Contains Nonbinding Recommendations

Recommended Content and Format of Non-Clinical Bench Performance Testing Information in Premarket Submissions

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Guidance for Industry and Food and Drug Administration Staff

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U.S. FOOD & DRUG ADMINISTRATION

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Devices and Radiological Health
Center for Biologics Evaluation and Research

Preface

Public Comment

You may submit electronic comments and suggestions at any time for Agency consideration to https://www.regulations.gov. Submit written comments to the Dockets Management Staff, Food and Drug Administration, 5630 Fishers Lane, Room 1061, (HFA-305), Rockville, MD 20852. Identify all comments with the docket number FDA-2018-D-1329. Comments may not be acted upon by the Agency until the document is next revised or updated.

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Additional copies are available from the Internet. You may also send an email request to CDRH-Guidance@fda.hhs.gov to receive a copy of the guidance. Please include the document number 18011 and complete title of the guidance in the request.

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Guidance for Industry and Food and Drug Administration Staff

This guidance represents the current thinking of the Food and Drug Administration (FDA or Agency) on this topic. It does not establish any rights for any person and is not binding on FDA or the public. You can use an alternative approach if it satisfies the requirements of the applicable statutes and regulations. To discuss an alternative approach, contact the FDA staff or Office responsible for this guidance as listed on the title page.

I. Introduction and Scope

The Food and Drug Administration (FDA) has developed this document to describe relevant information that should be included in test report summaries, test protocols, and complete test reports for non-clinical bench performance testing provided in a premarket submission (i.e., premarket approval (PMA) applications, humanitarian device exemption (HDE) applications, premarket notification (510(k)) submissions, investigational device exemption (IDE) applications, and De Novo requests).

For the purpose of this document, non-clinical bench performance testing is defined as performance testing, performed by either a device manufacturer or a third party testing facility (e.g., test laboratory), which encompasses all bench testing and will be dependent upon the specifics of the actual device or device type. Non-clinical bench performance testing includes, but is not limited to: mechanical and biological engineering performance (such as fatigue, wear, tensile strength, compression, and burst pressure); bench tests using *ex vivo*, *in vitro*, and *in situ* animal[1] or human tissue; and animal carcass or human cadaveric testing.

[1] FDA supports the principles of the "3Rs," to reduce, refine, and replace animal use in testing when feasible. We encourage sponsors to consult with us if it they wish to use a non-animal testing method they believe is suitable, adequate, validated, and feasible. We will consider if such an alternative method could be assessed for equivalency to an animal test method.

Non-clinical bench performance testing excludes biocompatibility evaluation, reprocessing or sterilization validation, human factors, software verification and validation, and computational modeling, because relevant information on these assessments are detailed in associated guidance documents. Test reports for clinical studies, animal studies, and studies evaluating the performance characteristics of *in vitro* diagnostic devices are also excluded from the scope of this document.

The information listed below is intended to help ensure that clear and consistent information is provided in premarket submissions containing non-clinical bench performance testing.[2] The information in this guidance is intended to be used in conjunction with other FDA guidance documents, including device-specific guidances, as well as in conjuction with specific test reporting recommendations in FDA-recognized standards. For more information regarding use of consensus standards in regulatory submissions, please refer to the FDA guidance titled "Appropriate Use of Voluntary Consensus Standards in Premarket Submissions for Medical Devices"[3] and "Standards Development and the Use of Standards in Regulatory Submissions Reviewed in the Center for Biologics Evaluation and Research."[4]

FDA's guidance documents, including this guidance, do not establish legally enforceable responsibilities. Instead, guidances describe the Agency's current thinking on a topic and should be viewed only as recommendations, unless specific regulatory or statutory requirements are cited. The use of the word *should* in Agency guidance means that something is suggested or recommended, but not required.

II. Reporting of Non-Clinical Bench Performance Testing Information

To facilitate FDA's review, we recommend that in all premarket submissions containing non-clinical bench performance testing information, you include "test report summaries" (i.e., a summary of the conducted testing as described by the submitter of the premarket submission) and "complete test reports," when appropriate. You should provide test report summaries either embedded within an executive summary section of the premarket submission or provided as a separate document within the premarket submission (see Section II.A for more details). When necessary, you should provide complete test reports as separate attachments to the premarket submission (see Section II.B for more details). You can provide test protocols as separate attachments to the premarket submission, or as part of a complete test report (see Section II.B

[2] The recommendations in this guidance are consistent with the least burdensome provisions (see Sections 513(a), 513(i), and 515(c) of the Federal Food, Drug, and Cosmetic Act) and guiding principles described in the guidance "The Least Burdensome Provisions: Concept and Principles" available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/least-burdensome-provisions-concept-and-principles.

[3] Available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/appropriate-use-voluntary-consensus-standards-premarket-submissions-medical-devices.

[4] Available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/standards-development-and-use-standards-regulatory-submissions-reviewed-center-biologics-evaluation.

and C for more details). The submitted summaries, test protocols, and test reports should be clear, legible, and written in English or have English translations.

Complete test reports are typically not needed for Special 510(k)s and for some testing provided within Abbreviated 510(k)s. For premarket submissions with tests for which a Declaration of Conformity (DOC) to an appropriate FDA-recognized consensus standard is provided, the information to support the DOC (i.e., supplemental documentation) will vary based on the elements addressed by the consensus standard, but may include test report summaries, test protocols, and/or complete test reports. For additional information regarding the use of consensus standards and a DOC, please refer to the FDA guidance titled "Appropriate Use of Voluntary Consensus Standards in Premarket Submissions for Medical Devices"[5] and "Standards Development and the Use of Standards in Regulatory Submissions Reviewed in the Center for Biologics Evaluation and Research."[6]

Your premarket submission should also discuss how the non-clinical bench performance test results support the overall submission (e.g., substantial equivalence for 510(k), reasonable assurance of safety and effectiveness for PMA). The conclusions from your testing should discuss, for example, how the testing demonstrates substantial equivalence of your device to the identified primary predicate device for a 510(k)[7] or demonstrates a reasonable assurance of safety and effectiveness of the device for a PMA[8] or De Novo request.[9] This information can be provided in the test report summary (see Section II.A below) or another location in your premarket submission, and the information should be referenced appropriately for ease of identification within the submission.

A. Test Report Summaries

We recommend that within the body of your premarket submission, you provide test report summaries that briefly describe and summarize the testing performed to support the submission. The test report summaries may be included within the executive summary of a premarket submission. Alternatively, a test report summary may be provided as a distinct document within the premarket submission (e.g., as a preface to the complete test reports). The test report summaries should include the following elements:

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[5] Available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/appropriate-use-voluntary-consensus-standards-premarket-submissions-medical-devices.

[6] Available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/standards-development-and-use-standards-regulatory-submissions-reviewed-center-biologics-evaluation.

[7] See FDA Guidance, "The 510(k) Program: Evaluating Substantial Equivalence in Premarket Notifications [510(k)] - Guidance for Industry and Food and Drug Administration Staff", available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/510k-program-evaluating-substantial-equivalence-premarket-notifications-510k.

[8] See 21 CFR 814.20.

[9] See FDA Guidance, "De Novo Classification Process (Evaluation of Automatic Class III Designation) - Guidance for Industry and Food and Drug Administration Staff", available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/de-novo-classification-process-evaluation-automatic-class-iii-designation.

1. Test(s) performed

You should identify the tests performed. If the testing was conducted as recommended by a FDA guidance document or FDA-recognized consensus standard, we recommend that you state such in the test report summary.

2. Objective(s) of the test(s)

You should provide test objectives in the test report summary if a complete test report is not provided within the premarket submission.

3. A brief description of the test methods, including sample size, device(s) tested, and any consensus standard(s) utilized

In the test report summary, you should briefly describe the test methods used for the conducted bench tests, or reference an established method that was followed, such as any FDA-recognized consensus standards that were used for the conducted testing. You should also provide a description of the test sample that was tested (whether it is a final, finished device or not), and whether that sample is the entire device, a part or component, or an attribute of the device (e.g., the device's material composition/properties or packaging). In addition to the description of the test sample, you should include a brief discussion on sample selection (e.g., size or configuration) and how the samples represented a clinically relevant worst-case scenario(s).

4. Pre-defined pass/fail criteria (when applicable)

We recommend that your test report summary include an identification of the acceptance criteria, when applicable, that were pre-defined and that were applied during testing. When a non-clinical bench performance test that is conducted for characterization purposes does not have acceptance criteria, you should still provide a description of the assessment criteria that you used to allow for interpretation of the data, for example, the visual inspection criteria utilized for coating integrity testing when assessing voids or cracks.

5. Results summary

a. Provide an appropriate summary of data (in tabular and/or text format), including a summary from any analyses performed. For example:
    - For quantitative assessments, provide appropriate summary parameters such as: the mean, standard deviation, minimum, and maximum for normal data; or summary parameters per the data analysis plan.
    - For attribute or qualitative data, provide an appropriate summary of the number of observed characteristics by category (e.g.,

characteristic present/total observations, characteristic absent/total observations). Include statistical information such as confidence/reliability level, if applicable.

b. Specify whether the acceptance criteria (if applicable) were met.
c. Provide a brief explanation of study results that do not meet acceptance criteria, and/or protocol deviations that may have impacted the study results, conclusions, or data integrity, and describe how the resulting concerns were resolved.

6. Discussion/Conclusions

Your test report summaries should provide a discussion of the conclusions drawn from the test results. This section of the test report summary can be used to provide additional information regarding the testing conducted and/or observed test results (e.g., justification for the methods used to perform the testing, clinical/scientific/ engineering basis for the acceptance criteria, outlying and anomalous results). Note that a justification for methods and/or acceptance criteria is generally not needed if they were directly obtained from a FDA-recognized consensus standard or guidance document. A discussion of the test methods or acceptance criteria, if needed, can include how the testing relates to the use of the device in clinical practice or as described in literature. For example, tracking tests typically use a fixture that simulates the target anatomy. A discussion or justification for the tracking test fixture used would address how the testing relates to expected worst-case clinical use for the indicated anatomical location. For non-clinical bench performance tests that are conducted for characterization purposes, the conclusions should address the relationship between the results and the intended performance of the device. As noted above, a brief discussion of how the test results support the overall submission can be included in the test report summary or another location in your submission.

7. Location of complete test report

We recommend that you identify the location (e.g., appendix and/or page number) for each complete test report for which a summary is provided, if applicable.

8. Summary table (optional)

As an alternative to a written narrative for each non-clinical bench performance test, a tabulated summary can be provided to organize the information recommended in a test report summary (see below for example). If a summary table is used, it is still recommended that a narrative discussion of the results/conclusions be provided as described above in Section II.A.6, when needed.

Test Performed	Device Description/Sample Size	Test Method/Applicable Standards	Acceptance Criteria	Unexpected Results/Significant Deviations	Results
Test title, document number, location in file	Test/control article identification, sample size	Brief summary of test method, preconditioning, standard(s) used	Include clinical/scientific/ engineering justification	Report any unexpected results or significant deviations with an explanation of how they do not affect the overall conclusion	Pass/Fail Or Min, max, average

B. Complete Test Reports

We recommend that premarket submissions include complete test reports attached to the main body of the submission (e.g., in an appendix). A complete test report means the entirety of the testing documentation submitted for a study, which some submitters or test labs might embody in a single document, while others might embody in multiple and separate documents (e.g., a test protocol and a test report; see Section II.C). We recommend that efforts be made to ensure that scanned test reports are legible in order to reduce the likelihood of requests for additional, more legible, copies.[10]

Complete test reports should include the information described below.

1. Test performed

The test report should clearly state the test that was performed.

2. Objective of the test

The test report should state the purpose of the test that was conducted. Note that this information can alternatively be provided in the test protocol.

3. Description of test methods

You should provide a detailed description of the test methods with sufficient detail that an individual familiar with testing of the device type will be able to interpret the purpose of the test, how the test was conducted, and whether the test setup and data analysis was appropriate to assess the performance of the device type.

If FDA-recognized consensus standards that include test methods are utilized during testing, providing detailed test methods or a test protocol is generally unnecessary,

[10] See FDA Guidance "eCopy Program for Medical Device Submissions - Guidance for Industry and Food and Drug Administration Staff," available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/ecopy-program-medical-device-submissions.

even when a DOC to the standard is *not* provided (i.e., general use of consensus standards). Instead, you should provide a full citation of the standard, including the version, and information regarding the extent to which the standard was followed, including deviations from the standard. Similarly, if you provide a DOC to a FDA-recognized consensus standard that includes test methods, providing detailed test methods or a test protocol is typically not necessary. When the FDA-recognized consensus standard includes choices related to, for example, what is to be tested, which test methods to use, or performance limits to assess conformity, you should include an explanation for the choices and selections made. When test methods have deviated from the FDA-recognized consensus standard used, we recommend that you provide this information within the DOC if one is submitted, or within the complete test report if no DOC is submitted. For additional information regarding the use of consensus standards, DOC, and supplemental documentation to support a DOC, please refer to the FDA guidance titled "Appropriate Use of Voluntary Consensus Standards in Premarket Submissions for Medical Devices"[11] and "Standards Development and the Use of Standards in Regulatory Submissions Reviewed in the Center for Biologics Evaluation and Research."[12]

a. Test sample information

The test report should provide a description of the test sample that was tested (whether it is a final, finished device or not), and whether that sample is the entire device, a part or component, or an attribute of the device (e.g., the device's material composition/properties or packaging).

Generally, the tested devices should represent the final, finished device that has been subject to all manufacturing processes for the "to be marketed" device (including sterilization, environmental conditioning, simulated transportation, etc.). If you conducted any testing on samples that are not the final, finished (e.g., sterilized) product or part or component, we recommend that you indicate this in the test report summary and the test report, if known (e.g., if test lab is aware that the test sample is not the final, finished device), along with a justification explaining why this approach is appropriate given any differences that may impact performance of the tested device compared to the final, finished device that is to be marketed. You should specify the number of sterilization cycles or other conditioning (e.g., simulated use, environmental conditioning, distribution simulation, aging) that the samples have been exposed to prior to testing. If test samples were conditioned or sterilized in a manner that is different than what is intended for the marketed product, we recommend that you provide a justification.

b. Test sample size/selection

[11] Available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/appropriate-use-voluntary-consensus-standards-premarket-submissions-medical-devices.
[12] Available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/standards-development-and-use-standards-regulatory-submissions-reviewed-center-biologics-evaluation.

We recommend that you provide a scientific rationale to support the number of samples tested. The sample size selected should be based upon the objective of the study and supported by your risk analysis and sampling plan. For testing performed according to a FDA-recognized consensus standard or as specified in a FDA guidance document, the sample size selected should meet the applicable recommendations of the standard or guidance. When applicable, you should follow any device-specific guidance document recommendations for sample selection.

If one particular device model is used to represent the entire family (or a subset thereof) of device models included in your submission, you should justify why the tested device is representative of the entire product family (or subset) and explain why the tested device represents the worst-case design for that respective test. In some cases, there may be multiple worst-case designs per family, and a "four-corners" or bracketed approach may be appropriate and should be justified.

Finally, your test sample selection should account for both inter- and intra-lot variability by examining multiple manufacturing lots, when appropriate (e.g., when it is expected that such sampling is likely to impact the testing results and/or is needed to adequately capture the variability in the testing results).

c. Test methods

The test report should contain a concise description of the test methods utilized in the conducted testing. You should also include materials used, methods, and a description of the test parameters, including an explanation of and rationale for critical test parameters, when appropriate, and any specific sample preparation steps. In many cases, labeled diagrams or photographs of the test setup and test fixtures can be helpful in understanding the test methods, and should be included with the test methods to provide appropriate context.

4. Pass/Fail criteria

You should describe in the test report, the acceptance criteria that you prospectively identified, including specifications or acceptance and rejection criteria, and a clinical/scientific/engineering justification for these criteria, when applicable. The acceptance criteria should be based on the specific performance needs of the device and the intended use of the device. An example of an appropriate clinical/scientific/ engineering justification for an acceptance criterion includes a performance specification of the device based on clinical use; e.g., "tensile strength of component should be 10 times the expected normal working load since failure of the component could cause serious injury to patients." If applicable, you should refer to FDA-recognized consensus standards or FDA guidance documents for recommended acceptance criteria. When a non-clinical bench performance test that is conducted for characterization purposes does not have acceptance criteria, you should still provide a description of the assessment

criteria that you used to allow for interpretation of the data, at a minimum, in the test report summary.

5. Data analysis plan

We recommend that your test report include the data analysis plan used to analyze your results. Your data analysis plan should include all planned quantitative and/or qualitative assessments.

6. Test results

We recommend that you include the following items in the test results section of your test report:

a. Data

We recommend that you present the data collected for all test samples (including outlying and anomalous results) during the tests conducted to support the premarket submission, where appropriate and routinely provided. The results should be presented in data sheets or tables. These data should be accompanied by a summary of the data and applicable statistical information. Also, in situations where they may yield additional context, such as when testing to failure, images of the failure mode should be provided. You should use appropriate units of measure that are consistent throughout your report. Values should be reported to the appropriate significant digit, and if the data is rounded, you should specify the rounding method used.

b. Data analysis

You should analyze the data, including any outlying points and anomalous results, using statistical analyses when appropriate, and indicate whether the acceptance criteria were met. As discussed in Section II.A.5, these analyses could include quantitative and/or qualitative assessments. If the data analysis concludes that the acceptance criteria were not met for either individual samples or entire sample populations, we recommend that you discuss (in either the test report or test report summary) the potential reasons for failure of the testing to meet the acceptance criteria, and whether re-testing was determined to be appropriate and why.

c. Protocol deviations

We recommend that you describe test protocol deviations, particularly those that may have impacted the study results, conclusions, or data integrity. The test report should discuss the reasons why the deviations occurred, a description of any activities executed to determine the source of the deviation, and an assessment of their impact on the test results, conclusions, or data integrity.

7. Discussion/Conclusions

We recommend that the test report discuss the conclusions drawn from the test results in consideration of the stated study objective. For example, the test report conclusions should indicate whether the pre-specified acceptance criteria were met.

C. Test Protocols

A "test protocol" typically consists of the methods that were used to conduct the testing (see Section II.B.3), the objective of the test (see Section II.B.2), pre-specified acceptance criteria (see Section II.B.4), and data analysis plan (see Section II.B.5). This information can be provided in the premarket submission within the complete test report, or can be provided as a separate test protocol document submitted along with the test report.