Free Space Communications to Z136.6.
29	R. J. Thomas	Z136.8	Eval	Consider parsing into separate sections, based upon use cases: Laser Research vs Use of Laser as a Tool for Research.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
30	M. Woods	All listed	Eval	Philosophy for Horizontal and Vertical Standards. • Many of the vertical standards are being written with the intention of being standalone documents not dependent on Z136.1. Thus they duplicate much of the material in the .1 that is not application specific. • We should evaluate the historical evolution of the philosophy for horizontal and vertical standards + how well or not it's articulated and communicated, for example in the Procedures and Conventions. + there was a 2015 ASC motion that passed related to this, though it didn't address whether the verticals were to be "standalone" We should also evaluate how the vertical standards reference Z136.1 and to what extent they use .1 as a companion document or generally ignore it and try to be a standalone document.
31	M. Woods	All listed	Eval	Sales data. • How useful and needed are the different standards? • What is the most effective way to convey information in the standards to users for different applications? • Do other standards (such as IEC) better serve the users? • Is the time and effort by LIA and Z136 members commensurate with benefit to users provided by producing each standard?
	R. Paura Response			*Response to Comment 31:* • Must ask why Z136.6 is absent from this examination if sales is a factor for consolidation. If it because Z136.6 is distinct and unique, then the proposed directions of Z136.9 and Z136.5 address the concern of duplication of Z136.1 core content. • Market review of LSO classes shows that industrial LSO classes are the most popular next to medical. What is interesting is that only one organization provides the Z136.9 standard with their industrial LSO classes. The market demand is there for Z136.9.
32	M. Woods	All listed	Eval	Evaluating normative parts of vertical standards • How consistent is organization for sections between standards? • How many pages of content duplicate what's covered in Z136.1? • How many pages of content duplicate what's covered in other vertical applications standards? • How many pages have content specific to the vertical application?

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
33	M. Woods	All listed	Eval	Informative appendices: • How much overlap is there between standards for topics covered and content? • What is relative importance of informative appendices wrt normative part of standard?
34	M. Woods	All listed	Eval	Consolidation could: • make it easier to meet 5-yr revision goal and then also easier to avoid withdrawing standards that aren't revised/reaffirmed within 10yr limit. • make it easier to have more meaningful content updates between revisions. • reduce time pressure since if an application does not complete its expected update the next revision would be only 5 years away
35	J. Casson	All	Con	One combined standard might be bulky depending on the consolidation. Cost might make the document unaffordable for some.
	M. Woods Response			*Response Comment* Not appropriate for Z136 to consider cost. But is appropriate to consider what relevant content is and how best to get the standards used effectively.
36	J. Casson	All	Con	Revisions of the combined standards might be complicated, since there would be no one group of people with expertise in all the topics. It might mean having subgroups working on each of the different topics and then one oversight group whose job would be to read through the whole standard to ensure that the writing and tone was consistent throughout. Doing a combined 5/8/9 and keeping 2 and 10 separate might make the revision task easier.
	R. Paura Response			*Response to Comment 36:* Each vertical has a market segment with different operating environments where lasers can be employed.
37	T. Early	All	Con	There is a wide variety of duplication with Z136.1 - Most definitions are duplications. In Z136.5, Z136.9, and Z136.10, 75 % of the definitions were duplicates of those in Z136.1 - Z136.9 is primarily a repeat of Z136.1, while Z136.10 has information specific to its scope
38	T. Early	All	Con	As a physicist I like to start with general concepts and end with specific examples applying those concepts. I recognize the physicist approach is not typical, and users of the standards need immediate, practical advice.
39	R. Fairchild	All	Con	If we are streamlining, why not simply add chapters to Z136.1, make is an all encompassing standard.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
40	R. Fairchild	All	Con	Having the subject areas as chapters in a single standard may result in delays in getting the standard updated and approved. For example, If research and development contributors are all in agreement, but the fiber optic contributors are not, then the whole process could stall, because not enough passing votes are obtained. Likewise, if enough overall votes are obtained from those chapters that are in agreement and their information is ready, this could result in information in one or more chapters getting published where the contributors to those chapters have no concensus. Thus, having individual standards for each application area would allow for more efficient review and updating of the individual standard.
41	LIA: Gus	All	Con	Before we had vertical standards, all of the standards were combined in the Z136.1; we then decided to break them out into their own vertical standards. If we combine everything, it's like we're going back in time to re-creating the original dot 1. Then we'll have what is basically the original dot 1, and also the new dot 1 that is just a reference…
42	LIA: Lily	All	Con	The various SSCs have their own internal cultures and values concerning their standards, so developing consensus could be very time consuming, easily taking more than ten years with a great deal of time spent developing the new SCD, then multiple rounds of balloting and resolving comments, leading to many standards being withdrawn due to age.
43	T. Lieb	Z136.9	Con	• We have a substantial case that our new standard (next Z136.9 revision) is of benefit beyond what is offered to our user community by dot 1, and the information is not readily adapted to integration with other formats. • Re-combination is not a desirable result for the manufacturing community, but more effective marketing of the standard does have potential of increasing revenue
	M. Woods Response			*Response Comment* It's not appropriate for Z136 to consider increased revenue for LIA. But increased sales to get the standards used effectively is an appropriate consideration.
44	R. McHatton	All	Con	Create confusion, difficult to coordinate joint goals (such as shared publication deadlines).
45	R. Paura	All	Con	Consolidation is contrary to the mission statement of ANSI *"To enhance both the global competitiveness of U.S. business and the U.S. quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems, and safeguarding their integrity."* Lasers are an enabling technology: they are increasingly being adopted in all sectors of the economy. Respective of that, appropriate verticals from Z136 are required to address this growth and need for safety.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
46	R. Paura	Z136.9 and Z136.8	Con	These two sectors have different approaches and philosophies towards safety principles, reflecting their work environments. For manufacturing, greater emphasis is placed upon engineering controls and keeping human decision making out of the safety equation, with PPE only as a last line of defense. Conversely, R&D tends to be very dynamic and non-repetitive in their work, necessitating greater flexibility in their safety options, with greater access to PPE in the hierarchy of safety control measures. Both sectors are best served with a stand-alone document, that holistically spells out safe use of laser for their distinct and unique work environments. To incorporate into one document, would require continually attempting to clarify, delineate and explain the apparent dichotomy of approaches to safety in that document.
47	F. Seeber	.Z136.5	Con	During the 1990s at the annual ANSI Z136 meetings comments were made about the fact that educators from high school to college who were using lasers were not able to use the Z136 .1 standard mainly because of lack of technical backgrounds. Hence the birth of the Z136.5 for Educational Institutions. Not much has changed today. The .5 is written and organized to accommodate educators. A chapter in a combined standard or document is not acceptable. The .5 is different than the other dots because of the reason stated above. I do not endorse consolidating the .5 into a combined standard or document.
48	R. J. Thomas	Z136.2, .5, .8, .9, .10, .X	Con	Larger content/scope will lengthen timeline for revisions.
40-48	*R. Paura Response*	All	Con	*Response to Comments 40-48* • Concur
49	M. Woods	All listed	Con	Significant change in scope and approach to vertical standards, so a lot of logistics to address
50	J. Casson	5/8/9	Pro	Consolidation would eliminate a lot of the duplication in the acronyms, definitions, controls, training, alignment, LSO duties, medical exams, non-beam hazards, signage, and many of the appendices and tables which are taken straight from .1. The topic specific items from the three could be consolidated into one document with reference to .1.
51	J. Casson	5/8/9	Pro	If cost of the combined publication was kept on par with what the current publications are selling for, it is likely that more copies of the combined publication would be sold
	M. Woods Response			*Response Comment* It's not appropriate for Z136 to consider publication. But increasing the distribution of relevant standards so they are effectively used is an appropriate consideration.
52	J. Casson	All	Pro	Combining all the standards would mean people would only need to buy two standards (.1 + new one) and have fewer reference books to look through and might learn about the other standards.
53	T. Early	All	Pro	Vertical standards have parallel structures for the normative sections, which favors comparisons and consolidations

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
54	T. Early	All	Pro	As a physicist, I am pre-disposed to consolidation. I like to start with general concepts and end with specific examples applying those concepts
55	T. Early	All	Pro	Politically, there is value in the individual vertical standards to encourage participation by the practitioners of those sectors
56	R. Fairchild	All	Pro	Having a supplemental standard to Z136.1, where .1 is the horizontal standard and the supplemental standard consists of various chapters of application specific information currently published as individual standards, would be very useful over the current process of having individual publications for each application. This would allow individuals who need to obtain application specific guidance to obtain guidance from multiple subject areas in one publication. This is a benefit to LSOs who support more than one application.
57	R. Fairchild	All	Pro	Theoretically reduced acquisition cost for those LSOs who support more than one application area (i.e. research and development and education).
	M. Woods Response			*Response Comment* Not appropriate for Z136 to consider publication cost. But increasing the distribution of relevant standards so they are effectively used is an appropriate consideration.
58	J. King	.2/.5/.8/.9/.X	Pro	By combining all of these into one document, you eliminate duplicitous text across all.
59	J. King	.2/.5/.8/.9/.X	Pro	Being on the ASC and reviewing all of these, I see new terminology being created by each group.
60	J. King	.2/.5/.8/.9/.X	Pro	Each group is interpreting and rewriting the .1 into their own standard as they see fit.
61	J. King	.2/.5/.8/.9/.X	Pro	The time that is spent in reviewing each of these would be reduced considerably
62	R. McHatton	.10 and Proposed LIP	Pro	Have 1 standard for at least both of these applications with separate chapters, scopes, and unique definitions as needed. It might be appropriate to add educational applications to this publication. I would need to hear more
63	R. McHatton	.10 and Proposed LIP	Pro	Per recommendations for efficient standards we are tasked for form “joint” working groups. Many of the same volunteer sub-committee members would develop the standard for LIP so would be more efficient use of volunteer time.
64	R. McHatton	.10 and Proposed LIP	Pro	The .10 ‘audience’ is similar to the LIP audience even though some of the control measures may be different. Many of the same people would need both standards in entertainment industry.
65	R. McHatton	.2, .5, .8, .9 and .10 and LIP	Pro	Combining all of these might be more efficient for all those involved. Doing so offers opportunity to eliminate duplicating work, encourages engagement and cooperation across disciplines, maximizes use of resources. Critical to success would be if joint projects clearly delineate responsibilities, establish quality project tracking mechanism.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
66	R. McHatton	All	Pro	To eliminate duplicate information, ensure outreach across applications, encourage shared clear 'common' language terminology
67	R. J. Thomas	Z136.2, 5, 8, 9, 10	Pro	Standards could be representative of control measures and laser safety programs in specific use cases that are non-medical. The document would emphasize laser safety program definitions, and contain much common material. Bringing the standards down to one vs 5 should bring adoption of the document up to a level comparable to the Z136.3, which I believe is a very specific use case with less commonality to these other documents. Recommend creating sections which are basically the titles of the current standards and encapsulating what is different in each environment with the remainder of the sections having common materials for programs, not represented in the Z136.1
68	R. J. Thomas	Z136.1	Pro	Reduce document to exposure limit definitions and classification scheme, and defer to a new Z136.2 that is the consolidation of the .2, .5, .8, .9, .10 and any additional.
69	R. J. Thomas	Z136.1	Pro	Reduction of content in Z136.1 will permit a review and update with a more narrow agenda and more quickly incorporate latest research relevant to setting exposure limits
70	M. Woods	All listed	Pro	Consolidation would improve thoroughness of SCDV and CDV reviews, which will improve quality of standards.
71	M. Woods	All listed	Pro	Consolidation would improve efficiency and reduce time required for review by SSCs, TSCs, EWG and ASC + especially for people who are members on multiple committees. A large management effort by LIA and ADCOM and a lot of additional coordination are required by ASC, its sub-committees and their member volunteers. Some consequences reflecting management, efficiency and time pressures include: • Currently the .5 and .7 are withdrawn due to 10-yr limit and the .4 will likely get withdrawn for same reason in 2020. • The .2 has previously been withdrawn for an extended period and its 10yr limit will expire in 2022, likely requiring it to be either withdrawn again or just reaffirmed with no opportunity to update the content until a subsequent revision • 13 years after SSC-10 was formed there's still no Z136.10 standard. Difficult to accommodate new applications if have to create a new vertical standard (e.g., LIPs)
72	M. Woods	All listed	Pro	Consolidation would improve consistency and completeness for acronyms, abbreviations, definitions and terminology. For example • should decide on LEP or LPE and be consistent in all standards • can't have should or shall requirements in a definition where common definitions are used, the vertical standard(s) should use .1 definition if available

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
73	M. Woods	All listed	Pro	Consolidation would improve consistency for use of informational notes • need to explicitly describe they are given for information only and do not contain requirements needed to implement the standard. • can't contain should or shall requirements
74	M. Woods	All listed	Pro	Consolidation would help reduce or eliminate redundant information. For example: • Control Measure section on laser use outdoors should only reference Z136.6 (as is done in Z136.1 and Z136.9, but this is not done in Z136.5 or Z136.8) • Z136.9 normative sections largely duplicate exactly what's in Z136.1
75	M. Woods	All listed	Pro	Consolidation would improve consistency and completeness of requirements. For example: • regarding when LPE/LEP is required the following .1 requirement needs to be referenced or duplicated in each vertical standard. "Eye protection devices which are specifically designed for protection against radiation from Class 3B and Class 4 lasers or laser systems shall be administratively required within the NHZ and their use enforced when engineering and other administrative and procedural controls are inadequate to eliminate potential exposure in excess of the applicable MPE." • Classification by LSO is inconsistent between .1 and .8. Need to use .1 (Z136.8 mistakenly references CDRH manufacturer regulation rather than Z136.1 which is relevant for laser use).
76	M. Woods	All listed	Pro	Consolidation would make it easier to leverage good input across applications. For example, the .8 SOP requirement should be adopted in all the standards, o Z136.8 states that Class 3B lasers shall have an SOP, o this is only a "should" requirement in Z136.5, Z136.9 and Z136.1.
77	M. Woods	.2, .5, .8, .9	Pro	Consolidation would help identify items with applicability across multiple applications and help ensure a consistent approach. For example: • Fiber use is common for delivering beam from pump or seed lasers to amplifiers. It's also used for beam transport between laser tables or between LCAs.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
78	M. Woods	All listed	Pro	Consolidation should improve clarity for scope of the horizontal .1 standard compared to a vertical application standard. • These should be companion documents with minimal overlap. The .1 should be referenced where applicable. Where there is overlap/duplication for clarity or emphasis, then the vertical application should adopt exactly the .1 statements/requirements. For example: • the .1 should be referenced for determining MPEs, laser eyewear OD calculations and for laser classification.
79	M. Woods	All listed	Pro	User organizations may have laser operations that span multiple applications and so would be much more efficient to have these described in a single document. For example, at a university: • Educational setting for classes and teaching labs, Z136.5 content applicable • Research labs, Z136.8 content applicable • Research and applications using industrial lasers for machining, welding, additive manufacturing; Z136.9 content/scope applicable • + can have applications where Z136.2 and Z136.10 content/scope are applicable For example, at a high school • Many now have industrial lasers in shops that students use for cutting, welding and 3D printing applications. Not addressed in the Z136.5 standard.
80	M. Woods	All listed	Pro	Other applications may be outside scope of a vertical standard or have scope that span multiple standards. A new applications standard would more easily be able to incorporate descriptions for these. Applications not covered in existing standards include: • Laser demonstrations involving the general public: a control measures section was included in Z136.1-2000 but was removed in subsequent revisions anticipating that Z136.10 would address this. But Z136.10 won't be published before 2021. • Laser illuminated projectors. Would be easier to incorporate into an existing standard than to develop a new one. • Construction use of Class 3B and Class 4 lasers • Hobbyists using Class 3B and Class 4 lasers for cutting, welding, marking, additive manufacturing
R1	*R. Paura Response*	All	Eval	*Response to all Comments submitted*: Z136 is in transition to the horizontal and vertical arrangement, the process is not complete. Understanding is that the Dot1 gestation to a true horizontal will be achieved in next revision cycle, not this current one. This would allow for the subject verticals to mature.

	Submitted by [Name]	**Relevant Standards**	**Comment Type [Pro/Con/Eval]**	**Comment with Rationale**
R2	*T. Early Response*	All	Con	*Response Comment* Having just reviewed CDV1 of Z136.8, and performed more cursory reviews of the other standards considered for consolidation, I think our efforts should be directed at making these standards truly vertical before tackling consolidation. There is still much to do to make the existing standards vertical, in my opinion meaning removing information already contained in Z136.1 and emphasizing those aspects unique to the application. Z136.2 and Z136.10 have much information specific to their applications, Z136.5 is somewhere in the middle, and Z136.8 and Z136.9 have almost no normative information that is not in Z136.1.
R3	*T. Early Response*	All	Con	*Response Comment* Several sub-group members commented on having greater consistency between standards. This seems to be an issue for the standard subcommittee chairs to address, as well as the technical subcommittees.
R4	*T. Early Response*	All	Con	*Response Comment* I am still thinking including control measures in vertical standards specific to the potential exposees would be beneficial to emphasize the unique aspects covered by each standard. For example, how laser technicians are protected is different than for high school students, which is different than concert goers. The cross-referencing between laser class and control measure is excellent, but could be extended to include potential exposee.
R5	*M. Woods Response*	All listed	Eval	*Response Comment* There is currently good consistency for Section Titles and how they are organized in Z136.1/.2/.5/.8/.9 (+ future .10 working draft). • The documents posted for planned revision work for Z136.5 and Z136.9 have some significant deviations for the Sections titles and organization. This could complicate the review process and affect how consistent similar requirements are between applications.
R6	*M. Woods Response*	All listed	Eval	*Response Comment* Page counts in normative Sections 1-9 + Appendix A (where applicable) vary from 34 in Z136.5 to 79 in Z136.10 (Z136.1 is 71). For Control Measures Section 4, page counts vary from 12 for Z136.5 to 37 for Z136.10 (Z136.1 is 25). • There is a limited amount of unique material in Z136.5, so would not be difficult to combine it with another standard. • More evaluation is needed on amount of unique material to each application.

Appendix 2: Comments from SSC Chairs

SSC	SSC Chair	Response
1	S. Zimmerman	• I still think that the unanimous agreement was that MPEs, classification, and hazard evaluation belong in the dot 1 because a laser is a laser is a laser. If users of the vertical standards are not doing any of those sorts of calculations, then they might not need the dot 1, thereby making the vertical a standalone document from their perspective and for their use. But if they are doing those calculations, then they should have the dot 1 to have the most current and correct MPEs, etc. and they will remain companion documents. • I do still strongly believe that duplication of material should be minimized to avoid conflict, but if there is going to be duplication of material, it must be absolutely clear which standard takes precedence. Where we run into issues – dot 1 says "Other special vertical application standards within the Z136 series may deviate from the requirements of this standard. Each deviation is valid only for applications within the scope of the standard in which it appears. Guidance in vertical standards that appears to conflict with the requirements of this standard shall have precedence within the scope of that standard." But then if a vertical says "dot 1 rules" on some matter, we may have a circular reference problem.
2	D. Sliney	• I understood the motion to state that ANSI Z136.1 was a needed reference and that the user of the vertical standard would refer to it for MPEs and quite possibly on classification. But I do not think this meant that the vertical standard had to be cited here and there throughout the document. ANSI Z136.2 has little to do with MPEs but has much to do with hazard levels that have some similaries with AELs but refer to servicing and maintenance disconnections. • ANSI Z136.2 has always been unique in that it is devoted to Class 1 products almost exclusively, i.e., to OFCS, and servicing and maintenance exposure conditions differ from classification measurement conditions. It is largely a different standard, but like several other vertical standards, we try to conform with consistent meanings of restricted and unrestricted access and occupancy and also controlled area concepts. • I think that it is important to employ consistent language wherever possible and not have the same word having quite different meanings in different vertical standards, in case someone really works in two totally different specialties.
3	R. Lanzafame	• There seems to be little logic in my opinion in the "one size fits all concept", and I agree that there is a user audience that would prefer to have one document as a main reference and that contains pertinent information for the particular discipline. • The Dot 1 should serve as the base, but in the case of healthcare, there are several cases and issues that aren't addressed specifically in the Dot1 and/or that require additional elaboration. This latter case may indeed require some separation from the Dot 1 as a "standalone" document although the Dot 3 is somewhere in the middle. • Some degree of repetition (or reference to Dot1) is reasonable and prudent. Stripping out content to force the issue of procuring more than one document risks making the other standards less valuable.

SSC	SSC Chair	Response
5	F. Seeber	• In the next revision of the .5 due to come out for a CDV2 at the end of this month. This standard is designed to be a standalone document for almost all situations and does contain MPEs,NOHDs and other pertinent tables. THE .1 is referred in some areas for references, but the .5 will also provide online sites to provide information. • The audience being served by the .5 is much different than the .1 and the other dots. These are not engineers,techs and others with similar backgrounds. The standard is written for educators from elementary, middle, high and tech schools as well as college laser teaching labs and college LEOT [laser electro-optic programs]. Again I support the .5 as a standalone document. • I made the effort to look at the table of contents, scopes and applications for most of the verticals. I understand why so many individuals have volunteered so much time to create them. ANSI recognized the need to serve these distinct audiences and had them published. People are more likely to feel confortable using a standard that has been written especially for their particular safety concerns and needs.
6	R. Aldrich	• There is a wide variety of potential users of the Z136.6. Since it was decided that the .1 would be the source of MPE values, many of these users may find value in having both documents. However, for more casual users (or those with some limited and specific applications), we hope that the .6 can suffice. It was a concerted effort that we strive to minimize the number of people that would need to have both documents. We defer to the .1 for MPE values, but we also provide simplified example MPEs for many casual uses. • I don't mind duplication of information as long as it is clear which document supersedes in the case of a version change. • I would expect that for a user needing to do a complete hazard evaluation, they would need to have both documents. But simple calculations or most of the users can be achieved with just the .6. • Additionally, last time through, we removed the technical definitions of Hazard Classes and replaced them with explanations of each class.

SSC	SSC Chair	Response
8	K. Barat (+ B. Fairchild, Vice Chair)	• Ken: The SSC8 made a consensus decision with its first publication and continuing not to include MPE values, therefore making it necessary for users of Z136.8 to purchase Z136.1 for calculation reasons. The reason goes back to the fact that the Z136 standards are issued in a what seems like random time frame. Therefore, any standard that contains MPE values, those values could be superseded by new MPE's from a new issue of Z136.1. Which would make it possible for a LSO do use an out dated MPE for calculations. For when MPE values are included there is little incentive for a user to buy any standard than their application standard. Therefore, until such time as MPE values and examples are published in a standalone booklet, SSC8 believes its user community should buy both standards. Do I think this happens, I would say those who do not use calculation software do, while the others not. Now to the issue of Z136.8 not repeating items found in Z136.1 we have a different point of view. I would say SSC8 is somewhat split (not 50/0, more of a 30/70). A number feel referencing back to Z136.1 is enough and Z136.8 could delete such material (i.e. Signage, many engineering controls, PPE section, etc.). While others feel the document needs to have enough material to standalone to be a more useful document. Also such a change should not be made until a new version of Z136.1 comes out with that change in mind. Bob: I believe the vertical application standard dot 8 should use the Z136.1 as a companion document, as described in the 2015 ASC motion, and avoid unnecessary duplication of that material. We have endeavored over the long haul, nevertheless, to produce a standard for which you do not necessarily have to purchase a dot1 as a companion for dot 8 (simultaneously), unless you have the need to use it for the required references. • Hazard Evaluation: Z136.1 referenced in Section 3. There is minor duplication of topics, but content has been adjusted and expanded in Z136.8 as appropriate to research and development. • Laser Classification: Z136.1 referenced in Sections 1 and 3. There is no duplication of substance and one would be required to own a copy of Z136.1 to complete classification. Z136.8 revision in process states, "Individuals shall refer to ANSI Z136.1 for the current hazard classifications and process for classification, MPE values for ocular and skin exposure, as well as quantitative hazard analysis calculation methods. The tables and figures that are included in this document are provided solely as a convenience for the user." • MPEs: Z136.1 is referenced. No duplication. • Measurements: N/A. No duplication. (Z136.8 does not have a Section on Measurements.) • Non-beam: Some duplication in explanation of what non-beam hazards are and how they may be generated, but not in specific types of non-beam hazards. Z136.8 addresses additional non-beam hazards (e.g. laser related wastes) not addressed in Z136.1. Z136.1 Table 7.1 duplicated in entirety. • Outdoor laser applications: Z136.6 referenced in Sections 3 and 4. Minimal duplication and Z136.8 expands topic as related to R&D.

SSC	SSC Chair	Response
9	T. Lieb	• I believe the vertical application standard dot 9 should use the Z136.1 as a companion document (in a sense….. where it is referenced for its content), as described in the 2015 ASC motion, and avoid unnecessary duplication of that material. We have endeavored over the long haul, nevertheless, to produce a standard for which you do not necessarily have to purchase a dot1 as a companion for dot 9 (simultaneously), unless you have the need to use it for the required references. • We take some pride in serving the manufacturing community, and anecdotally have experienced positive comments especially once they are aware of the Dot9, for things like the fact that we use point source exposure as our foundation, as it serves most of the applications in industry.
10	J. Parkinson	• The original direction of the .10 was to provide simplified, moderate, and advanced approaches to hazard evaluation and application of control measures. The simplified version required the least amount of technical knowledge and was based simply on knowing the hazard classification of the product. The moderate approach applied just to visible lasers and would allow a user to determine conservative ODs, NOHDs, and NHZs. The .10 would include the cw, small source visible wavelength AEL for Class 2 (= 1 mW), Class 3R (=5 mW) and the 0.25 s MPE value (=2.6 mW/cm^2). There would also be simplified examples of how to calculate OD, NOHD, NHZ based on the calculation models shown on page 204 and 205 of the ANSI Z136.1:2014 using the cw, small source, 0.25s MPE and the cw power or peak power if pulsed. The advanced method would be needed if the product was not classified or if more advanced AELs, MPEs, or calculations were needed. If the product was not classified, the user would first be referred to the laser product standards for classification (CDRH 1040.10 & IEC 60825-1) and second to the ANSI Z136.1 and Z136.4. For other MPEs, measurements, or calculation methods, the user would be referred to the Z136.1 and Z136.4. Bottom line for any advanced information (limits for Class 1, repetitive pulse lasers, extended source lasers, etc.) the user will need to have a companion document (ex. .1, .4, 1040.10, 60825-1). Lasers used outdoors will need the .6 or the FAA regulations. • Hazard Evaluation: Basic is in the .10. If MPEs or advanced calculations or measurements are needed, they will be referred to the .1 or .4. • Laser Classification: How to classify the product will be in another document (1040.10, 60825-1, Z136.1, or Z136.4). • MPEs and MPE criteria for exposures of eye and skin: see first bullet above. • Measurements: Other than a basic discussion for laser light shows on the use of a 7 mm and 50 mm diameter aperture for measurements, the user is directed to another standard. • Non-beam Hazards: The original plan is to list the applicable hazards covered in the .1 with an appropriate summarized version but add information on hazards that are specific to the display and exhibition of lasers that are not covered in the .1. • Outdoor laser applications: We reference the Z136.6 and FAA requirements. Bottom line, a basic laser light show operator and many people exhibiting a laser at a trade show should be able to use the .10 without needing an additional ANSI standard. However, for any type of "advanced use", the user will likely need the .1, possibly the .4. For outdoor shows they will need the FAA regulations (or other national airspace requirements if outside of the US) and/ or the .6

K. Barat additional input to SCE

Each SSC Chair has a feeling of ownership of their Standard, as well it should be. Meaning they should become defensive when one talks about doing away with it or combing with other standards. When one can put their emotions and pride aside, I see some opportunities to reduce the number of standards while maintaining the critical information for users use.

Below I have a case for folding Z136.5 into a Normative Appendix of Z136.1. I can also see removing Trade show and exhibits from the scope of SSC10.Laser use in the Fabrication setting needs a home, one of which I have no good suggestion for at this time, maybe one of the other SSC chairs will have a suggestion, that is all I will say on this at this time.

Concerning Z136.5- SSC5

Let me start out saying I was an orgainal member of SSC5 and was involved in the first two edition. I left the committee for reasons not germain to the SCS. One can argue about the use or lack of use of Dot 5 by its intended audience but once again that is another issues.

When one looks at Dot 5's audience it is clear the majority of its user base has limited laser safety background or is depended on the instructors awareness of laser safety. The plan of developing a "Lesson Plan" plan approach was to give users a term within their comfort zone, rather than saying SOP.

In addition it is expected that the class laser this population will use will be Class 2 or 3R or low power 3B's as opposed to class 4devices. With all this said, I strongly submit that an normative appendix in Z136.1 could address the safety issues found in Educational Institutions below the research level.

Existing sections 6 Medical Examination, Section 7 Non Beam Hazards, Section 8 Criteria for Exposure of Eye & Skin, and Section 9 ANSI Standards in the existing Dot 5 contain limited information, when compared to the versions more comprehensive in Z136.1. Allowing the Dot 5 user to choose what they need.

Section 4 Control Measures, once again the most relevant part of the existing section is not Engineering controls, which is very much a repeat of items from Dot 1, but rather the Administrative controls which takes up about 3 pages. Being in a sperate normative appendix, would also allow an expanded amount of text on laser pointer use, misuse and controls for classroom use, that would not be relevant to the majority of Dot 1 readers.

The only part of Section 3 Hazard Evaluation and Classification, that has any real variation from Z136.1 material is the subsection on Environment in Which the Laser is Used. Once again, I see this as a perfect fit for a part of a Normative Appendix.

Training requirements, for this user population could easily be a paragraph or two added to Section 5 or placed in the purposed appendix. This would also allow one to go into more detail on the issue of visible hazards below the MPE threshold.

As well as maturity considerations of users and ability to follow instruction. Through that material could go into the appendix

SSC10

SSC10 has been in the works since 2009. A great deal of work has been done on Light Shows and Projectors. Guidance for Trade shows has been a part of the plan since the start. For various reasons work on a voting draft has stalled. Therefore I suggest the small, but important parts on Trade show and exhitbitions be placed in a Normative Appendix of Z136.1. Similar to the my arguments for an educations institution appendix in Dot 1, laser safety at trade shows is a unique setting and greater explanation of show charterisitics could be served in an appendix. Warning signs are generally not used, nor is

PPE, all due to how display systems are set up. This distinction could easily be represented in such an appendix as well as the unique but different non-beam concerns. Once again visible exposure concerns below MPE limits could be explained. For the record, I am a member of SSC10.

Z136.8

Just for the record, I strongly oppose combining Z136.8 with any existing Z136 standard. As SSC8 Chair I maintain that the research setting is as unique as medical applications. Z136.1 seems to treat every laser as it is a commercial product which is not the case in the R&D environment. Yes, a great deal of commercial lasers is used, but the way they are combined, and changes made to wavelength and output on the optical table, etc., as well as routine manipulation of beams require an application standard that recognizes that fact. In addition Z136.8 allows the LSO in this environment a great deal of latitude and support that would not be appropriate for the typical Z136.1 user. I would be happy to expand on this, if invited to do so by the SCS.

J. Parkinson additional input to SCE

1. Make a Z136.1A and Z136.1B. 1A has the MPEs, calculations for OD, NOHD, etc. 1B is a general guidance document to cover the groups not covered by the other dots. For example, make 1B similar to the OSHA Technical Manual with a section on non-beam hazards added in. MPEs can be updated as needed without delays for other issues. When another dot applies, the user would not need to purchase 1B.
2. Many users I work with have both R&D groups and a production floor where laser process machines are used. They currently just buy the Z136.1 because they don't want to buy 2 -3 standards.
3. Trade shows and laser light show applications provide guidance for laser users that are normally operating Class 3B and 4 lasers in a temporary location where the general public, facility personnel, and other persons not trained in laser safety are expected to be present. These locations can be quite a bit different than the controlled environment you can have in a research facility, manufacturing facility, and school.
4. The original direction of the .10 is to provide guidance that a less technically sophisticated operator can understand.
5. The dot 10 committee is also trying to tackle issues that have not been addressed in other standards. (ex. Coordination with FDA/CDRH regulations, unattended Class 3R and 2 laser products, guidance on facility operator responsibilities, defining personnel categories and location types, risk assessment(done for now), etc.)