412TW-TIH-14-01

THE AUTHOR'S GUIDE TO WRITING 412TH TEST WING TECHNICAL REPORTS

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DECEMBER 2014

TECHNICAL INFORMATION HANDBOOK

412th TEST WING
EDWARDS AIR FORCE BASE, CALIFORNIA
AIR FORCE MATERIEL COMMAND
UNITED STATES AIR FORCE

This technical information handbook (412TW-TIH-14-01, *The Author's Guide to Writing 412th Test Wing Technical Reports*) replaces AFFTC-TIH-09-01, *The Author's Guide to Writing Air Force Flight Test Center Technical Reports* (reference 1). This handbook was submitted by the Engineering Directorate, 412th Test Wing, Edwards AFB, California 93524-6843.

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This report has been reviewed and is approved for publication: 18 December 2014

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This handbook provides guidelines to assist technical report authors in writing accurate, precise, and clearly written reports. This handbook is intended to instruct authors on the technical reporting process, policies, and procedures, as well as the approved types of reporting products.

15. SUBJECT TERMS

Reports; technical reports; executive summary; PRR(Preliminary Report of Results); handbook; preparation technical writing; writing instruction manual; AFTC(Air Force Test Center)

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PREFACE

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The author also wishes to thank those who provided examples of well-written reports for the Selected Bibliography: John Manke, 773 TS/ENFA; Paul Sorokowski, 773 TS/ENFB; Thane Lundberg, 773 TS/ENFM; Reagan Woolf, 773 TS/ENFB; Chris Webber, 773 TS/ENFH; Ralph Brooks, 773 TS/ENFR; Don Lange, 773 TS/ENFS; John Miljan, 775 TS/ENVC; Chris Eaton, 775 TS/ENVD; Bill Gaddis, 775 TS/ENVR; Pat Cronin, 775 TS/ENVW; and Steve Ruthven, 771 TS/EWAS.

Notes: This document includes several links (typed in blue and underlined) to examples provided in appendix B. To jump to an example, click on the desired link. To jump back to the link, hold down the alt key and tap the left arrow key. All examples provided in this document are fictitious representations and present no actual 412th Test Wing data.

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TABLE OF CONTENTS

OVERVIEW

The 412th Test Wing (412 TW) mission is to conduct independent testing and evaluation of aerospace systems and provide customers with unbiased, technically correct, decision-quality information as quickly and economically as possible. Customers include: the warfighter, the program office (PO), and future AFTC testers. Reporting test results to the PO plays a critical role in weapon system acquisition processes. The 412 TW has standardized a set of reporting products in order to promote consistency, which saves time and effort, and reduces confusion for both authors and readers. The standards for these reporting products serve as a starting point, but flexibility in the reporting products is allowed in order to meet customer needs, satisfy the immediate need for information of decision makers throughout the acquisition community, and provide developmental test and evaluation (DT&E) documentation.

The purpose of this handbook is to provide the author with 412 TW reporting guidance. This handbook should be used in conjunction with current 412 TW-approved templates, which are available from your technical editor or the Technical Publications Office.

This handbook has the same overall goal of providing value-added, decision-quality technical information as EdwardsAFBI 99-103, *412 TW Technical Report Program* (reference 2). The two documents are complementary: EdwardsAFBI 99-103 defines the reporting process, policies, and procedures, as well as the approved types of reporting products (who, what, and when), and this handbook's purpose is to provide format, preparation, and coordination guidelines (how).

REPORT TEAM

The report team (also referred to as the report integrated product team [RIPT]) consists of everyone who will be involved in the reporting process. The primary members of the team include: authors, RIPT co-leads (typically Chief Engineer and Home Office representative), project pilots, and technical editors.

HANDBOOK LAYOUT

Following the Overview, this handbook is constructed in sections matching those of a technical report (TR). They are presented in the order they normally appear: Front Matter, Body of the Report, and Backup Material.

REPORT TYPES

The type of report required for your project is usually determined during the program introduction/statement of capability (PI/SOC) process. If not, your chief engineer can help determine the appropriate type of report. The overall goal is to meet our customer's needs, which may require flexibility and innovation to our standard products. Additionally, the time to produce these products will vary based on the needs of the customer. The intent is to produce a well-written, polished report that not only provides the proper technical content and conveys the correct message, but is also grammatically correct and properly formatted. The author's main focus should be on providing the proper technical content and ensuring that the report conveys the correct message. The author does not need to be overly concerned with the technical editing, grammar, and formatting. The technical editor will do the bulk of the formatting, editing, grammar, etc. Many authors waste time focusing on font size, formatting, chart and table formats., etc, only to find their work redone by technical editors who are more knowledgeable of the most current formatting requirements and faster at implementing them.

The report types covered in this guide include:

Technical Report (TR):

A TR provides the final documentation of test results and evaluations. The content and size are flexible, depending on project requirements. The TR should be concise; it is not intended to contain all the test data that were analyzed. The TR is not generally releasable to the public. While the OI indicates that the maximum number of days for the technical report to be delivered to the customer is 42 days after the last test event, the real goal is to deliver a quality report that meets our customer needs. In many cases this can be accomplished in less than 21 days or even 10 days. In other cases, where the TR is more complex or involves many disciplines, more than 42 days may be required, even up to 90 days. In any case, a proactive approach should be taken in drafting, working, and finishing the TR. The initial writing of the TR should begin as soon as the TRM is completed; data review, submittal of WITs, and TR updates should occur during test execution; and final draft should be worked as soon as practical. All TRs must be approved for publication by the 412 TW.

TR Addendum.

Occasionally, a portion of testing is delayed to the point that the report team does not wish to postpone publication of the already-completed test results. In this case, the completed test results will be published in a TR, and the delayed test results can be published later in the form of an addendum to this same TR. The addendum uses TR formatting and will share the number of the original TR, with the addition of ADD1 at the end (e.g., 412TW-TR-11-55ADD1).

Data Package (DP) (Supplemental Data to the TR):

Supporting test data may be incorporated into a DP and provided to the PO along with the TR. The DP is approved by the technical expert(s) and your Combined Test Force's (CTF's) chief engineer (CE), rather than 412 TW leadership. The supplemental data (figures, plots, etc.) do not have to be 412 TW-report quality, nor is the presentation required to meet 412 TW report standards. However, DPs should include the same front matter and distribution list as the original TR. In the event of a high page count, the DP should be sent via digital format where paper copies of the original TR were distributed.

Preliminary Report of Results (PRR):

A PRR is a term that is no longer valid. It was a short memorandum and/or briefing/presentation given to decision makers when the PO needed an immediate answer and was willing to accept preliminary (before testing has been completed) results, such as for Milestone C decisions. These types of products are now created as a short version of the TR. Format (style and media) and timeline varies according to need.

Technical Information Handbook (TIH):

A TIH is generally intended to provide a broad scope of instruction or guidance for test enterprise use. Less frequently, a TIH is used to document internal processes and archive technical information for future reference. The TIH is generally releasable to the public. There is no specific timeline for TIHs.

Technical Information Memorandum (TIM):

A TIM formalizes or validates studies that cover subjects of narrow scope and is intended primarily for in-house use. The TIM is not generally releasable to the public. There is no specific timeline for TIMs.

TECHNICAL REPORT PURPOSE

A TR answers the customer's questions about the system's ability to perform as intended. The 412 TW recommends either the system under test (SUT) is ready or is not ready for the next step in the acquisition process. The SUT may also be ready with qualifications. Often, the next step is Operational Test and Evaluation (OT&E) or operational fielding, but other next steps are possible. The author should develop a detailed understanding of this next step to fully answer the question with supporting evaluation.

The 412 TW bases this recommendation on system performance, integration, or functionality tests derived from test requirements. These test requirements are often stated in a program document, including the Test and Evaluation Master Plan (TEMP), Operational Requirements Document (ORD), Key Performance Parameters (KPPs), and Key System Attributes (KSAs). Programs often have different documents and agreements with contractors, so authors should investigate what is important to the customer, including the ultimate customer: aircrew represented by such organizations as Air Combat Command (ACC). By the time the author is writing the report, these requirements should have been distilled to test objectives and parceled out to test points, runs, or scenarios. As a result, completing the test plan provides the data planned for the TR.

Additionally, test plans and TRs should comply with the current DoD, USAF, and Air Force Materiel Command Technical Reporting and Scientific and Technical Information (STINFO) Program regulations and guidance. A TR should also:

Purpose	Benefit
Assess the SUT mission capability (military utility).	Describes usefulness from an operator's perspective, putting the capability in context.
Be an independent assessment.	Avoids the potential for conclusions not in the user's, taxpayer's, or Air Force's best interests.
Without excessive jargon, demonstrate an understanding of the weapon system's mission.	When the 412 TW provides conclusions and addresses recommendations in operationally significant ways, it enhances 412 TW credibility, increases customer confidence, and focuses on mission capability.
Document the test results and related information for historical purposes, such as comparing to a performance baseline and instructing future testers.	Test often continues after the end of the initial developmental program. What was tested, how it was tested, and what was learned can provide a starting point for future evaluations.
Provide foundational data.	Various Technical Orders and standard aircraft characteristics charts may rely on test results.

CHARACTERISTICS OF A WELL-WRITTEN REPORT

Organized. Lead the reader from each test objective, and its findings, to the next. Briefly describe the test item, test methods and conditions, and data analyses that helped you reach your test results, evaluations, conclusions, and recommendations.

Clear and concise. Say only what needs to be said and use straightforward language. The PO's primary interest will be your evaluation and recommendations concerning the system under test; therefore, that information should be easy to find and understand. To detail a test technique, document a new one, or to describe a system that is not the system under test, use a reference, an appendix, or a supplementary document (such as a DP).

Precise. Be specific to help the reader better grasp concepts. For instance, "The radio's intermittent power failures prevented the timely transmission of mission-critical information," provides much more information than, "The anomaly affected performance." Vague wording leaves readers to guess at the meaning and significance of test results. Embedding videos in your report can greatly improve comprehension of complex systems and/or events that are difficult to articulate.

Consistent. Use the same formatting style and wording choices throughout the document. Consistent formatting helps the reader stay focused and also makes locating similar types of information easier. Avoid using two different terms for the same thing, even in cases where both terms are correct. For instance, if "images" and "scenes" are used interchangeably in a report, a reader might guess they mean the same thing, or they might assume that scenes are collections of images, because that was its definition in another report.

Credible. Don't act as an advocate for or an enemy of the system. Present all results, both positive and negative, in a fair, accurate, and impartial way. Critical observations about the contractor, PO, or Test Wing are inappropriate as they reveal emotion and bias, undermining the integrity of your conclusions.

Thorough. Use a representative amount of data to substantiate your conclusions. Comparing test results to stated operational requirements, specification requirements, or performance figures for the previous version of the test item gives your reader a sense of perspective and proportion. Include appropriate aircrew and maintainer comments, along with substantiating data, screenshots, images and/or video to provide a comprehensive evaluation of the weapon system.

Logical. Look for and bridge any gaps between results which seem to point to a different conclusion and/or rating than the one given, or between an overall rating and specific test objective ratings which appear contradictory. Provide the specific context that affected your conclusions and ratings in ways that would not otherwise be obvious to a reader, such as history, workarounds, relative significance, and/or expected modifications/replacements.

Follows through. The most common methods of "closing the loop" are DRs, T.O. change requests, and formal report recommendations. Any deficiency reported in a TR should include a recommendation. The conclusions and recommendations should clearly and specifically state your findings and the actions needed to ready the system for operational test and evaluation or fielding.

See the Tips on Composition at the end of the Overview section for further general guidance on writing TRs.

> We explain in English, not test-speak, why we need to conduct a certain number or type of test, why particular tests are mission- or safety-critical, what we need to understand from the tests, how particular tests increase our confidence in the answer we give the customer and what the risks are of not testing as we recommend.
>
> Maj. Gen. Arnold W. Bunch, Jr.
> AFTC Commander
> *Craniums Up • December 2014*

REPORTING PROCEDURES

EdwardsAFBI 99-103 (reference 2) provides guidance on reporting timelines; however, the timeline developed should support customer requirements. You should schedule time in advance to work on your TR throughout the test period, to obtain, analyze, and evaluate your data, and write about what you've learned. Spare moments and downtime throughout the test phase are unpredictable and often filled with interruptions, or lost to unexpected administrative functions or other authors' test projects. Do not leave data analysis and report writing until testing has been completed, as hastily written reports often require extensive rewriting.

Progress Tracking:

To help you plan ahead, this section outlines the typical progression of the reporting process over a test project cycle. Also, the Mapping the Technical Report Tool (table A3), is an excellent resource for keeping on track.

There are three basic phases to a test project cycle: test planning, test execution, and test reporting.

Phase 1 – Test Planning

1. Review your test and evaluation master plan or other pertinent documentation, which should help define how your test fits in with the overall program and contains the critical issues pertinent to the system under test.
2. Have your technical editor help you construct a test plan (TP) that mirrors the structure of the TR, so that writing your TR will be easier.
3. Think ahead to the TR when writing your TP; ensure your test objectives are well-defined and they address the customer's needs.
4. Once the test plan is approved, you and your technical editor can create a customized template (also known as a skeleton) for the TR.
5. Hold a report team meeting to review the report's layout/presentation of data.
6. After the test plan has been completed and before test execution starts, there is often an opportunity to begin writing your TR and working on your data analysis tools and products.

Note: If you have been assigned a TR, but were not involved in the test planning phase of the project, ask your technical editor whether a customized template has been created for your TR. If not, request one.

Phase 2 – Test Execution.

1. Begin writing the report at the beginning of test execution, and work with your RIPT co-leads on your data analysis and the writing of your report throughout testing.
2. Keep up with your data reduction; you will understand the test item and be able to articulate your conclusions better because you are looking at test results and analyzing as you go. Meet with your technical experts as needed to ensure your data analysis is on track.
3. Get feedback. The report team co-leads should periodically assemble the report team to review what you have written, or you may solicit their comments as your writing progresses.
4. Work with your technical editor as needed to incorporate changes during this period. This will facilitate the coordination process to follow.
5. Write WITs and DRs throughout the test period.

Phase 3 – Test Reporting.

1. Revise the report draft at report team meetings and/or sequentially via report team members until it is ready for the FLTS/CTF coordination meeting. This coordination meeting is designed to be the final review before the report is polished and presented to the 412 TW for final approval.
2. Coordinate with your technical editor to distribute the report to the report team members and other reviewers prior to the final 'real-time update' FLTS/CTF coordination meeting.
3. Complete the 10 Questions document during the review time before the FLTS/CTF coordination meeting. Your technical editor can provide you with a template and help you complete it.
4. Attend the FLTS/CTF coordination meeting. Anyone who needs to provide input should attend the coordination meeting or send a representative with comments. Everyone, including the report team co-leads, should have reached agreement on the content presented in the report. At the end of this meeting, *all the changes will have been made* so that the report can move forward for final approval. Once the FLTS/CTF coordination meeting is over, everyone agrees to the changes, and the technical editor has updated the final draft, the report can now begin the final coordination and approval cycle to the level of 412 TW management, as outlined in EdwardsAFBI 99-103 (reference 2).
5. Coordinate with your technical editor to schedule the 412 TW approval meeting. The technical editor in turn coordinates with the Technical Publications office, prepares and distributes readahead packages to invitees, and tracks the report through the 412 TW approval cycle.
6. Attend the 412 TW approval meeting. The 412 TW leadership may request changes to ensure the product reflects TW standards and priorities. After the report is approved and signed, and final edits are made, the final report is distributed to the PO and then all others on the report's distribution list.

FURTHER RESOURCES

Your engineering home offices (412 TENG and 412 EWG) will provide you with technical assistance and guidance. Keep them apprised of any difficulties you encounter as you write your report – do not wait until the last minute.

The Technical Publications Office is the primary point of contact for all administrative matters pertaining to the TR process. From assignment of a report number through final distribution, this office is there to answer your questions and provide you with the latest guidance and direction on the reporting process. The 412 TENG Technical Report Site is home to the latest versions of instructional templates. **Before you start writing, ask for a template; it will save you time and effort.**

Refer to EdwardsAFBI 99-103 (reference 2) for further information on 412 TW technical reporting process requirements.

FRONT MATTER

The front matter includes much of the boilerplate sections necessary for all reports. Links (shown in blue type and underlined) jump to visual examples from appendix B.

OUTSIDE FRONT COVER

The 412 TW technical report is an official U.S. Government publication; the front cover reflects the professionalism of the 412 TW and the USAF to the world. It is the reader's first impression of your work. An aircraft photo is encouraged – discuss it with your lead engineer if you are uncertain – but cartoons or personalized logos are inappropriate here.

Your technical editor or the Technical Publications Office can provide you with a front cover template and formatting guidance.

QUICK TIP
Links Jump to Examples
Click on the link.

Return to Link
Hold the alt key down and tap the left arrow key.

Front Cover Requirements:

1. Report number: This number is unique to each report and is assigned by the Technical Publications Office, usually prior to the first report team meeting. Your technical editor creates a tracker form for each report that contains this number, along with other information unique to the report.
2. Title: The title should be brief and clear. Start the title with the aerospace vehicle system name, followed by the system under test, and end the title with "Test and Evaluation," "Test Report," or "Data Package." If your report is classified, make every effort to ensure your report title is unclassified.
3. Authors: This includes the primary government author and a project aircrew member or maintainer. Authors can be project or discipline engineers (avionics, performance and flying qualities [P&FQ], human factors [HF], and reliability and maintainability [R&M], etc.). No more than two author names, in addition to the aircrew, should appear on the cover; more than that indicates a committee. Authors who wrote significant portions of the report, yet do not appear on the cover are listed on the signature page and the SF 298 form (up to 20 authors allowed), or are mentioned in the preface. Editorial comments and pilot or maintainer notes do not constitute authorship. You can acknowledge such contributions in the preface.
4. Type of report: Indicate whether the report is preliminary or final, a test plan, a data package, or other possible formats such as interim or annual update.
5. Report date: This is the month and year the report is approved, not begun or finished.
6. Distribution statement: The purpose of the distribution statement is to control secondary distribution of the report. Your PO will determine the correct distribution statement for your report. The proper distribution statement will be IAW DoD Directive 5230.24, *Distribution Statements on Technical Documents* (reference 3), as implemented by AFI 61-204, *Disseminating Scientific and Technical Information* (reference 4). The Technical Publications Office will provide guidance on the wording of the distribution statements for test and evaluation reports (distribution statements B, E, or F).
7. Controlling authority: This is the sponsoring or funding agency, typically the PO.
8. Warning statement: Required on reports containing export controlled data.

INSIDE FRONT COVER (SIGNATURE PAGE)

The purpose of the signature page is to document who wrote the report and who approved its publication and release.

Your technical editor or the Technical Publications Office will provide the latest template, which contains a boilerplate paragraph and formatted signature columns. The signature page appears on the back (inside) of the front cover. The opening paragraph includes the TR number, title, and job order number (JON). It may also include identification of the originating office and its affiliation with the 412 TW, program authorizations, and dates or program management directive, if applicable. Below this paragraph are the signature blocks in two columns. The left column is for the author(s) signature(s). The right column is for the approval authority signatures, as listed in EdwardsAFBI 99-103 (reference 2).

STANDARD FORM 298 (SF 298)

The SF 298 is required for all reports going to DTIC. Per EdwardsAFBI 99-103 (reference 2), all scientific and technical reports go to DTIC except reports classified higher than collateral secret.

The SF 298 has required blocks and includes instructions for filling out each block. If your report is classified, do not include any classified wording on this form.

The abstract (block 14) should be narrative in nature and limited to approximately 200 words. Do not include test results, conclusions, or recommendations. You may copy and paste the first paragraph of the Executive Summary into this field, remove acronyms which are not repeated within the paragraph, and be sure to update as needed.

For subject terms to include in block 15, you may use the originating TP's SF 298 as a starting point and make modifications as needed. For further guidance, consult the Edwards AFB Technical Research Library.

For contact information in blocks 19A and 19B, insert your chief engineer's name and phone number.

QUALIFIED REQUESTORS AND EXPORT CONTROL STATEMENTS

The qualified requestors and export control statements are required for reports not cleared for public release. The format and wording for these statements are governed by regulation (AFI 61-204 [reference 4]). The Qualified Requestor's Notice tells readers where to get additional copies of the report and provides instructions for destroying the document. The Export Control Statement tells the reader that the information contained in the report is not to be released to foreign nationals and explains the penalties for releasing the information without proper approval.

PREFACE OR ACKNOWLEDGEMENTS

The preface is optional. The purpose is to recognize individuals or organizations that made substantial contributions to your report, but are not on the cover and signature page. Military personnel should be identified by rank and branch, and civilians and contractors by job title/position. Contractors listed must also include their companies' names. Limit the preface length to half of a page.

EXECUTIVE SUMMARY

The executive summary is an overview of your test results and is written for those who may not read the entire report. Often, these are the people who determine funding for the program – readers who are very important, but not expert. This section should not exceed one page. Be brief, be clear, use a narrative style, and avoid jargon and acronyms. Do not introduce any material that is not presented in the Test and Evaluation (T&E) section.

When test results are mixed – negative and positive – be balanced and do not overemphasize the negative or positive results. No system is perfect; state what needs fixing, but do not belabor deficiencies to the extent that you leave the impression the system or item won't work when in fact it does work. Be factual, but offer a balanced representation of overall operational usefulness. Often, despite deficiencies, the item under test will function effectively in the field.

The following is required in the Executive Summary, in the order presented here:

Opening Paragraph:

Include the report purpose statement from your introduction section, stripped of acronyms and references. Include the current lead developmental test organization (LDTO) and participating test organizations (PTOs) if applicable, and mention that testing was conducted by the CTF. State the timeframe and location(s) of testing. Identify the number of sorties, ground test hours, and flight test hours.

Operational Need and Test Item Description:

In one or two paragraphs, describe the operational need that drove the development of the test item. This section can include a test item description (a brief explanation of what the item is and what it was designed to do, not what it actually did). Use plain language. Think in terms of function in the field – the warfighter needs this device, upgrade, or functionality in order to do… what? Do not write "we tested this because the SPO asked us to" or "the operational need is that it's a CDD requirement." The top-level reader – oftentimes someone in the Pentagon who's deciding whether to support funding for the item – wants to know what this thing will do in the field that makes it vital to the warfighter.

Overall Test Objective:

State the overall, or general, test objective. Do not include the specific test objectives.

Test Results Summary:

The final paragraph provides the test results summary, comprising three parts:

1. **Overall rating.** Give an overall rating and state the extent to which the test article or major subsystem(s) met or did not meet design objectives.
2. **Significant Findings**. Summarize significant findings that led to the major conclusions and recommendations. Discuss only the most significant test results. If the rating was satisfactory, begin with good test results, followed by any poor ones; if the overall rating was marginal or unsatisfactory, begin with the negative results that fueled that rating, followed by any good test results. If a test objective was not met, or only partially met, mention that. If all test objectives were fully met, do not state that here.

3. **Overall Recommendation.** Make a clear statement about what the next step should be, or an overall conclusion and recommendation. For example, after deficiencies are addressed, what would happen? Release to the fleet, go to OT&E, perform further tests, or release to operational utility evaluation? If you rate an item marginal but recommend release, explain why you believe the marginal rating should not prevent release. If testing of a system, subsystem, etc., was not accomplished, recommend IOT&E, not "evaluate the system until it has been tested," or state limitations for IOT&E.

TABLE OF CONTENTS

The table of contents presents the hierarchical listing of the headings within the report. The hierarchy, headings, and format must match those in the report. It is generally not necessary to list headings beyond the third or fourth order in the table of contents.

Your technical editor can create and update the table of contents if your document does not have one already.

QUICK TIP
Use the template:
The template contains a table of contents that updates with one keystroke after changes to the document.

BODY OF THE REPORT

INTRODUCTION

The Introduction section informs the reader of the purpose of the test project and answers the following questions: Who requested testing? Who was the PO? What was tested? Where and how was testing accomplished? Why was testing requested in the first place? What was the operational need? Add any background information and program chronology to further help your reader. This section does not contain results, conclusions, or recommendations. The introduction contains the following subsections:

Opening Paragraph(s):

This paragraph is a duplicate of the opening paragraph in the Executive Summary, but leaves out the overall/general test objective and is allowed to contain references, such as to the relevant test plan(s).

Background:

Reference previous tests, as appropriate, or problems found during operational use, etc. Be sure to tie everything together, e.g., previous builds, blocks, and references to previous technical reports, test plans, or other supporting data.

Test Item Description:

Describe only the item(s) under test, not the entire aircraft. Keep the test item description concise. If the test item description exceeds two pages, leave a summary and move detailed information to an appendix. State whether the test item is production representative, a prototype, or modified. If it is not production representative, describe what was different from, or similar to, the production configuration. Frame your description in terms of what the item was designed to do; how it actually worked sounds like test results, which belong elsewhere.

Overall or General Test Objective:

State your overall or general test objective. Test objectives should be worded exactly as they appeared in the test plan. If you need to reword a test objective for clarity, get permission to do so from your report team co-leads and the technical review authorities (TRA) who reviewed the test plan. If you have specific test objectives, you may list them here as well, but it is not required.

Limitations and/or Constraints:

Limitations prevent test objectives from being met. If you met all test objectives, there is no need to address limitations. If you did not meet all your test objectives, this section is where you say which ones you didn't meet, why, and what effect, if any, that had on your results. If cost, schedule, or asset availability was an issue, say so, but do not denigrate other persons or organizations.

Constraints restrict the scope of activity but do not keep you from meeting the test objective(s). If the constraints affected several areas or test objectives, state that here. If only one area was affected, consider discussing the constraint in the appropriate T&E section.

If there were no limitations or constraints, leave this section out of your TR.

TEST AND EVALUATION (T&E)

The T&E section is where you detail what you did, how you did it, and what you found out. Write in USAF terms using simple sentences. Be thorough, yet concise. Summary plots and tables, which support major conclusions, are appropriate in this section. Highly detailed or complex plots and tables belong in an appendix. Avoid excessive use of acronyms and abbreviations. All results, analyses, conclusions, and recommendations go in this section.

Though this section is written in a narrative style, careful organization will reduce your workload and increase the TR's readability. For instance, if you are evaluating numerous subsystems for specification compliance, organizing by subsystem is appropriate. If you are evaluating a combination of radar, weapons system computer, and forward looking infrared (FLIR) as a total package in operationally representative scenarios (air-to-air, high-dive angle, air-to-ground, or terrain following ingress, etc.), you might organize your report by mission scenario. Organize the test objectives in logical order to support your conclusions and recommendations.

QUICK TIP
Use the template:
The latest template contains guidance on preferred formatting and language.

Where appropriate, add capability-based test objectives at all levels of the evaluation (subsystem [mode], system, or system-of-systems). Measures of performance (MOPs) are not rated, but can be addressed individually under their specific test objective; descriptors should be applied. Integrate military utility, qualitative pilot statements, or other crewmember statements, as appropriate, into each test results section.

Typically, the flow of the T&E section is as follows:

Opening Paragraphs:

The first paragraph is essentially the same as the last paragraph in the Executive Summary, containing an overall rating, significant findings, and an overall recommendation.

In the second paragraph, state that system assessments were made according to the 412 TW rating criteria (table E1), or whatever criteria you used. The Test Wing has asked that authors provide the total number of deficiencies discovered throughout testing, as in the following: "A total of 180 deficiencies were discovered during testing of the developmental and production software versions. Of these, 60 were corrected and 120 resulted in deficiency reports (DRs)." State that system assessments were made according to the 412 TW rating criteria (table X1), or whatever criteria you used. State that DRs were written in accordance with T.O. 00-035D-54, *USAF Deficiency Reporting, Investigation, and Resolution* (reference 5). Add this reference to your report and, if you wish, include the standard recommendation (with the footnote shown here) to correct the DRs:

Correct the deficiencies documented in the deficiency reports, and evaluate any modifications incorporated as a result of the corrective actions. (R2)[1]

The first recommendation in the body of the report, whether it is the overall recommendation, the "correct the deficiencies" boilerplate recommendation, or a specific recommendation later in the TR, must include the footnote defining recommendation numbering (as shown below). If there are no DRs, you do not need to provide the standard recommendation (but you may have other specific recommendations in the document not associated with any DRs).

[1] Numerals following an R represent recommendation numbers.

Another recommendation that may be presented here is the publication change request recommendation reported on AF Form 847 and AFTO Form 22 (flight manual) or AFTO Form 27 (technical order manual). That recommendation format is as follows:

The following change should be added to [the document or manual in question] using AF Form 847/AFTO Form 22: (The words after the colon should come verbatim from your AF Form 847 or AFTO Form 22 or AFTO Form 27). (R##)

All other recommendations belong in the discussion of the appropriate test objective.

An optional stoplight table presenting a summary of your general and/or specific test objectives and their ratings would go here.

OVERALL TEST METHODS AND CONDITIONS (OPTIONAL)

If the same test methods and conditions were used for most or all test objectives, an Overall Test Methods and Conditions section here would prevent needless repetition. Significant deviations from these overall methods and conditions should be included under the appropriate specific test objective(s).

OVERALL OR GENERAL TEST OBJECTIVE (OPTIONAL)

The overall or general test objective is presented first as a shortened header, then in sentence form.

Specific Test Objective:

If there were no specific test objectives, then skip this subsection. Otherwise, this is presented first as a shortened header, then in sentence form. The sentence should be worded exactly as it appeared in the test plan. If you need to reword a test objective for clarity, get permission to do so from your report team co-leads and the technical review authorities (TRA) who reviewed the test plan. You should address every test objective from your test plan in your report; however, if you have many specific test objectives and prefer to address your test results more broadly, you may refer to your general test objectives rather than your specific test objectives.

Test Methods and Conditions.

Briefly summarize your test methods and conditions, using your test plan as the basis (but adjusting to actual test methods and conditions). Be brief when discussing standard test maneuvers or instrumentation. If you used a new technique or datum-gathering concept, describe it briefly, but reserve details for an appendix, TIH, or TIM. Do not include test results in this section.

If you did the same thing for three test objectives, describe it once, then refer back to it in subsequent sections. If a test method, equipment, or a certain configuration was unusable, say so up front, possibly in the Limitations and/or Constraints section, to eliminate having to address it repeatedly throughout the TR.

Test Results.

This section includes test results, analyses, conclusions (in the form of a rating – satisfactory, marginal, or unsatisfactory), and recommendations. First state the rating, then lead your reader through the results and analyses supporting the conclusions/ratings. Use the descriptors that match the associated rating from the 412 TW rating criteria (table E1). Be sure to provide sufficient summary data to justify your ratings. Address both positive and negative test results, in that order as a rule.

Make sure your conclusions/ratings follow logically from your discussions. If you rate something marginal or unsatisfactory, say so (e.g., "The performance of xxx was marginal.") and then explain why in the next sentence(s). Also, if a marginal or unsatisfactory rating is reached, include information as to the severity and impact.

Other rating scales are also provided in appendix E. The intent behind these descriptors and scales is to maintain consistency throughout the squadrons and the 412 TW over time.

QUICK TIP
DR references in body:
Use the complete DR number:
(DR FA2305-13-0170).

MILITARY UTILITY

One of the key aspects of the TR is military utility, where the test results are tied directly to the ability of the entire weapon system to accomplish the mission. This helps the reader understand exactly how the test results will impact capability. For example, a limited flight envelope might restrict the pilot from accomplishing a needed combat maneuver, hence military utility is poor or even unsatisfactory due to the pilot's inability to perform A/A combat. Another might be a software problem in one of the avionics subsystems that prevents the pilot from using a particular function, thus negatively affecting his effective ability to prosecute a target or defend the aircraft. Examples might be a radar mode that does not provide accurate information or an ECCM mode that is ineffective against an enemy's radar.

The author should carefully balance the effectiveness of each part as well as the whole of the weapon system against the ability to accomplish the overall mission; simply because one function does not work effectively does not necessarily equate to the entire weapon system being unsatisfactory or having poor military utility. However, there may be cases where one seemingly minor problem could have far-reaching impacts into parts of the target engagement chain that degrade overall probability of kill or likelihood of accomplishing the objective; this is the section where this should be explained. This section typically requires substantial input from or may even be written by the aircrew.

There are typically two methods of reporting military utility, but as in all areas of the report, flexibility is allowed in order to meet customer needs and communicate results. The first and preferred method is to weave the military utility discussion throughout the TR as each test result is presented. This gives the reader closely tied narratives as each result is discussed, providing the aircrew effectiveness point of view along the way. The second method, less preferred but acceptable, is to write a separate section to address military utility; this is typically used when test results are not easily or conveniently related to the weapon system operation, so the section stands by itself tying the sum of the results back to the mission. Whichever method is employed, the important aspect is for the author to clearly explain whether the tested capabilities advance or degrade the overall ability of the weapon system to safely and effectively accomplish the mission.

Recommendations and DRs

All recommendations must be preceded by conclusions. Recommendations indicate what needs to be done based on your conclusions. Who do you want to act? How? When?

Recommendations are written in active voice. Be specific. State what you want fixed and how you want it to work when fixed, but not how to fix it. The word "must" is reserved for health and safety issues, and should include information on the potential for harm in order to justify the degree of severity.

The recommendation always appears after the relevant discussion, as a part of the same paragraph. Recommendations are numbered sequentially in the T&E section, starting with R1. The recommendation

number is listed after the actual recommendation and after the sentence's period as in this example: **Find and correct the root cause of the intermittent radio failures. (R3)**

Every DR should be followed by a recommendation. The recommendation can be specific to the DR (copied or rephrased from the DR summary), or it can refer back to a previously stated recommendation, such as the standard boilerplate recommendation. Recommendations referring back use the referral style: "**(See R2)**".

The same is true of any publication changes. If more than three DRs deal with one situation, try to find a concise way of writing it into the text:

Additional degradation of navigation units caused by false alarm built-in test failures of all four navigators were observed during testing (DRs FA4605-11-0055, FA4605-11-0059, FA4605-11-0062, and FA4605-11-0073). **(See R4)**

When referring to DRs in text, use the complete set of report control letters and numbers as entered into the DR database (e.g., FA4605-11-0055).

All DRs and publication change requests referenced in the text must be included in an appendix. The DRs do not need to be presented in their entirety; a 412 TW-approved summary format is in appendix B, and in the TR template. Include a table of DR numbers, titles, and page numbers if more than two DRs are included; the same rule applies for publication change requests. Do not differentiate between enhancement DRs and deficiency DRs.

Watch items (WITs) should either be closed or turned into DRs by the time the final report is written.

Do not use contractor discrepancy tracking system numbers. If you want to refer to a contractor document, include a copy of the document(s) in an appendix.

When recommending flight manual or T.O. changes, use (in order of severity):

- "Note" for items without possibility of asset damage
- "Caution" when there is possible asset damage
- "Warning" for a possible safety issue or the possibility of crew injury

QUICK TIP
Visual styles for notes, warnings and cautions:

WARNING

NOTE:

CAUTION

REGRESSION TESTING

Regression testing is meant to spot check whether new software or hardware introduced an unintended change, and if so, to what effect. Results of the regression test may be conveyed by using ratings, descriptors, or impact/no-impact. The RIPT should discuss how best to describe the results that will provide the best description and ensure that the correct message is sent.

Example 1:

Overall, regression testing of the AN/APX-99 avionics navigation was satisfactory. Navigation regression consisted of demonstrations of navigation and anti-jamming control. There were no notable changes to the legacy avionics system functions from previous builds.

Example 2:

Avionics regression testing was satisfactory and consisted of demonstrating radio altimeter functionality. Regression testing with AN/APX-99 software series RK 4.7 showed no change from the inconsistent and incorrect warning advisories found in software series RK 4.6, documented in 412TW-TR-12-98, *AN/APX-99 RK 4.6 Avionics Test and Evaluation* (reference 33). The DRs listed in appendix F were updated. Regression tests showed no degradation to legacy avionics capabilities in AN/APX-99 software series RK 4.6.

ADDITIONAL FINDINGS (OPTIONAL)

If you discovered something during testing that was not within the scope of a test objective, move that discovery discussion to an Additional Findings section, which is located just before the Test Results Summary section.

TEST RESULTS SUMMARY

The test results summary contains a table summarizing the test objectives and ratings.

QUICK TIP
Automatic Update
Sometimes footnote numbers change over the course of reporting. To update the cross-references without having to manually hunt for them:

Select all text (control key+a) then press the F9 key to update all cross-references.

RECOMMENDATIONS (OPTIONAL)

A standalone Recommendations section may be useful for reports with six or more recommendations. The recommendations list is usually ordered numerically, but can be ordered by priority. List the recommendations verbatim from the body of the report and include the page in the TR on which they appear.

In preliminary-style TRs, list the recommendations on the briefing slide(s) if a slide format is used.

REFERENCES

References provide the information necessary for a reader to locate and retrieve any source you cite in the body of the paper. References should be listed in the order they appear in your report.

Fewer than Five Different References:

For TRs, TIHs, and TIMs with fewer than five different references, use a footnote for each reference instead of a References section. In the text of the report, use the Insert Footnote function immediately following the reference document's title (before punctuation). For example:

"The general test objective was to evaluate the supportability and maintainability of the AN/PX-2 system, as documented in AFI 99-103, *Capabilities-Based Test and Evaluation*[2]. There were three specific test objectives."

If you have multiple references to the same source, insert a cross-reference to the original footnote number each time you refer back to it. For example:

[2] AFI 99-103, *Capabilities-Based Test and Evaluation*, HQ USAF, Washington, D.C., October 2013.

"For further guidance, consult EdwardsAFBI 99-103.[2]"

Five or More Different References:

For TRs, TIHs, and TIMs with more five or more different references, a separate page is placed immediately after your T&E section listing all references, numbered, in the order they appear in your report. In the text of the report, use the complete, italicized title of your reference on first use, followed by the reference number in parentheses:

"The test-based lift curves are documented in 412TW-TR-02-97DP1, *AN/APX-99 Spoilers Test and Evaluation Data Package 1* (reference 32)."

On second and further references back to a reference you already discussed, use a shortened, non-italicized title followed by the reference number in parentheses. Be consistent and keep using this same shortened title every time you refer to the document.

"The AN/APX-99 drag polars are documented in Data Package 1 (reference 32)."

For small reports, either format can be used.

- Be careful about the distribution level of the material you are using as references. Be sure that content from more-restricted material is not included in a report with less-restricted distribution. Check with the Edwards AFB Technical Research Library on the level of distribution statements.
- Do not reference classified documents in unclassified reports that are approved for public release. Avoid referencing classified documents in limited distribution unclassified reports, if possible.
- Do not reference a memorandum for record (MFR); include a copy of the MFR in an appendix.
- It is best to include the actual contractor material in an appendix in the report or data package if possible to ensure availability. If the contractor's material is proprietary, check with the Edwards AFB Research Technical Library for guidance.
- Review correspondence and emails with respect to distribution level, origin, and intent. Was the origin from a government source or a private/commercial source? Was the information intended for a DoD-only audience, U.S. Government agencies-only audience, or public release? Always ensure the appropriate distribution statements are included in the report.
- If you use a classified reference, please ask your technical editor for guidance on placing classified references in unclassified technical reports. See appendix C for further classified guidance.

Reference information generally includes:

1. Who – author (when known; omit for test plans)
2. What – document title and number
3. Publisher – name of publishing organization and location (city, state)
4. When – date of publication (use a consistent format; if you have the date, month, and year for some, but only the month and year for others, simply use month and year throughout)
5. Classification level (if applicable)

Reference examples can be found in appendix D.

BIBLIOGRAPHY (Optional)

The bibliography section, which is optional, lists sources of information not referenced in the text. This list will be used by the reader for further reading and is formatted like the references list, without the numbering. The list can be ordered alphabetically by authors' last names, by title when there is no author, or by descending order of priority. Do not reference classified or limited distribution documents in the bibliography, as mandated in AFI 61-202, *United States Air Force Technical Publications Program* (reference 61-202). For more information regarding bibliographies, see the following style manuals:

- *U.S. Government Printing Office, Style Manual,* revised edition GPO S/N 2100-0068. U.S. Government Printing Office, Washington DC, 2008, pp. 25.
- *The Chicago Manual of Style*, University of Chicago Press, I, 16th edition, 2010, Chapter 15.

Complete bibliographic entries include the name of the author, the title, and the full publication history (including the edition, the publisher or press, the city of publication, and the date of publication).

BACK MATTER

APPENDICES

Appendices are for supplemental information. Each appendix should be specific to one type of information.

All TRs, TIHs, and TIMs must contain an appendix listing abbreviations, acronyms, and symbols, and a distribution list appendix (these are, respectively, the second-to-last and last appendices in any document). In addition, TRs must contain an appendix with the rating criteria used in the testing, and a DR summary appendix for any DRs discussed in the main document. More appendices may be added to any document as needed, for such elements as detailed test item descriptions, data analysis methods, detailed plots and figures, or other specific data too cumbersome to be included in the body of the report.

QUICK TIP
Appendices' Order:
The acronym list is always the second to last appendix.

The distribution list is always the last appendix.

Other than for the acronym and distribution appendices, there is no required order of appendices. The following order is suggested for guidance:

APPENDIX A – 412 TW RATING CRITERIA

APPENDIX B – DETAILED TEST ITEM DESCRIPTION

APPENDIX C – DRS AND/OR PUBLICATION CHANGE REQUESTS

APPENDIX D – SPECIAL PROCEDURES OR TECHNIQUES

APPENDIX E – DATA PLOTS AND TABLES

APPENDIX F – ANALYSIS TECHNIQUES

APPENDIX G – ABBREVIATIONS, ACRONYMS, AND SYMBOLS

APPENDIX H – DISTRIBUTION LIST

Consider the reader when putting the information in order. It may be more user-friendly to have the data in appendix A because you require more flipping back and forth to support the conclusions and recommendations. You may not want to include a section for test techniques or maintenance procedures if they were not new. Or perhaps you want to document what was done because you used a technique that has not been performed in 30 years and you want to be a better source for someone trying to perform the same test 30 years from now.

What to include, and how much, is a judgment call. Data should be sufficient to substantiate the analyses and conclusions. Not every bit of a data set should be included unless there is a requirement to do so. Work with your lead engineer to develop appropriate boundaries.

Consider including a table of contents and headings in each appendix if they enhance the presentation and readability/usability.

Do not include flight logs.

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

Include all abbreviations, acronyms, mnemonics (combination of words into letters), and symbols in your report. Define acronyms at first use, beginning with the introduction section of your report, except for those common acronyms that do not require it (appendix F lists them). You do not need to redefine your acronyms in other sections of the report, or in the appendices associated with your report unless they are presented under separate cover. All abbreviations, acronyms, and symbols used in the report must be included in the abbreviations, acronyms, and symbols appendix – even the ones that are not required to be defined on first use.

Include:

- System-specific acronyms and mnemonics
- Abbreviated units of measurement
- Symbols in tables, figures, and equations (including Greek letters)

The list should be compiled in alphabetical order (regardless of capitalization) as follows:

- Numbers precede capital letters and lowercase letters
- Superscripted and subscripted terms are treated as normal letters
- Abbreviations and acronyms with special punctuation or symbols (i.e. periods, &, /, etc.) are listed in alphabetical order as though no special symbol was included
- Numbered subscripts follow in order

Order Acronyms IAW the Following Example:

412 TW	412th Test Wing
AFB	Air Force Base
C	Centigrade or Celsius
c	length of the mean aerodynamic chord
C^2	command and control
CAD	computer aided design
cc	cubic centimeters
C.O.	carry-over
c/o	checkout
USAF	United States Air Force
C_1	rolling moment coefficient
°C	degrees Celsius
%	percent
β	angle of sideslip

Note: Appendix F contains a master list of abbreviations, acronyms, and symbols that are commonly used and therefore do not have to be defined on first use in the body of a document (although they still must be defined in your document's abbreviations, acronyms, and symbols list appendix).

TECHNICAL REPORT COMPOSITION

The foundation of your writing process is the TR template. The central Technical Publications Office provides it, and every technical editor has access to the latest version (minor modifications occur from time to time, so the template is occasionally updated). The latest version is also uploaded to the TENG TR website as changes are requested and incorporated.

When your test plan is finalized, ask your technical editor to create a customized template (a TR skeleton) for you. Your editor will take your test plan and copy the relevant information (background, test item description, test objectives – any information that is unlikely to change during testing) into a TR template. This is not required – you can start your TR yourself – but it gives you a head start on writing your TR and also guides you on the correct formatting.

Do not start your TR using an old TR Word document as a framework – styles and requirements change often, and old document files can get corrupted. Ask your technical editors for the latest template.

TECHNICAL EDITING TIPS

The following tips may assist you in maximizing the value of technical editing, while greatly reducing turnaround time throughout the reporting process:

Early involvement. Request customized templates/skeletons prior to test end to reduce time spent "on the clock" updating your TR to follow current TW content and formatting guidelines.

Communicate your priorities. Let your technical editor know the reporting process schedule, and be specific about your editing expectations, such as:

> "I will be on TDY for a week leading up to the next scheduled IPT meeting; please send your revision to the IPT lead while I'm out."

> "Please track content changes only; do not track changes to formatting, punctuation, spelling, grammar, or document (page, reference, table, or figure) numbers."

> "I would like a formatting-only edit for a first-draft review by the technical expert. How soon can I expect it back?"

Keep tech editing in the loop. In addition to editing, technical editors act as a liaison between document development and production for either review or distribution. They are responsible for collecting and tracking key metadata for the Test Wing, coordinating meetings with multiple stakeholders, generating various forms for document processing, creating read-ahead packages and completing final distributions. To the extent they know your timeline/progress, they can plan their administrative tasks such as to minimize the reporting process time at all stages, particularly between final CTF approval and final TW approval.

CONFIGURATION CONTROL

Configuration control, also known as version control, is the proper management of changes to documents. The main purpose of configuration control is to ensure all changes are made to or incorporated into one "live" document. Good communication is key; document ownership should be clear to both parties whenever ownership is transferred from one IPT member to another, particularly just before and after IPT meetings. Work with your technical editor to prevent losing changes or the

time-consuming retyping that occurs when changes are made to multiple copies of a document simultaneously. Additionally, these tips can help you avoid configuration control problems:

- Include a revision number or letter in the document file's title, and increment the revision as the document changes ownership.
- When sending the document to multiple parties for review, include a reminder to track changes for incoporation into the live document later.
- Tell your technical editor when you wish to continue working on a section (e.g., the DR appendix) after you have submitted the document for editing.

STYLES AND STYLE TAGS

Do not worry about style and formatting. Your job is to make sure the report is technically correct. Technical editors will ensure formatting is consistent with 412 TW guidelines. To simplify the process of report writing and provide for uniform formatting for 412 TW documents, only certain styles are permitted. The template contains these styles, which is why you should always start with a new template or customized "skeleton" from technical editing.

Different tests and different disciplines require different methods of reporting. In this respect, the template is a guide, not a rule book. You must use your professional judgment in how you write your results. However, in terms of *format* – type font and size, margins, the formatting of headers, tables, and figures – reports are expected to be consistent with 412 TW rules.

Do not waste engineering hours formatting your report; technical editors will do this for you.

TIPS ON COMPOSITION

Report Text:

Avoid using the words problem, anomaly, and trouble. Describe what happened. For example, "The AN/APX-99 departed controlled flight at lower angles of attack than simulation results predicted," rather than, "There was a high angle-of-attack anomaly experienced during testing." The PO may not consider it a "problem." In this example, the PO might not have an issue with this angle of attack if the aircraft will rarely be used in that manner. A flight manual change might be an acceptable solution.

Avoid use of proprietary information. If proprietary information is included, ensure the appropriate distribution statements are included in the report.

If the list of test objectives gets long, consider categorizing the test objectives and talking about them in groups. For example:

"The general test objective was to verify the engine lubrication system maintenance functions and tasks. There were 30 specific test objectives; 15 verified removal and replacement times for key hardware, 10 verified all-weather and chem-bio gear tasks, and 5 evaluated new support equipment developed for this aircraft system."

Write in USAF terms using simple sentences. Include sufficient detail to allow the reader to clearly understand what you did and what you found.

Minimize use of abbreviations and acronyms. If you need the acronym, spell it out the first time used followed by the abbreviation/acronym letters in parentheses. You are free to use the acronym once it is defined.

In the T&E section, discuss every test objective you've stated in the Introduction. Even if you didn't execute or complete the test, if you've brought it up in the Introduction, address it in the T&E section. Don't leave readers asking, "Well, what about this test objective?"

QUICK TIP
Use the template:
Don't create new styles. If you're having trouble with formatting or spacing, etc., ask your technical editor for help.

When referring to results, tie them to the test item configuration or flight condition – not the flight number. Flight numbers are usually meaningless to all but you, the tester. Flight logs provide information on which pilot flew what tests.

Integrate qualitative comments from aircrew, maintainers, or others as appropriate; they provide validation for your C&Rs. Use quantitative rating scales whenever possible (see appendix E).

Put enough information in tables and figures so they can be easily understood. Keep the number of tables and figures to a minimum in the body of the report, using only those that summarize key points or results. Highly detailed and complex tables and figures belong in an appendix. Tables and figures should be introduced in the text before they appear in the document.

Style Tips:

Use articles to avoid starting sentences with common abbreviations or acronyms, and spell out numerals that begin sentences (e.g., "The FLIR was awesome," and "Nine minutes after takeoff, the soundtrack from *Jurassic Park* began playing in the co-pilot's left ear cup. Hilarity ensued.")

Separate numbers and units (e.g., 5 hours).

Use conjunctions, such as "and" or "with," rather than slashes (/).

Hyphenate unit modifiers (e.g., the 50-foot radius, the 3-mile sector).

Capitalize the definitions of proper nouns only (e.g., Armament Division [AD], but not line replaceable unit [LRU]).

Voice:

There are two types of voices report writers use: active and passive. The voice indicates whether the subject of the verb performed the action (active voice) or received the action (passive voice).

Active voice: The aircraft's control surfaces and differential brakes properly returned the aircraft to the runway centerline.

Passive voice: The aircraft was properly returned to the runway centerline.

The first example has the benefit of specificity – it tells you not only what happened, but who or what caused it. Use active voice whenever possible, but don't be afraid to use passive voice when it seems more appropriate.

Tense:

When you write the report, keep in mind that the test is in the past. The report is historical in nature and will be written in past tense. Your test item description will also be written in past tense because the results of your testing may start to drive configuration changes (e.g., "The system tested was an AN/APX-99 Block 5 with …").

When discussing testing, evaluating, or other events to take place in the future after the report is published, use wording such as, "further testing was planned" or "The IOT&E was scheduled to begin in March 2016."

Exceptions to the Past-Tense Rule.

- References to other sections of the report (e.g., "Table B2 summarizes the test objectives and ratings.")
- Titles of DRs (and their summaries in the DR appendix)
- Recommendations

Lists:

There is no 412 TW-preferred method for writing lists, but for consistency, minimize the number of styles you use in your report. There is one rule: indent is .25-inch (sublists are indented a further quarter-inch). Consider using bullets when the items are presented in no particular order and numbers when you wish to indicate the consecutive steps of a process or you provide a total number of items in the list.

Hardware removed from the aircraft included:

- Ejection seat
- Windshield wipers
- Cigarette lighter

Notice that "the following" was not added after "included," a colon was used to start the list, and, because listed items are not complete sentences, there is no closing punctuation after each listed item. When each listed item is a complete sentence, each ends with a period.

The committee considering engineers for promotion decided that:

- Engineer A was as good as engineer B.
- Engineer B was better than engineer C.
- Engineer Dee would get the job because the other three were just letters.

Technical Report Writing Tips:

- Spell out common units of measure in the text of the report such as feet, pounds, inches, degrees, miles, etc., but abbreviate in tables and plots.
- Be consistent in the use of descriptor adjectives (table E1) and keep them to a minimum.
- Do not capitalize the words figure, table, and reference when referring to them in the text.
- Express integers whose absolute value is 10 or greater in numerals. Spell out integers whose absolute value is less than 10. A unit of measurement, time, or money, which is always expressed in numerals, does not affect the use of numerals for other numerical expressions in the sentence (e.g., "A team of four men ran the 1-mile relay in 3 minutes and 20 seconds.").

- Program-specific abbreviations, acronyms, and symbols (those not defined in appendix F of this document) must be defined the first time they are used in the report and must be included in the list of abbreviations, acronyms, and symbols.
- Round numbers in tables to the level of significance based on your instrumentation accuracy.
- Avoid using the word "should" in a sentence in the T&E section. Readers might search for a recommendation that does not exist.
- Only use brand names if they are necessary to clarify meaning. At no time should your words imply product endorsement.
- Always add "testing" after "regression" since "regression" used alone implies going backward in time.

Words and Phrases to Avoid:

- "At the time of this writing" – Your TR is dated; therefore, this is unnecessary.
- "Felt" – How they feel isn't relevant; what did they report specifically? For example, instead of saying the test subject felt the task was difficult, say they had difficulty operating the hoist while wearing arctic gloves.
- "The pilot said" – Reword aircrew and maintainer comments as statements rather than as quotes.
- "Problem," "Anomoly," or "Issue" – It may not be a problem to the operator or PO. Just report the deficiency.
- "Results were satisfactory" – We do not rate the results. Instead, we rate the performance, functionality, etc., of the system. Results are data that are complete, incomplete, consistent, etc. The performance of the system was satisfactory, marginal, or unsatisfactory.
- "Totally useless" – Too negative.
- "Extreme" – Use only if it really busts the limits.

QUICK TIP
AVOID JARGON
Assume the reader is unfamiliar with aerospace terminology.

Better Words to Use:

- Instead of "acceptable" or "unacceptable," use the standard ratings: satisfactory, marginal, or unsatisfactory.
- Instead of "contractor" use the company's proper title.
- Instead of using "anomaly," state what in particular was inconsistent with expectations or previous results (e.g., instead of "The aircraft exhibited anomalous behavior" say "The aircraft departed controlled flight at a lower angle of attack than wind tunnel data predicted.").
- Instead of "nominal" (jargony) use "expected" or "usual."
- Instead of "obfuscated" (pedantic) use "confused."
- Avoid parenthetical statements when possible. Use parentheses when referring to tables, figures, acronyms, appendices, DR numbers, and references.

Jargon:

Jargon is specialized language that excludes others from understanding what is said. Write such that a reader who doesn't have a technical background can understand your meaning. When jargon is unavoidable, clearly define the term(s) used, either in text on first use or in a footnote.

General Guidance for Figures and Tables:

In figures or tables, it is preferred, but not required, to spell out all terms. When acronyms or abbreviations are used, include a note directly below the table/figure referring the reader to the appropriate appendix for definitions of abbreviations, acronyms, and symbols.

All information necessary to understand a figure or table should be included and not implied. Use a consistent layout. Check and cross-check data points and tabular data. Label axes properly (do not use measurand numbers as the label; use the title of the measurand). Account for obvious outliers. Avoid the use of flight numbers. They are not an independent variable and are meaningless to readers.

Be consistent with the use of initials capitalization throughout the tables and plots.

When tabulating or plotting test results, use actual flight conditions, not planned test conditions.

Parameters that do not change, or that apply to the entire table or plot, should be in the heading, typically listed in parentheses under the title. If the parameter applies to an entire column or row, it should be in that column or row title. Fill in all spaces/cells of a table; use not applicable (N/A) or --- if necessary.

Never use more significant digits than are justified by the resolution and accuracy of your instrumentation system. All decimals in a given column should be rounded to the same number of significant places (e.g., in the case of 5.1 and 4.48, either 5.1 becomes 5.10, or 4.48 becomes 4.5). Use a zero in front of a decimal when the integer is smaller than 1 (e.g., 0.82).

Headings should include information that is the same for all data presented (i.e. aircraft and engine serial numbers, flight condition, software load, etc.).

In figures, use standard symbols (e.g., ⊙, ⊡, ⟐, △, ▲). Keep like data symbols consistent between plots (e.g., all 10,000-foot data use an ⊙). Include a legend to explain each symbol.

Do not run data past scales, scales past numbers, or fairings past data (unless it is an extrapolation, in which case make the extrapolation fairing dashed). Fair the data whenever possible. Do not connect the dots with straight-line segments. When you have many nearly identical plots, highlight or circle important differences. Put identifiers on complex fairings or fairing families.

Make the scales easy to read and interpret (smallest division should be a multiple of 1, 2, or 5). Use the same scales for each plot in a series or family of plots.

When selecting colors and line patterns, consider contrast with the background color and differentiation between various data sets, particularly where data nearly or completely overlaps.

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Figure numbers and titles are placed at the bottom of the photograph regardless of page layout orientation.

Use color photographs whenever possible to provide the most detail.

Use callouts (labels) to bring attention to significant parts of your photographs.

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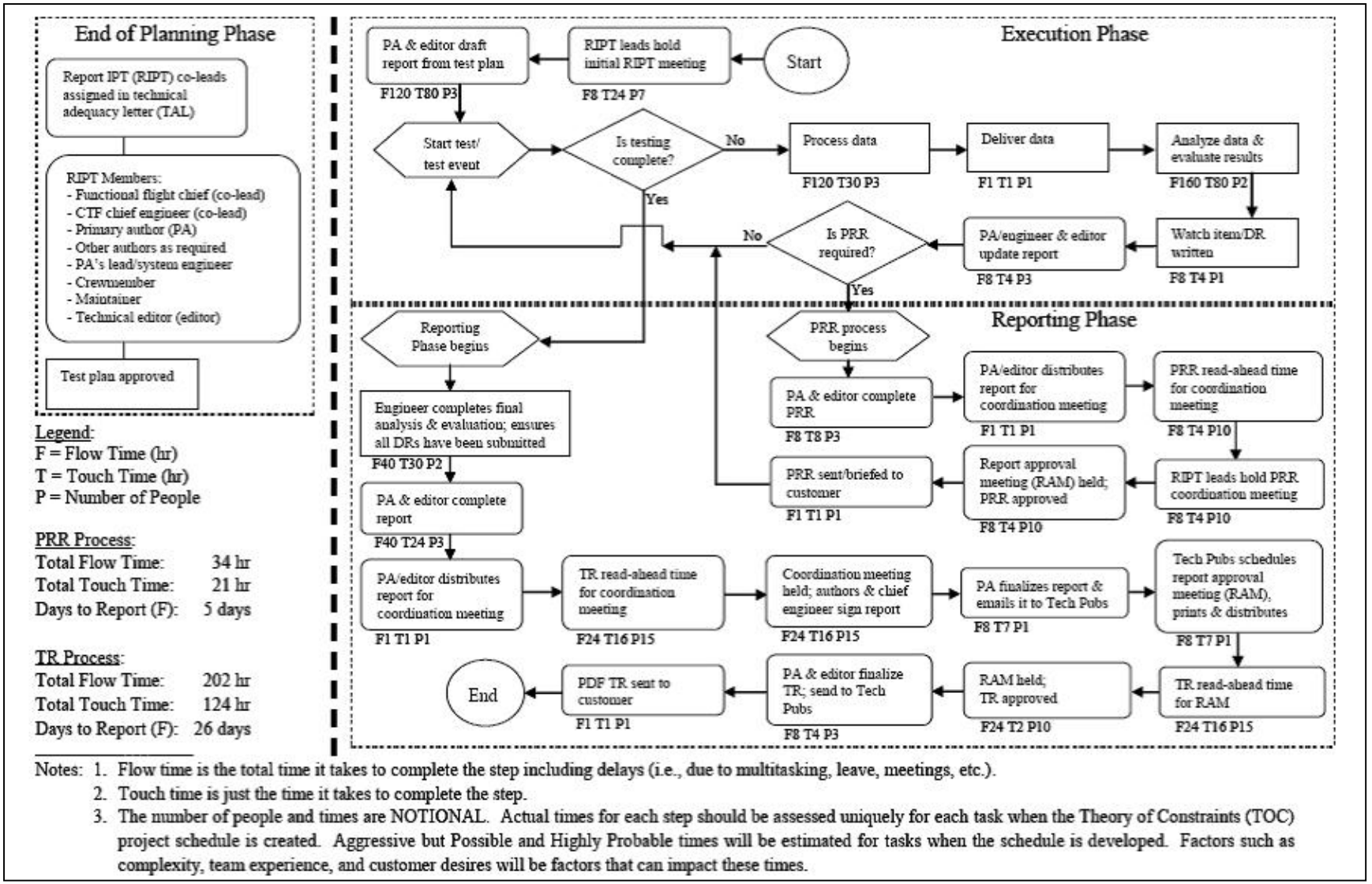
APPENDIX A – QUICK TIPS ON THE TR PROCESS

Table A1 Elements of Documentation

Element	Document Type		
	TR	TIH/TIM	DP
Cover	Yes	Yes	Yes
Signature Page	Yes	Yes	Yes
298	Yes	Yes	Yes
Qualified Requestors Statement	Yes	Yes	Yes
Export Control Statement	Yes	Yes	Yes
PREFACE	N/R	N/R	N/R
EXECUTIVE SUMMARY	Yes	Yes	N/R
TABLE OF CONTENTS	N/R*		
INTRODUCTION	Yes	Yes	N/R
Opening Paragraph	Yes	Yes	N/R
Background	Yes	Yes	N/R
Test Item Description	Yes	Yes	N/R
Test Objectives	Yes	Yes	N/R
Limitations or Constraints	If any	If any	N/R
TEST AND EVALUATION	Yes	N/R	N/R
Opening Paragraph	Yes	N/R	N/R
Overall Test Results	N/R	N/R	N/R
General Test Objectives	Yes	N/R	N/R
Specific Test Objectives	If any	If any	N/R
Test Methods and Conditions	Yes	If any	N/R
Test Results	Yes	If any	N/R
Test Results Summary	Yes	No	N/R
Recommendations (list format)	N/R		
BACKUP MATERIAL			
References	Yes	Yes	N/R
Bibliography	N/R		
APPENDICES			
Rating Criteria	Yes	N/R	N/R
DRs	Yes	N/R	No
List of Abbreviations, Acronyms, and Symbols	Yes	Yes	Yes
Distribution List	Yes	Yes	Yes
Other appendices	As needed	As needed	As needed
Who signs?	Author(s), Chief Engineer, CTF CC (optional), 412 TW/CT	Author(s), Chief Engineer, 412 TW/CT	Author(s), Chief Engineer

Notes: N/R – not required.

* Recommended for documents more than eight pages long.



Notes: 1. Flow time is the total time it takes to complete the step including delays (i.e., due to multitasking, leave, meetings, etc.).
2. Touch time is just the time it takes to complete the step.
3. The number of people and times are NOTIONAL. Actual times for each step should be assessed uniquely for each task when the Theory of Constraints (TOC) project schedule is created. Aggressive but Possible and Highly Probable times will be estimated for tasks when the schedule is developed. Factors such as complexity, team experience, and customer desires will be factors that can impact these times.

Figure A1 EdwardsAFBI 99-103 (reference 2), 412 TW Technical Reporting Process

Table A2 Technical Reporting Activities

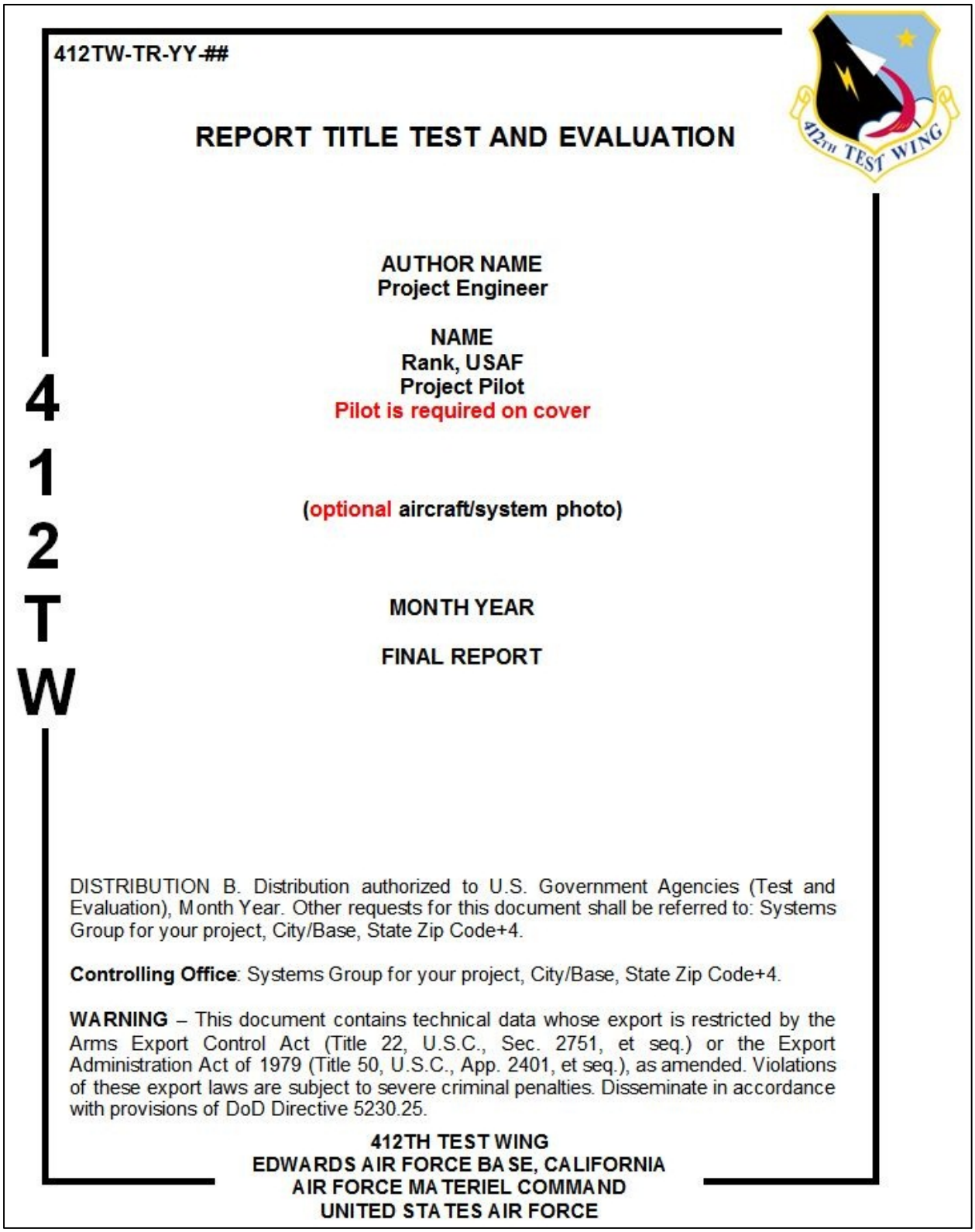
Test Planning	Test Execution	Technical Reporting
During test planning working group meetings, determine WHAT questions need to be answered and WHEN.	Analyze test data real-time, near-real-time, and as soon as possible after each mission.	Finish the analysis.
Draft report outline with help of report team leads and discipline experts. Identify report team members and clarify responsibilities.	Evaluate analytical results to identify potential deficiencies, need for T.O. changes, and places where system meets or does not meet expectations and mission needs.	Finish the evaluation.
Get inputs from POs regarding type of answers needed, WHY (decisions?) and for WHOM. (Generate distribution list.)	Generate deficiency reports and/or draft T.O. (flight manual) changes as soon as issues are identified.	Finish submitting DRs and T.O. change recommendations.
Use PO inputs to generate final report outline.	Draft contents of test and evaluation sections of the report as data analysis progresses.	Finish the T&E section of the report.
Research the system under test. Talk with contractors, POs, past testers and current users. Read system documents, mission documents, manuals, and technical reports.	Review data, DRs, T.O. changes, and T&E section content with report team co-leads and members. Work with lead to draft major conclusions and recommendations (C&Rs).	Finish the C&Rs. Include major C&Rs in the Executive Summary. If there are many recommendations needed, generate a separate recommendations section. Finish the remainder of the report. Schedule a coordination meeting.
Validate your instrumentation and data analysis systems. Review with technical expert.	---	Hold coordination meeting and incorporate changes. Schedule 412 TW approval meeting.
Use information gathered to build test item description, data analysis sections and to set expectations.	---	Hold 412 TW approval meeting and incorporate changes. DONE!

Notes:
1. Read this handbook from cover to cover. Refer to it each time you begin a new report.
2. Consult your report team co-leads to obtain guidance on the report content, the report layout, and the data presentation format. Read examples of recent reports on subjects similar to the one you must address. Discuss the strong and weak points of those examples with your report team co-leads.
3. Begin writing the report once the test plan is approved. Your technical editor is there to help you get started. Do not wait until after all testing is completed to begin writing.
4. Use the approved test plan to develop a thorough outline of your report. Your technical editor can help you with the report outline. Discuss your outline with your report team co-leads to ensure the report flow is smooth and logical.

Table A3 Mapping the Technical Report Tool

Expected Results	Actual Results	Analyses	Evaluation	Conclusions	Recommendations	Military Utility
These should be from the test plan. See if/where the actual results diverge from here.	What did you find? What happened, etc? Compare actual results to expected results to see if/where they diverge	How do you explain what you found or what happened? Why did negative results happen?	What is the quality of what you found or what happened? What was the importance of that result?	Based on that evaluation and using the evaluation scale, are the results satisfactory, marginal, or unsatisfactory as related to the test objective?	If the conclusions were satisfactory, marginal or unsatisfactory, what do you recommend to solve any problems identified?	What is the military significance of the results obtained?

APPENDIX B – VISUAL EXAMPLES



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NAME M. NAME
Rank, USAF
Project Pilot
(Aircrew should be included on the signature page only if they wrote a substantial portion of the report.)

NAME M. NAME (if contractor)
Project Engineer, Contractor Company Name
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This report has been reviewed and is approved for publication:

NAME M. NAME
Chief Engineer
XXX Combined Test Force

NAME M. NAME
Rank, USAF
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XXX Combined Test Force

NAME N. NAME
Technical Director
412th Test Wing

Figure B2 Signature Page

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Form Approved
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1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – Through)*
DD-MM-YYYY (report's TW approval date)	Final Report	DD Month – DD Month YYYY

4. TITLE AND SUBTITLE	5A. CONTRACT NUMBER
Complete Report Title from Cover	5B. GRANT NUMBER
	5C. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)	5D. PROJECT NUMBER
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9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
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14. ABSTRACT

This report presents the results of the (whatever you tested). Testing was requested by the Systems Group for your project, city/base, state. The lead developmental test organization was the Air Force Test Center, Edwards AFB, California, and the executing test organization was the 412th Test Wing/Your Combined Test Force. Testing was conducted at Edwards AFB from start date through last test date, and consisted of ground, taxi, and flight tests totaling XX test hours (XX ground test hours and XX flight test hours). The overall test objective was to XXX. All test objectives were/were not met. (This is the last sentence of the abstract; no results are included in this abstract.)

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Key words or phrases identifying major concepts in the report. (Call the Edwards AFB Technical Research Library @ 661-277-3606 to verify that these terms are acceptable or already in the DTIC thesaurus.)
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a. REPORT	b. ABSTRACT	c. THIS PAGE			412 TENG/EN (Technical Publications Office)
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Figure B3 SF 298

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Figure B6 Export Control Statement

PREFACE

The author would like to acknowledge the outstanding contributions of Mr. James P. MacDandy and Major Elroy Jetson, USAF, 4691 TS/ENFA Scissor-Tipped Jet navigation, guidance and control engineers; Mrs. Jayne Marble and Mr. Shylock Hommes, Martin Marietta landing gear engineers; and Mrs. Kandi Kandragon, JT3 technical editor.

Figure B7 Preface

EXECUTIVE SUMMARY

This report presents the results of the AN/APX-99 Wulph-10 software evaluation. Testing was requested by the Advanced Network Program Office, Wright-Patterson AFB, Ohio. The lead developmental test organization was the Air Force Test Center, Edwards AFB, California, and the executing test organization was the 412th Test Wing/Advanced Network Combined Test Force. Testing was conducted at Edwards AFB from 6 November to 12 December 2013 and consisted of 12 ground test hours and 0.4 flight test hour. The general test objective was to evaluate AN/APX-99 Wulph-10 software.

The purpose of this test was to evaluate Wulph-10 software functionality in the AN/APX-99 system. The Wulph-10 software was intended to replace Wulph-9 software, and included corrections for deficiencies discovered during Wulph-9 software testing at Edwards AFB in August 2012. The Wulph-10 software was designed to assist in gathering information to provide the warfighter with timely and accurate situational awareness, targeting, and battlefield status data.

Overall, functionality of the AN/APX-99 Wulph-10 software was satisfactory with good response time, window and tab performance, and internal data logging under all test conditions. Recommend release of the AN/APX-99 Wulph-10 software for fleet operations.

Figure B8 Executive Summary

TABLE OF CONTENTS

Figure B9 Table of Contents

INTRODUCTION

This report presents the results of the AN/APX-99 Wulph-10 software evaluation. Testing was requested by the Advanced Network Program Office, Wright-Patterson AFB, Ohio. The lead developmental test organization was the Air Force Test Center, Edwards AFB, California, and the executing test organization was the 412th Test Wing/Advanced Network Combined Test Force. Testing was conducted at Edwards AFB from 6 November to 12 December 2013 and consisted of 12 ground test hours and 0.4 flight test hour.

BACKGROUND

The purpose of this test was to evaluate Wulph-10 software functionality in the AN/APX-99 system. The Wulph-10 software was intended to replace Wulph-9 software, and included corrections for deficiencies discovered during Wulph-9 software testing at Edwards AFB in August 2012. The Wulph-10 software was designed to assist in gathering information to provide the warfighter with timely and accurate situational awareness, targeting, and battlefield status data.

The scope of this test effort was considered a limited evaluation because it did not include testing of all Wulph-10 software functions due to an inability to force the Wulph-10 to operate in degraded operating modes. This limitation is common to all previous Wulph test programs.

TEST ITEM DESCRIPTION

The AN/APX-99 Wulph-10 software built upon the Wulph-9 software build. The Wulph-10 software included upgrades to the user interface, data storage, and data transmission modules. A detailed description of the Wulph-10 modifications is presented in appendix B.

TEST OBJECTIVES or OVERALL TEST OBJECTIVE or GENERAL TEST OBJECTIVE

The general test objective was to evaluate the AN/APX-99 Wulph-10 software functionality.

OR

The overall test objective was to evaluate the AN/APX-99 Wulph-10 software functionality. The three general test objectives were to evaluate the functionality of the Wulph-10 software:

1. User interface
2. Data storage
3. Data transmission

All test objectives were met.

Figure B10 Introduction

TEST AND EVALUATION

Overall, functionality of the AN/APX-99 Wulph-10 software was satisfactory with good response time, window and tab performance, and internal data logging under all test conditions. **Recommend release of the AN/APX-99 Wulph-10 software for fleet operations. (R1)**[1]

A total of 200 deficiencies were discovered during testing of the developmental and production software versions. Of these, 60 were corrected and 180 resulted in deficiency reports (DRs), which are included in appendix B. System assessments were made IAW the 412 TW Rating Criteria (table A1). The DRs were written IAW T.O. 00-035D-54, *USAF Deficiency Reporting, Investigation, and Resolution*[2]. **Correct the deficiencies documented in the deficiency reports, and evaluate any modifications incorporated as a result of the corrective actions. (R2)**

WULPH-10 FUNCTIONALITY

The overall test objective was to evaluate the AN/APX-99 Wulph-10 software functionality.

User Interface:

The general test objective was to evaluate the Wulph-10 software user interface.

Test Methods and Conditions.

Testing was executed with the CPU off, internal electrical power disconnected, and the relationalities balanced. Fourteen flight sequences were performed to evaluate the Wulph-10 software user interface.

Test Results.

The Wulph-10 software user interface was satisfactory with good window and tab navigation during all test cases. The users reported that the Wulph-10 system responses were satisfactory with correct responses to all commands. Time histories are shown in figures C2 through C11.

Data Storage:

The general test objective was to evaluate the Wulph-10 software data storage.

Organization.

The specific test objective was to evaluate the Wulph-10 software data storage organization.

Test Methods and Conditions

Testing was executed with the CPU on, internal dialectic power connected, and the relationalities unbalanced. Ninety-eight simulated flight sequences were performed to evaluate the Wulph-10 software data storage organization.

[1] Numerals following an R represent recommendation numbers.
[2] T.O. 00-35D-54, *USAF Deficiency Reporting, Investigation, and Resolution*, 558 CBSS/BGHA, Tinker AFB, Oklahoma, November 2011.

Figure B11 Test and Evaluation Section, 1 of 2

TEST RESULTS SUMMARY

Table 5 presents the overall AN/APX-99 Wulph-10 software test results.

Table 5 Overall AN/APX-99 Wulph-10 Software Test Results

Title	Descriptor	Rating
Overall AN/APX-99 Wulph-10 Software Test Results	**Good**	**Satisfactory**
Evaluate the functionality of the Wulph-10 software user interface.	Good	Satisfactory
Evaluate the functionality of the Wulph-10 software data storage.	Good	Satisfactory
Evaluate the functionality of the Wulph-10 software data storage organization.	Good	Satisfactory
Evaluate the functionality of the Wulph-10 software data storage Auto Disencryptionalization Process Tuner (ADEPT).	Good	Satisfactory
Evaluate the functionality of the Wulph-10 software data transmission.	Good	Satisfactory
Evaluate the functionality of the Wulph-10 software data transmission speed.	Good	Satisfactory
Evaluate the functionality of the Wulph-10 software data transmission ADEPT.	Good	Satisfactory

Note: Abbreviations, acronyms, and symbols are defined in appendix G.

Figure B12 Test and Evaluation Section, 2 of 2 (Test Results Summary)

RECOMMENDATIONS

R1. Recommend release of the AN/APX-99 Wulph-10 software for fleet operations. (Page 3)

R2. Correct the deficiencies documented in the deficiency reports, and evaluate any modifications incorporated as a result of the corrective actions. (Pages 3, 5, and 6)

Figure B13 Recommendations Section

REFERENCES

1. *AN/APX-99 Wulph-10 Software Test and Evaluation*, 412TW-TP-11-11, 412th Test Wing, Edwards AFB, California, September 2011.

2. T.O. 00-35D-54, *USAF Deficiency Reporting, Investigation, and Resolution*, 558 CBSS/BGHA, Tinker AFB, Oklahoma, November 2011.

3. Coyote, Coolidge J., *AN/APX-99 System Performance Developmental Test and Evaluation*, 412TW-TR-11-111, 412th Test Wing, Edwards AFB, California, January 2011.

4. AFPD 31-4, Information Security, USAF HQ, Washington, D.C., September 1998.

5. AFI 31-401, *Information Security Program Management,* USAF HQ, Washington, D.C., November 2005.

6. *Worldwide Kittehbyte-to-Raptor Ponderosity (WKRP) Guidebook Volume II*, Version A.969102.4, Kittehbyte Counting Corporation, Cincinnati, Ohio, May 1979.

Figure B14 References

APPENDIX D – DEFICIENCY REPORTS

Table D1 Deficiency Reports

DR Number	Title	Page Number
FA1234-56-7890	Erroneous Symbol on Weather Radar HUD	3
FA5678-90-1234	Jittery Symbology on Weather Radar HUD	5, 13
AF Form 847 #1	Add Note Regarding Erroneous HUD Symbol	7

DR Number: FA1234-56-7890
A/CXX-X/DR Title: Erroneous Symbol on Weather Radar HUD
Category/Priority: 2

Test Conditions and Results: Evaluation of Wulph-10 software changes were being performed. During the ground test, the forward weapon bay doors were commanded to part (half) position with the auxiliary power units (APUs) providing both hydraulic and cooling air.

Mission Impact: Results in maintenance inability to reliably duplicate and isolate valid aircraft failures, and degrades reliability of system operational checks to certify weapon system as operational and free of defects.

Remedial Action Taken/Recommended: Recommend Wulph software is modified to reliably output forward weapon bay door hydraulic brake CMCs.

DR Number: FAXXXX -XX-XXXX
A/CXX-X/DR Title: Jittery Symbology on Weather Radar HUD
Category/Priority: 1

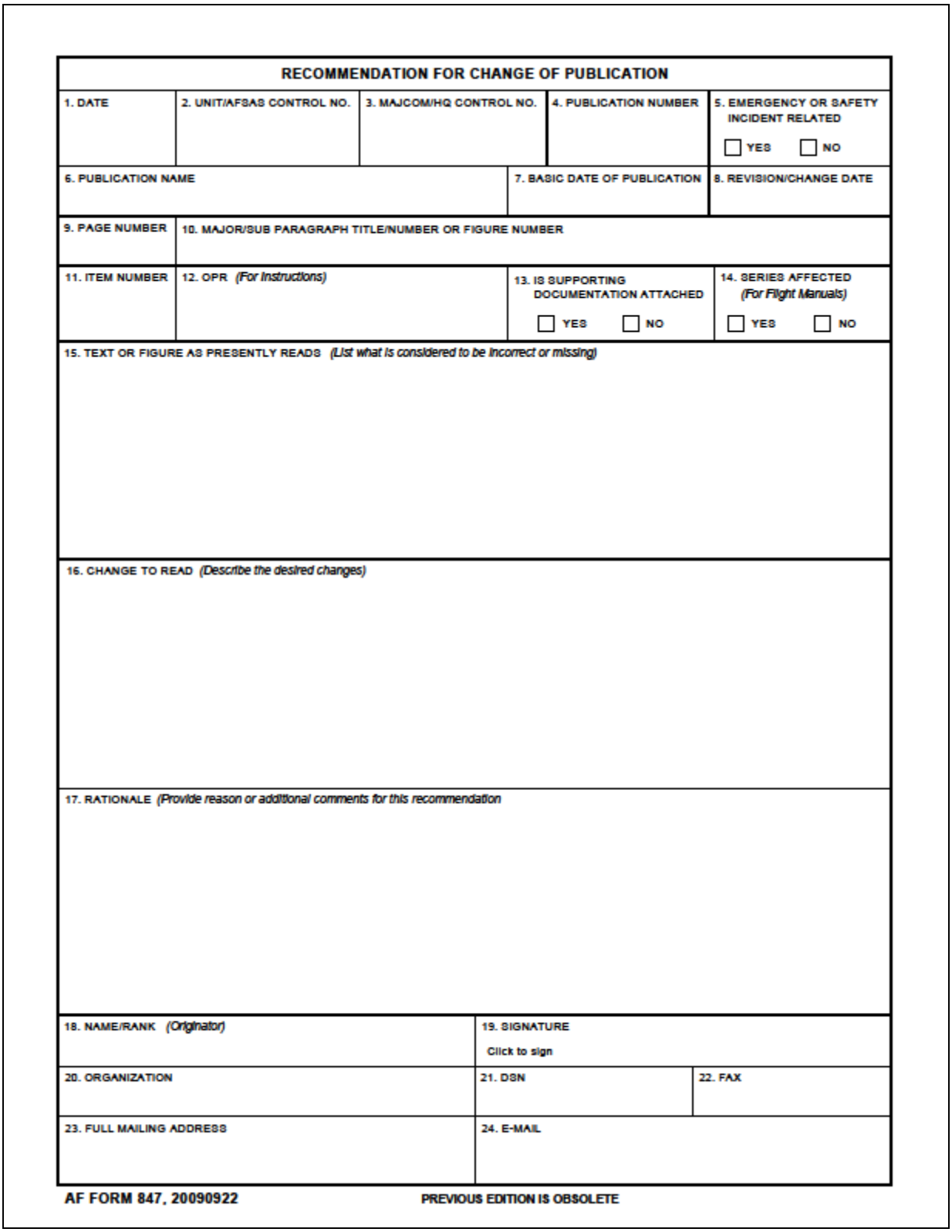
Test Conditions and Results: Evaluation of Wulph-10 software changes were being performed. During the flight test, the aft weapon bay doors were commanded to part (half) position with the auxiliary power units (APUs) providing both hydraulic and cooling air.

Mission Impact: Results in maintenance inability to reliably duplicate and isolate valid aircraft failures, and degrades reliability of system operational checks to certify weapon system as operational and free of defects.

Remedial Action Taken/Recommended: Recommend Wulph software is modified to reliably output aft weapon bay door hydraulic brake CMCs.

D-1

Figure B15 DR Summary Appendix



RECOMMENDATION FOR CHANGE OF PUBLICATION

1. DATE	2. UNIT/AFSAS CONTROL NO.	3. MAJCOM/HQ CONTROL NO.	4. PUBLICATION NUMBER	5. EMERGENCY OR SAFETY INCIDENT RELATED ☐ YES ☐ NO
6. PUBLICATION NAME			7. BASIC DATE OF PUBLICATION	8. REVISION/CHANGE DATE
9. PAGE NUMBER	10. MAJOR/SUB PARAGRAPH TITLE/NUMBER OR FIGURE NUMBER			
11. ITEM NUMBER	12. OPR *(For Instructions)*		13. IS SUPPORTING DOCUMENTATION ATTACHED ☐ YES ☐ NO	14. SERIES AFFECTED *(For Flight Manuals)* ☐ YES ☐ NO

15. TEXT OR FIGURE AS PRESENTLY READS *(List what is considered to be incorrect or missing)*

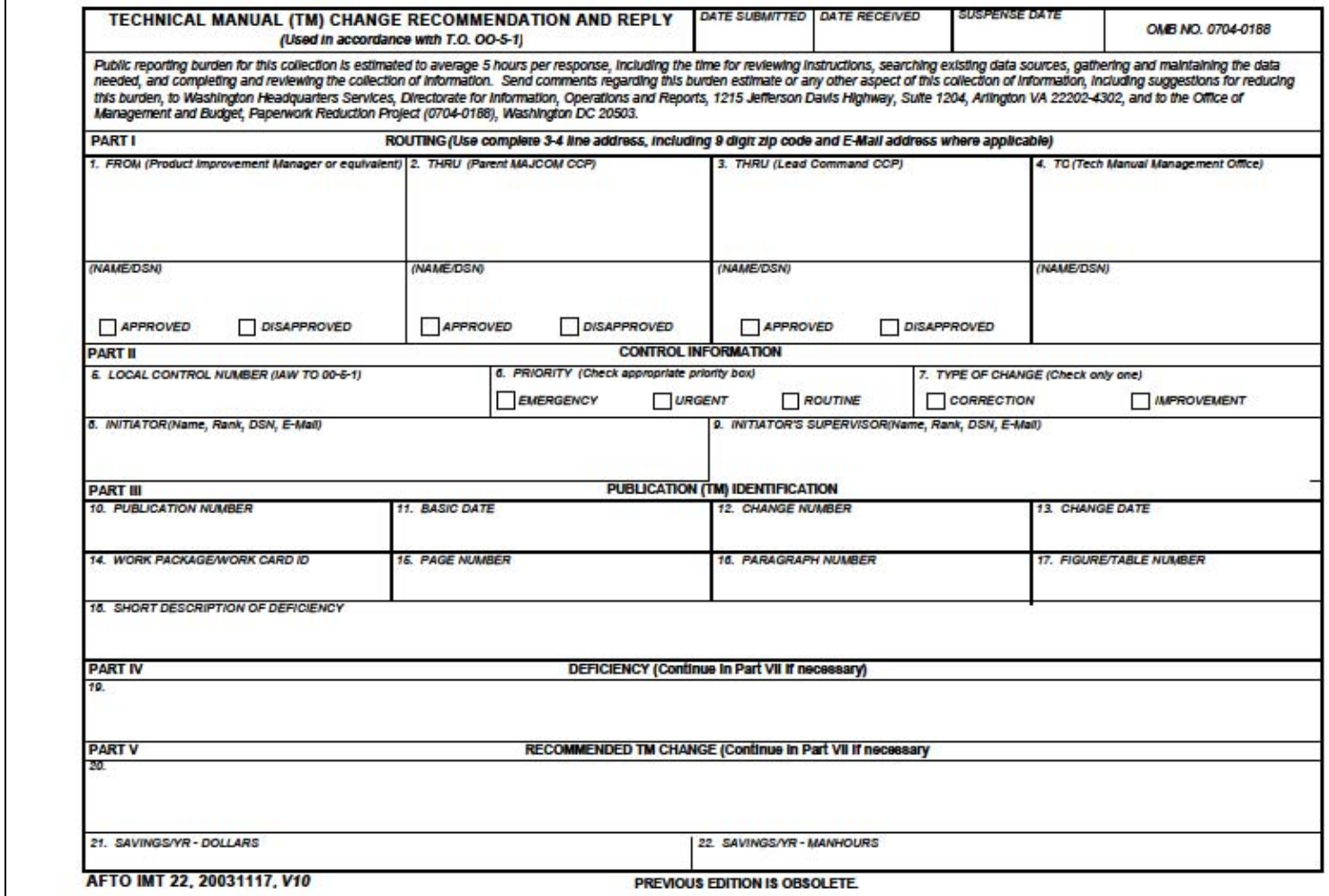
16. CHANGE TO READ *(Describe the desired changes)*

17. RATIONALE *(Provide reason or additional comments for this recommendation*

18. NAME/RANK *(Originator)*	19. SIGNATURE Click to sign	
20. ORGANIZATION	21. DSN	22. FAX
23. FULL MAILING ADDRESS	24. E-MAIL	

AF FORM 847, 20090922 **PREVIOUS EDITION IS OBSOLETE**

Figure B16 AF Form 847



TECHNICAL MANUAL (TM) CHANGE RECOMMENDATION AND REPLY
(Used in accordance with T.O. 00-5-1)

DATE SUBMITTED	DATE RECEIVED	SUSPENSE DATE	OMB NO. 0704-0188

Public reporting burden for this collection is estimated to average 5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information, Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington DC 20503.

PART I — **ROUTING (Use complete 3-4 line address, including 9 digit zip code and E-Mail address where applicable)**

1. FROM (Product Improvement Manager or equivalent)	2. THRU (Parent MAJCOM CCP)	3. THRU (Lead Command CCP)	4. TO (Tech Manual Management Office)
(NAME/DSN)	(NAME/DSN)	(NAME/DSN)	(NAME/DSN)
☐ APPROVED ☐ DISAPPROVED	☐ APPROVED ☐ DISAPPROVED	☐ APPROVED ☐ DISAPPROVED	

PART II — **CONTROL INFORMATION**

5. LOCAL CONTROL NUMBER (IAW TO 00-5-1)	6. PRIORITY (Check appropriate priority box)	7. TYPE OF CHANGE (Check only one)
	☐ EMERGENCY ☐ URGENT ☐ ROUTINE	☐ CORRECTION ☐ IMPROVEMENT

8. INITIATOR(Name, Rank, DSN, E-Mail)	9. INITIATOR'S SUPERVISOR(Name, Rank, DSN, E-Mail)

PART III — **PUBLICATION (TM) IDENTIFICATION**

10. PUBLICATION NUMBER	11. BASIC DATE	12. CHANGE NUMBER	13. CHANGE DATE
14. WORK PACKAGE/WORK CARD ID	**15. PAGE NUMBER**	**16. PARAGRAPH NUMBER**	**17. FIGURE/TABLE NUMBER**

18. SHORT DESCRIPTION OF DEFICIENCY

PART IV — **DEFICIENCY (Continue in Part VII if necessary)**

19.

PART V — **RECOMMENDED TM CHANGE (Continue in Part VII if necessary**

20.

21. SAVINGS/YR - DOLLARS	22. SAVINGS/YR - MANHOURS

AFTO IMT 22, 20031117, *V10* — **PREVIOUS EDITION IS OBSOLETE.**

Figure B17 AFTO 22

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APPENDIX C – CLASSIFICATION MARKUP FOR REPORTS

This section describes the requirements for marking classified reports from DoDM 5200.01, Vol. 1-4, *DoD Information Security Program* (reference 7). This section is intended not to replace the formal guidance, but to highlight some key items. The 412 TW/IPSM, Edwards AFB, has prepared a 412 TW marking guide with the latest guidance.

In accordance with these instructions, we have selected certain elements of the TR, explained how to mark the page and/or items on the page and then followed each element with an example**. If the direction in this guide conflicts with current classified marking regulations, use the current regulations.** Figures and tables in this appendix are for instructional purposes only.

OVERALL DOCUMENT MARKING

There are two methods of overall markings – that is, of marking the top and bottom of **every page** of a classified document in accordance with current regulations. You may either use the highest classification of the *entire document* to mark each page, or you may mark each page according to the highest classification *on that page*. Whichever method you choose, each page must also be portion marked.

Markings within a document, called portion markings, are abbreviated and appear inside parentheses: (C), (S) and (TS). Although it is not required that classifications above (U) be printed in red, it is commonly done in order to draw attention to the higher classification.

QUICK TIP
Classification Markings: Every page must be marked, top and bottom, with the highest classification of either (a) the overall document or (b) that page.

FRONT COVER

Document Title: Your document title should be unclassified whenever possible. The classification of the title goes in parentheses **before** the title.

Classification authority statement: Show the source and its date, which is used as the basis for classification. It is shown in a "Derived From" line. If more than one source is used, show "Multiple Sources" and list those sources in the references or as a separate statement in the report. In addition, show a "Declassify On: [date], obtained from your source and downgrade date. The author is responsible for supplying this information. Figure C1 shows the classification authority statement, just above the WARNING statement at the bottom of the page.

INSIDE FRONT COVER

This report element is normally unclassified and is so marked. Figure C2 shows an example of an unclassified inside front cover (signature page) for a classified report.

SF 298

Try to keep the material in the SF 298 unclassified. Usually, the 298 is unclassified and is so marked.

Block 4 – Title and Subtitle: The title of the document must be marked with the applicable classification abbreviation enclosed in parentheses (U) **before** the title.

UNCLASSIFIED

412TW-TR-YY-##

(U) REPORT TITLE TEST AND EVALUATION

AUTHOR NAME
Project Engineer

NAME
Rank, USAF
Project Pilot
Pilot is required on cover

This page is for instructional purposes only.

(optional aircraft/system photo
with UNCLASSIFIED clearly marked on it)

MONTH YEAR

FINAL REPORT

412TW

DISTRIBUTION B. Distribution authorized to U.S. Government Agencies (Test and Evaluation), Month Year. Other requests for this document shall be referred to: Systems Group for your project, City/Base, State Zip Code+4.

Classified by: individual authoring report and duty title
Derived from: usually Program Security Classification Guide and its publication date
Declassify on: YYYYMMDD of SCG + 10 years unless given a specific date

WARNING – This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec. 2751, et seq.) or the Export Administration Act of 1979 (Title 50, U.S.C., App. 2401, et seq.), as amended. Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DoD Directive 5230.25.

412TH TEST WING
EDWARDS AIR FORCE BASE, CALIFORNIA
AIR FORCE MATERIEL COMMAND
UNITED STATES AIR FORCE

UNCLASSIFIED

Figure C1 Example Classified Cover Page

UNCLASSIFIED

(U) This technical report (412TW-TR-YY-##, *Title of Report Here Test and Evaluation*) was submitted under job order number XXXXXXXX by the Commander, 412th Test Wing, Edwards AFB, California 93524-6843.

(U) Foreign announcement and dissemination by the Defense Technical Information Center are not authorized because of technology restrictions of the U.S. Export Control Acts as implemented by AFI 16-201, *Air Force Foreign Disclosure and Technology Transfer Program*.

(U) Prepared by:

[AUTHOR] NAME M. NAME
Project Engineer

NAME M. NAME
Rank, USAF
Project Pilot
(Aircrew should be included on the signature page only if they wrote a substantial portion of the report.)

NAME M. NAME (if contractor)
Project Engineer, Contractor Company Name
(The contractor cannot be a prime contractor and is always the last name to appear in the 'Prepared by' column.)

(U) This report has been reviewed and is approved for publication:

NAME M. NAME
Chief Engineer
XXX Combined Test Force

NAME M. NAME
Rank, USAF
Commander
XXX Flight Test Squadron
(Optional per CTF)

NAME M. NAME
Technical Director
412th Test Wing

This page is for instructional purposes only.

UNCLASSIFIED

Figure C2 Example Unclassified Inside Front Cover (Signature Page) in Classified Report

Block 13 – Abstract: The abstract should be unclassified whenever possible.

Block 14 – Subject Terms: These should be unclassified whenever possible.

Blocks 17, 18, and 19 – Security Classification of Report: The highest overall classification of the report must be entered in all capital letters.

Figure C3 shows an example of the SF 298 with appropriate portion marking for a classified report.

PREFACE AND EXECUTIVE SUMMARY

Title: The titles in the preface and executive summary are unclassified and must be marked with the unclassified abbreviation (U) **before** the title.

Text: Paragraphs of text must be marked with the applicable classification abbreviation enclosed in parentheses (S), (C), or (U) **before** the first word of each paragraph. This is called portion marking.

Figure C4 shows an example of an executive summary in a classified report.

TABLE OF CONTENTS

Standalone Titles: Titles are normally unclassified and must be marked with a (U) **before** the title. **Avoid the use of classified titles whenever possible.**

Appendix Titles: Titles are normally unclassified and must be marked with the applicable classification **before** the appendix title.

Portion markings are not required on an entirely unclassified TOC. You must, however, include this statement, "The contents of this page are unclassified" under the overall classification marking at the top of the page. Only use portion markings if there are classified titles.

Figure C5 shows an example of an unclassified TOC in a classified report.

Figure C6 shows an example of a classified TOC in a classified report.

MAIN BODY

Paragraph carryover: If a paragraph continues to the next page, an additional portion marking must be placed in front of the first word on the new page.

UNCLASSIFIED

REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Department of Defense, Executive Service Directorate (0704-0188). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.
PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – Through)*
DD-MM-YYYY (report's TW approval date)	Final Report	DD Month – DD Month YYYY

4. TITLE AND SUBTITLE	5A. CONTRACT NUMBER
(U) Complete Report Title from Cover	5B. GRANT NUMBER
	5C. PROGRAM ELEMENT NUMBER

This page is for instructional purposes only.

6. AUTHOR(S)	5D. PROJECT NUMBER
Last Name, First Name M., Project Engineer Last Name, First Name M., Rank, USAF, Proje included on this form only if they are on the signature page) Last Name, First Name, Contractor Project Engineer (No prime contractor authors for TR)	JON HERE (Optional) 5E. TASK NUMBER 5F. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
412th Test Wing Edwards AFB, CA 93524-6843	412TW-TR-YY-XX

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
Systems Group/Program Office Organizational information Street Address City/Base State Abbreviation Zip Code+4	*Example:* AFLCMC/WIG 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
DISTRIBUTION B. Distribution authorized to U.S. Government Agencies (Test and Evaluation), Month Year. Other requests for this document shall be referred to: Systems Group for your project, City/Base, State Zip Code+4.

13. SUPPLEMENTARY NOTES
SC: 012100 CA: 412th Test Wing, Edwards AFB, CA Print this document in COLOR.

14. ABSTRACT
This report presents the results of the (whatever you tested). Testing was requested by the Systems Group for your project, city/base, state. The lead developmental test organization was the Air Force Test Center, Edwards AFB, California, and the executing test organization was the 412th Test Wing/Your Combined Test Force. Testing was conducted at Edwards AFB from start date through last test date, and consisted of ground, taxi, and flight tests totaling XX test hours (XX ground test hours and XX flight test hours). The overall test objective was to XXX. All test objectives were/were not met. (This is the last sentence of the abstract; no results are included in this abstract.)

15. SUBJECT TERMS
Key words or phrases identifying major concepts in the report. (Call the Edwards AFB Technical Research Library @ 661-277-3606 to verify that these terms are acceptable or already in the DTIC thesaurus.)
Style according to DTIC: AFB(Air Force Base); AFTC(Air Force Test Center); AV(air vehicle)

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19A. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			412 TENG/EN (Technical Publications Office)
SECRET	U	U	Same as Report	XXX	19B. TELEPHONE NUMBER (INCLUDE AREA CODE) 661-277-8615

STANDARD FORM 298 (REV. 8-98)
PRESCRIBED BY ANSI STD. Z39.18

UNCLASSIFIED

Figure C3 Example SF 298 in Classified Report

SECRET

(U) EXECUTIVE SUMMARY

(U) This report presents the results of the AN/APX-99 Wulph-10 software evaluation. Testing was requested by the Advanced Network Program Office, Wright-Patterson AFB, Ohio. The lead developmental test organization was the Air Force Test Center, Edwards AFB [illegible]. The executing test organization was the 412th Test Wing/Advanced Network Combin[illegible]. Testing was conducted at Edwards AFB from 6 November to 12 December 2013 and cons[illegible] hours and 0.4 flight test hour. The general test objective was to evaluate AN/APX-9[illegible]

This page is for instructional purposes only.

(U) The purpose of this test was to evaluate Wulph-10 software functiona[illegible] system. The Wulph-10 software was intended to replace Wulph-9 software, and in[illegible] deficiencies discovered during Wulph-9 software testing at Edwards AFB in August 2012. The Wulph-10 software was designed to assist in gathering information to provide the warfighter with timely and accurate situational awareness, targeting, and battlefield status data.

(S) Overall, functionality of the AN/APX-99 Wulph-10 software was satisfactory with good response time, window and tab performance, and internal data logging under all test conditions. Recommend release of the AN/APX-99 Wulph-10 software for fleet operations.

Figure C4 Example Executive Summary in Classified Report

UNCLASSIFIED

(U) TABLE OF CONTENTS

(The contents of this page are UNCLASSIFIED.)

This page is for instructional purposes only.

Figure C5 Example Unclassified Table of Contents in Classified Report

SECRET//NOFORN

(U) TABLE OF CONTENTS

This page is for instructional purposes only.

Figure C6 Example Classified Table of Contents in Classified Report

Section or Chapter headings: Headings must be marked with the applicable security classification abbreviation **before** the heading. **Avoid the use of classified headings whenever possible.**

Untitled text: Untitled text must have the applicable security classification abbreviation **before** the first word of each paragraph. If the untitled text is a list, the applicable security abbreviation goes **after** the number or bullet and **before** the first word of the text. For example:

- (U) Weather Modes
- (U) Range and Azimuth Resolution
- (U) Usability, Lighting, and Interpretability
- (C) Military Utility

See figure C7 and figure C8.

TABLES

Table title: The appropriate security classification abbreviation is placed **after** the table number and **before** the table title. This indicates the classification of the table title, not the table.

Table: The appropriate overall classification of the table is typed in all capital letters enclosed in parenthesis between the table title and the table itself.

Table notes: Table notes are portion marked. The appropriate security classification abbreviation is placed **after** the note number and **before** the note text.

Table footnotes: Table footnotes are portion marked.

See figure C11.

FIGURES

Figure title: The appropriate security classification abbreviation must be placed **after** the figure number and **before** the title. It indicates the classification of the figure title, not the figure itself.

Body of the figure: The appropriate overall classification of the figure is typed in all capital letters and placed within or next to the body of the figure per DoD 5200.01 (reference 7).

See figure C9.

SECRET//NOFORN

(U) INTRODUCTION

(U) This report presents the results of the AN/APX-99 Wulph-10 software evaluation. Testing was requested by the Advanced Network Program Office, Wright-Patterson AFB, Ohio. The lead developmental test organization was the Air Force Test Center, and the executing test organization was the 412th Test Wing/Advanced N e. Testing was conducted at Edwards AFB from 6 November to 12 December round test hours and 0.4 flight test hour.

This page is for instructional purposes only.

(U) BACKGROUND

(U) The purpose of this test was to evaluate Wulph-10 software functionality in the AN/APX-99 system. The Wulph-10 software was intended to replace Wulph-9 software, and included corrections for deficiencies discovered during Wulph-9 software testing at Edwards AFB in August 2012. The Wulph-10 software was designed to assist in gathering information to provide the warfighter with timely and accurate situational awareness, targeting, and battlefield status data.

(S//NF) The scope of this test effort was considered a limited evaluation because it did not include testing of all Wulph-10 software functions due to an inability to force the Wulph-10 to operate in degraded operating modes. This limitation is common to all previous Wulph test programs.

(U) TEST ITEM DESCRIPTION

(U) The AN/APX-99 Wulph-10 software built upon the Wulph-9 software build. The Wulph-10 software included upgrades to the user interface, data storage, and data transmission modules. A detailed test item description is provided in appendix B.

(U) TEST OBJECTIVES

(U) The overall test objective was to evaluate the AN/APX-99 Wulph-10 software functionality. The three general test objectives were to evaluate the functionality of the Wulph-10 software:

1. (U) User interface
2. (U) Data storage
3. (U) Data transmission

(U) All test objectives were met.

SECRET//NOFORN

Figure C7 Example Classified Introduction in Classified Report

SECRET

(U) TEST AND EVALUATION

(U) Overall, functionality of the AN/APX-99 Wulph-10 software was s[illegible]se time, window and tab performance, and internal data logging under al[illegible]**nd release of the AN/APX-99 Wulph-10 software for fleet operations. (R1)**

This page is for instructional purposes only.

(S) A total of 200 deficiencies were discovered during testing of the [illegible]on software versions. Of these, 60 were corrected and 180 resulted in defici[illegible]re included in appendix B. System assessments were made IAW the 412 TW Rating Criteria (table A1). The DRs were written in accordance with T.O. 00-035D-54, *USAF Deficiency Reporting, Investigation, and Resolution*[2]. **Correct the deficiencies documented in the deficiency reports, and evaluate any modifications incorporated as a result of the corrective actions. (R2)**

(U) WULPH-10 FUNCTIONALITY

(U) The overall test objective was to evaluate the AN/APX-99 Wulph-10 software functionality.

(U) User Interface:

(U) The general test objective was to evaluate the Wulph-10 software user interface.

(U) Test Methods and Conditions.

(U) Testing was executed with the CPU off, internal electrical power disconnected, and the relationalities balanced. Fourteen flight sequences were performed to evaluate the Wulph-10 software user interface.

(U) Test Results.

(U) The Wulph-10 software user interface was satisfactory with good window and tab navigation during all test cases. The users reported that the Wulph-10 system responses were satisfactory with correct responses to all commands. Time histories are shown in figures C2 through C11.

(U) Data Storage:

(U) The general test objective was to evaluate the Wulph-10 software data storage.

(U) Organization.

(U) The specific test objective was to evaluate the Wulph-10 software data storage organization.

(U) Test Methods and Conditions

(U) Testing was executed with the CPU on, internal dialectic power connected, and the relationalities unbalanced. Ninety-eight simulated flight sequences were performed to evaluate the Wulph-10 software data storage organization.

---

[1] Numerals following an R represent recommendation numbers.
[2] T.O. 00-35D-54, *USAF Deficiency Reporting, Investigation, and Resolution*, 558 CBSS/BGHA, Tinker AFB, Oklahoma, November 2011.

Figure C8 Example of Classified T&E Section Page

SECRET

(U) APPENDIX B – APPLICATION MODES

(U) LANDING MODE

(U) Figure B1 presents an overview of the Wulph-10 software iOS app's landing mode.

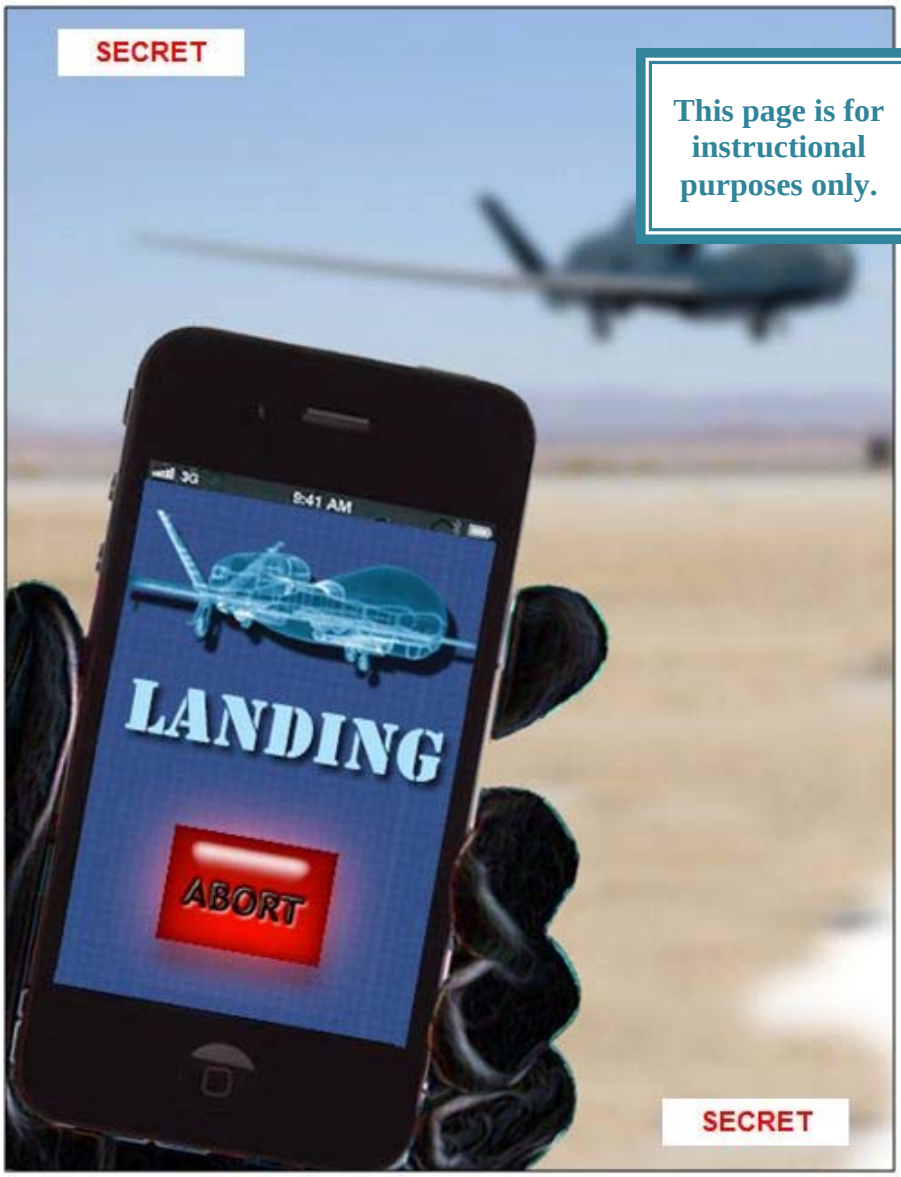

Figure B1 (U) Wulph-10 iOS App (Landing Mode)

B-1
SECRET

Figure C9 Example Classified Figure in Classified Report

REFERENCES AND BIBLIOGRAPHY

Section title heading: Place the portion marking **before** the title: (U) REFERENCES

Titles of listed documents: Titles of classified documents must have the applicable portion marking **before** the title. The classification of each referenced document must be spelled out at the end of each reference:

1. Coyote, Coolidge J., *(U) AN/APX-99 Block 7 Electronic Heating and Cooling System Test and Evaluation*, 412TW-TR-08-88, 412th Test Wing, Edwards AFB, California, May 2008. (SECRET)

BLANK PAGES

The statement, "(U) This page was intentionally left blank." is placed in the center. See figure C10.

APPENDICES

If an entire appendix is unclassified, the statement "The contents of this appendix are unclassified" appears on the appendix title page below the appendix title at the top of the page. Portion markings are not required; however, if the appendix is longer than two pages, consider either portion marking the appendix or repeating the "contents of this appendix are unclassified" statement on each page in order to prevent confusion should the pages become separated from the document. See figure C11. Otherwise:

Appendix title: Place the portion marking **before** the title: (U) APPENDIX A – RADIO ALTIMETER DETAILS.

Paragraph headings and untitled text: Security classification markings for paragraph headings and untitled text in appendices are marked in the same manner as in the main body of the report.

List of Abbreviations, Acronyms and Symbols: No portion markings are required unless the list contains a classified abbreviation, acronym, or symbol. If so, the entire appendix must be portion marked.

Distribution List: The distribution list is always unclassified. When using the page-level classification method, the top and bottom margins must be marked with UNCLASSIFIED at the top and bottom margin of each page and the statement "The contents of this appendix are unclassified" below the title. No portion markings are required. When using the overall classification marking method, the top and bottom of each page will be marked with the document's highest classification, and "The contents of this appendix are unclassified" appears under that label.

QUICK TIP
Classified markings: Talk to your security people first, and your technical editors second, if you have questions about marking your document.

This page is for instructional purposes only.

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Figure C10 Example Blank Page in Classified Report

SECRET

(U) APPENDIX D – DEFICIENCY REPORTS

Table D1 (U) Deficiency Reports

(UNCLASSIFIED)

DR Number	Title	Page Number
FA1234-56-7890	Erroneous Symbol on Weather Radar HUD	3
FA5678-90-1234	Jittery Symbology on Weather Radar HUD	5, 13
AF Form 847 #1	Add Note Regarding Erroneous HUD Symbol	7

(U) Note: Abbreviations, acronyms, and symbols are defined in appendix G.

(U) DR Number: FA1234-56-7890
(U) A/CXX-X/DR Title: Erroneous Symbol on Weather Radar HUD
(U) Category/Priority: 2

(U) Test Conditions and Results: Evaluation of Wulph-10 software c ed. During the ground test, the forward weapon bay doors were commanded the auxiliary power units (APUs) providing both hydraulic and cooling air.

This page is for instructional purposes only.

(U) Mission Impact: Results in maintenance inability to reliably dup raft failures, and degrades reliability of system operational checks to certify we nd free of defects.

(U) Remedial Action Taken/Recommended: Recommend Wulph software is modified to reliably output forward weapon bay door hydraulic brake CMCs.

(U) DR Number: FAXXXX -XX-XXXX
(U) A/CXX-X/DR Title: Jittery Symbology on Weather Radar HUD
(U) Category/Priority: 1

(U) Test Conditions and Results: Evaluation of Wulph-10 software changes were being performed. During the flight test, the aft weapon bay doors were commanded to part (half) position with the auxiliary power units (APUs) providing both hydraulic and cooling air.

(U) Mission Impact: Results in maintenance inability to reliably duplicate and isolate valid aircraft failures, and degrades reliability of system operational checks to certify weapon system as operational and free of defects.

(U) Remedial Action Taken/Recommended: Recommend Wulph software is modified to reliably output aft weapon bay door hydraulic brake CMCs.

Figure C11 Example Unclassified Appendix Front Page in a Classified Document

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APPENDIX D – REFERENCE EXAMPLES

These are examples for various types of references, not complete guidance for how to present your references page. See the References section for further guidance.

CONTRACTOR REPORT REFERENCE

Flight Test of the Production F100-PW-220 Engine in the F-16, TIS FA1198, General Dynamics Fort Worth Division, Fort Worth, Texas, revised June 1986.

412 TW TEST PLAN REFERENCE

RQ-4 Global Hawk Landing Performance Test and Evaluation, AFFTC-TP-10-101, Air Force Flight Test Center, Edwards AFB, California, August 2010.

Note: Author names are not included in test plan references.

412 TW TECHNICAL REPORT REFERENCE

Newell, Keith A., First Lieutenant, USAF, *F-16/F100-PW-220 Production Engine Flight Test Evaluation Volume 1 of 11,* AFFTC-TR-86-44, Air Force Flight Test Center, Edwards AFB, California, March 1987.

PRIME ITEM DEVELOPMENT SPECIFICATION (PIDS) REFERENCE

Prime Item Development Specification for Turbofan Engine F100-PW-200, 16PRXXXX, Pratt and Whitney Aircraft Group, West Palm Beach, Florida, July 1980.

REFERENCE MANUALS REFERENCES

Altitude Tables, 1962 United States Standard Atmosphere, Air Force Flight Test Center, Edwards AFB, California, April 1962.

Performance and Flying Qualities UFTAS Reference Manual, Air Force Flight Test Center, Edwards Air Force Base, California, October 1984.

DeAnda, Albert G., *AFFTC Standard Airspeed Calibration Procedures*, AFFTC-TIH-81-5, Air Force Flight Test Center, Edwards AFB, California, revised June 1981.

AIRCRAFT FLIGHT MANUAL REFERENCE

Flight Manual, USAF Series Aircraft, F-16C, Technical Order 1F-16C-1, General Dynamics Fort Worth Division, Fort Worth, Texas, 23 July 1984.

BOOK REFERENCE

Parkinson, C., Northcote, *Parkinson's Law and Other Studies in Administration*, Houghton Mifflin Company, Boston, Massachusetts, 1957.

JOURNAL ARTICLE REFERENCE

Carrier, G.F., "Heuristic Reasoning in Applied Mathematics," *Quarterly of Applied Mathematics, Vol XXX, No. 1*, Brown University, Providence, Rhode Island, William Byrd Press, Richmond, Virginia, April 1972, pp. 11-15.

CONTRIBUTION TO SYMPOSIUM OR CONFERENCE REFERENCE

Brown, R.C., "Fatigue, Fact or Fiction?" Presented at the Symposium on Fatigue (eds. Floyd, W.F. and Welford, A.T.), held by Ergonomics Research Society, Cranfield, England, 24-27 March 1952, H.K. Lewis and Co., Ltd., London, England, 1953, pp. 24-27.

MILITARY SPECIFICATION REFERENCE

Military Standard Climatic Extremes for Military Equipment, MIL-STD-210B, Hanscom AFB, Massachusetts, 15 December 1973.

INSTRUCTION REFERENCE

AFFTCI 91-5, *AFFTC Test Safety Review Process*, Edwards Air Force Base, 1 September 2001.

LETTER REFERENCE

See letter in appendix X dated 15 March 2001 from Joseph Engineering concerning minimum ground control speeds.

Note: Place a copy of these letters in an appendix because official files are purged after several years and the reference will be lost unless it is provided in the report.

ELECTRONIC SOURCE REFERENCES

Email:

See a copy of the email in appendix X sent from Bernice Smith, Project Manager, to Joseph Clark, Project Engineer, 1 April 2001, concerning bird strike capability of the YNEW aircraft.

Note: Place a copy of email in an appendix because files have either limited access or are purged after several years and the reference will be lost.

Website:

Government Publications, accessed 2 July 2001, http://bookstore.gpo.gov.

Note: Whenever practical, download what you are referencing from the website and include that material in an appendix or data package. This will help the reader in the event the website is closed, changes address, or is updated without your source information in the future.

APPENDIX E – DESCRIPTOR TERMS AND RATING SCALES

The 412 TW uses standard descriptors and rating scales: (1) The 412 TW Rating Criteria (table E1) is used to help you choose a rating based on whether or not the system met the requirements of the mission or task and the level of changes that are recommended for improvement. This is the most commonly used scale; (2) The Cooper-Harper scale is used for flying quality rating assessments; and (3) The 6-point and 5-point general purpose scales are used when the 412 TW rating criteria or Cooper-Harper ratings are not applicable.

The intent of the scales is to provide consistency in the individual and overall ratings of systems under test. It is important that there be consistency between squadrons, and between various projects within a squadron, in the use of descriptors explaining the various gradations of satisfactory or unsatisfactory ratings.

QUICK TIP
RATING RGB SETTINGS:
Blue: 0-153-255
Green: 102-255-102
Yellow: 255-255-0
Red: 255-0-0

If the scales discussed in this handbook are not applicable to your testing and you are required to create a different rating scale, obtain approval from the Human Systems Integrations office of the Test Engineering Group, the experts in rating scale development, prior to beginning your evaluation.

Table E1 412th Test Wing Rating Criteria

How Well Does the System Meet Mission and/or Task Requirements?	Changes Recommended for Improvement	Mission/Task Impact	Descriptor	Rating
Exceeds requirements	None	None	Excellent	Satisfactory
Meets all or a majority of the requirements	Negligible changes needed to enhance or improve operational test or field use	Negligible	Good	Satisfactory
Some requirements met; can do the job, but not as well as it could or should	Minor changes needed to improve operational test or field use	Minor	Adequate	Satisfactory
Minimum level of acceptable capability and/or some noncritical requirements not met	Moderate changes needed to reduce risk in operational test or field use	Moderate	Borderline	Marginal
One or some of the critical functional requirements were not met	Substantial changes needed to achieve satisfactory functionality	Substantial	Deficient	Unsatisfactory
A majority or all of the functional requirements were not met	Major changes required to achieve system functionality	Major	Unacceptable	Unsatisfactory
Mission not safe	Critical changes mandatory	Critical	Unsafe	Failed

412 TW RATING CRITERIA

Overall Rating:

The overall rating of a system under test is based on its ability to accomplish the mission or how well the system meets critical requirements. Successful execution of specific tasks within a mission or in a single mode does not necessarily result in a positive overall rating. You should address individual test objectives with ratings in the T&E section of your report, and these results will inform your overall rating, but they will not necessarily match it. Rather than trying to average your specific test objective ratings into an overall rating, weigh the relative importance of each test objective with respect to the system's ability to accomplish the mission, or meet critical requirements. It is possible for a test to result in marginal ratings for several specific test objectives and yet be rated satisfactory overall, if the most significant test objectives are satisfactory, or if the system nevertheless performs its mission adequately. Use your judgment and your knowledge of mission needs to weigh the various aspects of your testing.

When drawing formal conclusions regarding the overall adequacy of a system under test, it is 412 TW policy that only the terms satisfactory, marginal, or unsatisfactory are used. Table E1 presents degrees of satisfactory and unsatisfactory and an associated descriptor to use in your report to describe the rating. The following are guidelines on how to use the ratings:

Satisfactory:

In discussing degrees of satisfactory, the descriptor "excellent" conveys a meaning of "exceeds requirements." No changes are recommended for improvement and there is no negative mission/task impact.

The descriptor "good" conveys a meaning of "meets all or a majority of the requirements." Any negative mission/task impact is negligible, so any recommended changes would be negligible changes that would enhance or improve operational test or field use.

The descriptor "adequate" conveys a meaning of "some requirements met; can do the job, but not as well as it could or should." Negative mission/task impact is minor. Recommended changes fall in the category of "minor changes needed to improve operational test or field use."

Marginal:

Of all the words used in table E1, marginal is the most controversial and has the greatest variability of meaning between individuals. Typically, the term marginal is used when the test team cannot clearly call a system under test satisfactory or unsatisfactory, or when some items are satisfactory and others are unsatisfactory such that a minimum level of acceptable capability is not met.

Unsatisfactory:

In discussing degrees of unsatisfactory, the descriptor "deficient" implies a system that does not meet one or more critical functional requirements and there is substantial negative mission/task impact. Recommended changes would be in the category covered by the phrase "substantial changes needed to achieve satisfactory functionality."

For systems that are more severely deficient, the descriptor "unacceptable" conveys a meaning that the system does not meet a majority, or all, of the functional requirements. With major negative mission/task impact, the recommended changes would be in the category of "major changes required to achieve system functionality."

Failed:

The descriptor “unsafe” represents the negative extreme. The mission is not safe and the mission/task impact is critical. Recommendations associated with this category fall in the ‘critical changes mandatory’ classification.

Remember to apply common sense when using these ratings. If you found that one of the criteria you had in your test plan changed, needed to be better defined, or was unrealistic, take that into consideration on the overall and individual ratings. For example, if the test plan said engine start should take no longer than 60 seconds but you find the starts were 61 seconds long, your result is not necessarily marginal or unsatisfactory if the overall system mission could absorb 1 second more of start time.

GUIDELINES FOR DETERMINING RATINGS

If you could not meet a critical requirement, the system should be rated unsatisfactory.

You cannot have only marginal and satisfactory ratings and then rate the overall system unsatisfactory.

When an overall rating is different from various sub-ratings, explain why those ratings rolled up into a different overall rating (for instance, several subsystems might be rated marginal, but if they are of minor significance in overall performance as compared to the one or two subsystems that were rated satisfactory, that would justify an overall rating of satisfactory).

Comparisons:

Be sure you have baseline data when comparing or stating an improvement. When comparing to baseline performance, use the terms “comparable” and/or “degraded” rather than satisfactory, marginal, or unsatisfactory.

If there is no specification or value to compare data to, explain how you arrived at your standards for determining what constituted satisfactory, marginal, or unsatisfactory.

Do not compare data to past performance if you are not confident in the data due to setup or sample size differences, etc., but include the data for reference. If the analysis method has changed from what was done in the past, include the data and state that the data cannot be compared. Consider analyzing the data as it was accomplished previously, and include these results for future comparison.

When comparing or referring to specifications, cite the specification.

COOPER-HARPER RATING SCALE

The Cooper-Harper rating scale is used to rate the handling qualities of an aircraft based on data and pilot comments. Modified Cooper-Harper scales are not considered standard and should not be used. Figure E1 shows the Cooper-Harper rating scale.

The Cooper-Harper rating is arranged to make the pilot make three sequential decisions:

1. Is the aircraft controllable?
2. Is it acceptable?
3. Is it satisfactory?

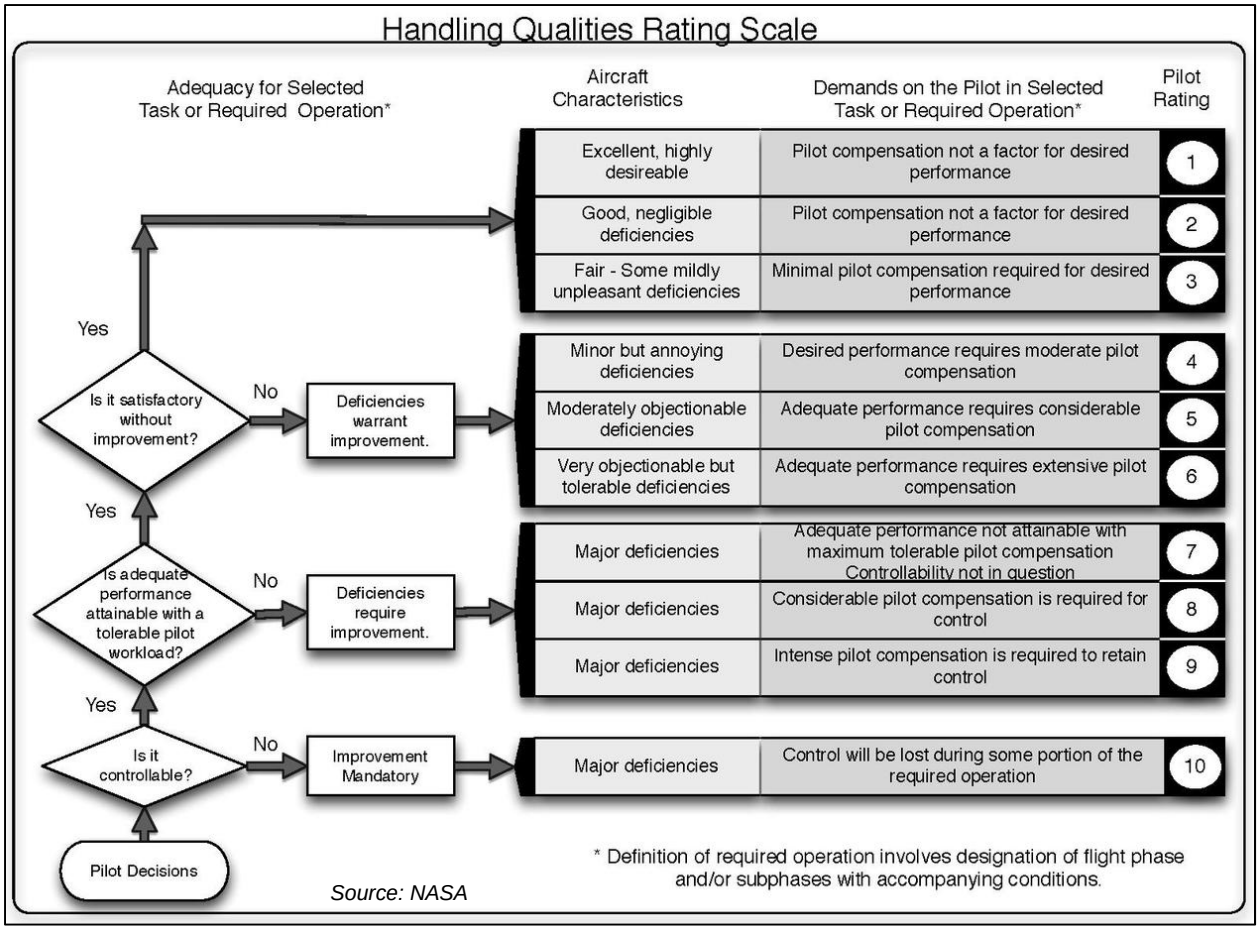

Figure E1 Cooper-Harper Rating Scale

After these decisions have been made, the aircraft handling qualities will be assigned to one of four categories, and further resolution is made within each category depending on the pilot compensation required. Table E2 lists the four categories and where they fall on the scale.

The Cooper-Harper scale should be used in conjunction with pilot comments. The pilot comments will help you discover aircraft control system deficiencies. This scale should not be used for anything but flying qualities testing. Consult the performance and flying qualities discipline experts for more guidance on how to apply this scale and incorporate pilot comments into a proper handling qualities rating.

Table E2 Aircraft Handling Quality Categories

Category	Description	Scale
Satisfactory	Good – does not need improvement	1-3
Unsatisfactory but Acceptable	Can do the mission but improvements desired	4-6
Unacceptable	Not suitable for the mission, the task cannot be repeatedly performed	7-9
Uncontrollable	While attempting to perform the task, control of the aircraft was temporarily lost	10

PILOT IN-THE-LOOP OCSILLATION RATING SCALE

Also known as the Pilot In-the-loop Oscillation (PIO) tendency classification, this scale is used to rate the aircraft-pilot combination susceptibility to PIO based on pilot comments (figure E2). Modified versions of this scale are not considered standard and should not be used. This scale is often used subsequent to Cooper-Harper ratings that warrant further investigation of aircraft handling qualities deficiencies. However, a pilot should be requested to provide a rating if the tendency for PIO is noted anywhere.

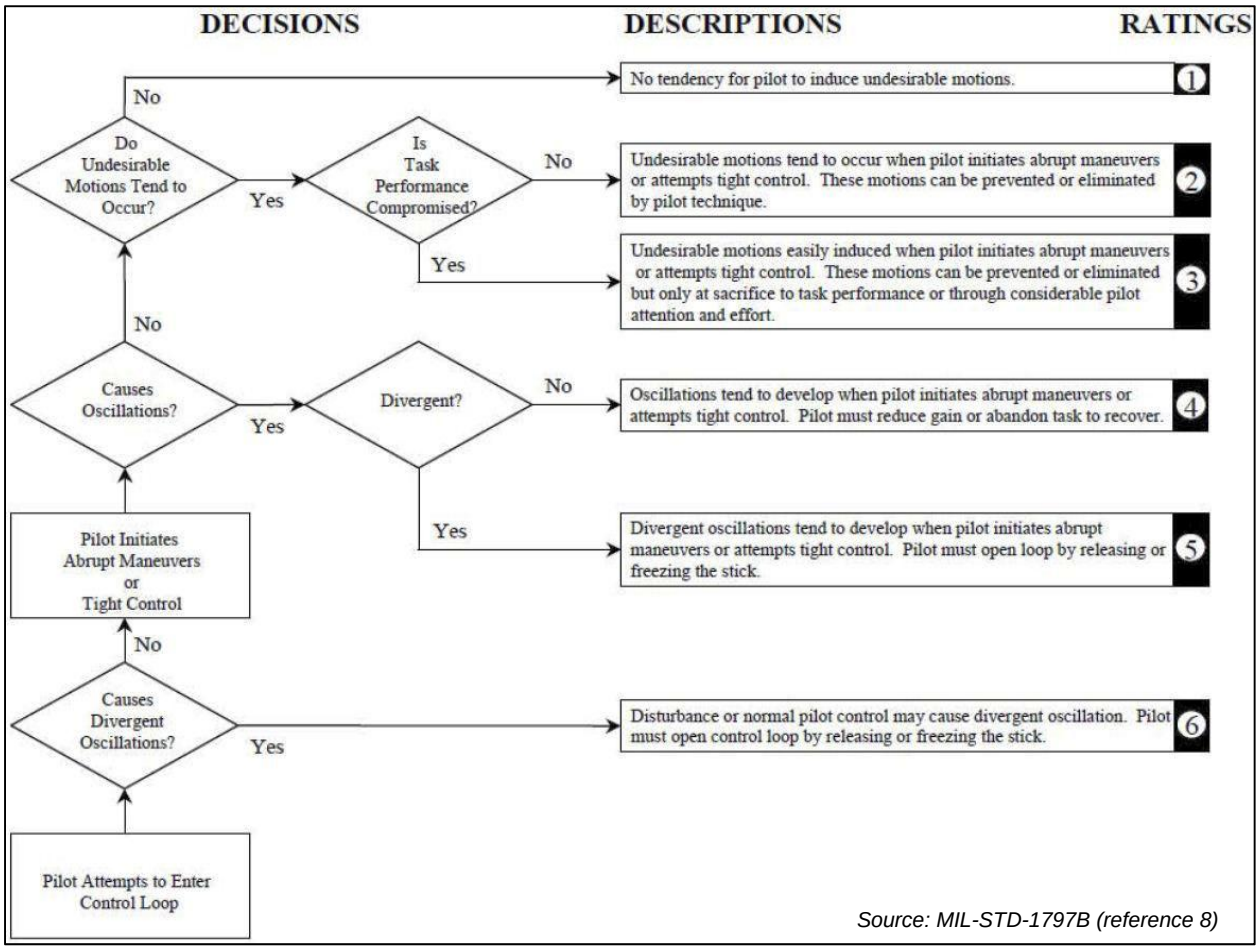

Figure E2 Pilot In-the-Loop Oscillation Tendency Classification

The PIO rating scale asks the pilot to make an assessment of PIO tendency based on his level of aggressiveness to perform the task:

1. When pilot enters the control loop, does input cause divergent oscillation?
2. When pilot initiates abrupt maneuvering or tight control, does input cause oscillation?
3. If neither 1 nor 2, do undesirable motions tend to occur?

Based on answers to these questions, the characteristics of the oscillation, and the ability of the pilot to adapt (if required) to perform the task, a numeric rating is provided. Consult the performance and flying qualities discipline experts for more guidance on how to apply this scale for proper handling qualities reporting.

Experience has shown that PIO ratings can be influenced by how the pilot chooses to fly the evaluation box: “Pilot initiated Abrupt Maneuvers or Tight Control.” Pilot comments should document how this box was flown for a given rating. Pilot-to-pilot differences in ratings (1, 2, or 3 vs. 4 or 5) have been noted by how a pilot chooses to interpret this box.

In general, PIO ratings of 5 or 6 are dangerous, ratings of 3 or 4 are undesirable, and ratings of 1 or 2 are acceptable.

412 TW SIX-POINT GENERAL PURPOSE SCALE

The 412 TW general rule is that the six-point scale be used rather than the five-point scale. There will be exceptions, and the scale experts should be contacted if an alternate scale is required.

The six-point general purpose scale (table E3) is typically used to rate the ability of a given modification, piece of hardware, or subsystem to support a given mission or given task. It can also be used to rate the ability of the human in the loop (pilot, crew chief, maintainer) to perform a given task or achieve the desired level of performance. The numbers used in this scale are used to roughly convert subjective data into a numerical database for statistical analysis or graphical presentation and usually come from a questionnaire used to solicit aircrew or maintainer opinions.

Table E3 412 TW Six-Point General Purpose Scale

Scale Value	Response Alternatives	Definitions
1	Very Unsatisfactory	Task cannot be performed or the item is unusable or unsafe. Mission/Task not accomplished due to equipment deficiencies or procedural limitations.
2	Unsatisfactory	Major problems encountered. Task accomplished with great difficulty or accomplished poorly. Significant degradation of mission/task accomplishment or accuracy.
3	Marginally Unsatisfactory	Minor problems encountered. Task accomplished with some difficulty. Some degradation of mission/task accomplishment or accuracy.
4	Marginally Satisfactory	The item or task meets its intended purpose with some reservations. Meets minimum requirements to accomplish mission or task.
5	Satisfactory	The item or task meets its intended purpose; it could be improved to make it easier or more efficient.
6	Very Satisfactory	The item or task is fine the way it is; no improvement required.

412 TW FIVE-POINT GENERAL PURPOSE SCALE

The five-point general purpose scale (table E4) is one exception to the six-point scale. This scale is generally used to show how much better or worse a given modification is than the original configuration and should be used only when a direct comparison is possible.

If these scales do not seem appropriate to your testing, do not construct a questionnaire or rating scale without first consulting appropriate human factors experts (Human-Systems Integration).

Table E4 412 TW Five-Point General Purpose Scale

Scale Value	Response Alternatives	Definitions
1	Much Worse	The item or task cannot be accomplished or the item is unusable or unsafe and is much worse than legacy.
2	Worse	This item or task cannot be accomplished or is accomplished poorly or with great difficulty and is worse than legacy.
3	About the Same	The item or task can be accomplished about the same as legacy.
4	Better	The item or task can be accomplished with some reservations but is better than legacy.
5	Much Better	The item or task can be accomplished much better than legacy.

412 TW REVISED BEDFORD WORKLOAD SCALE

When doing a workload evaluation, the approved tool is the 412 TW Revised Bedford Workload Scale (figure E3). Workload will be described as Insignificant, Low, Medium, Moderate, High, or Significant. On occasion, and with permission from the HSI home office, the original Bedford Workload Scale or the United States Air Force School of Aerospace Medicine Scale may be used.

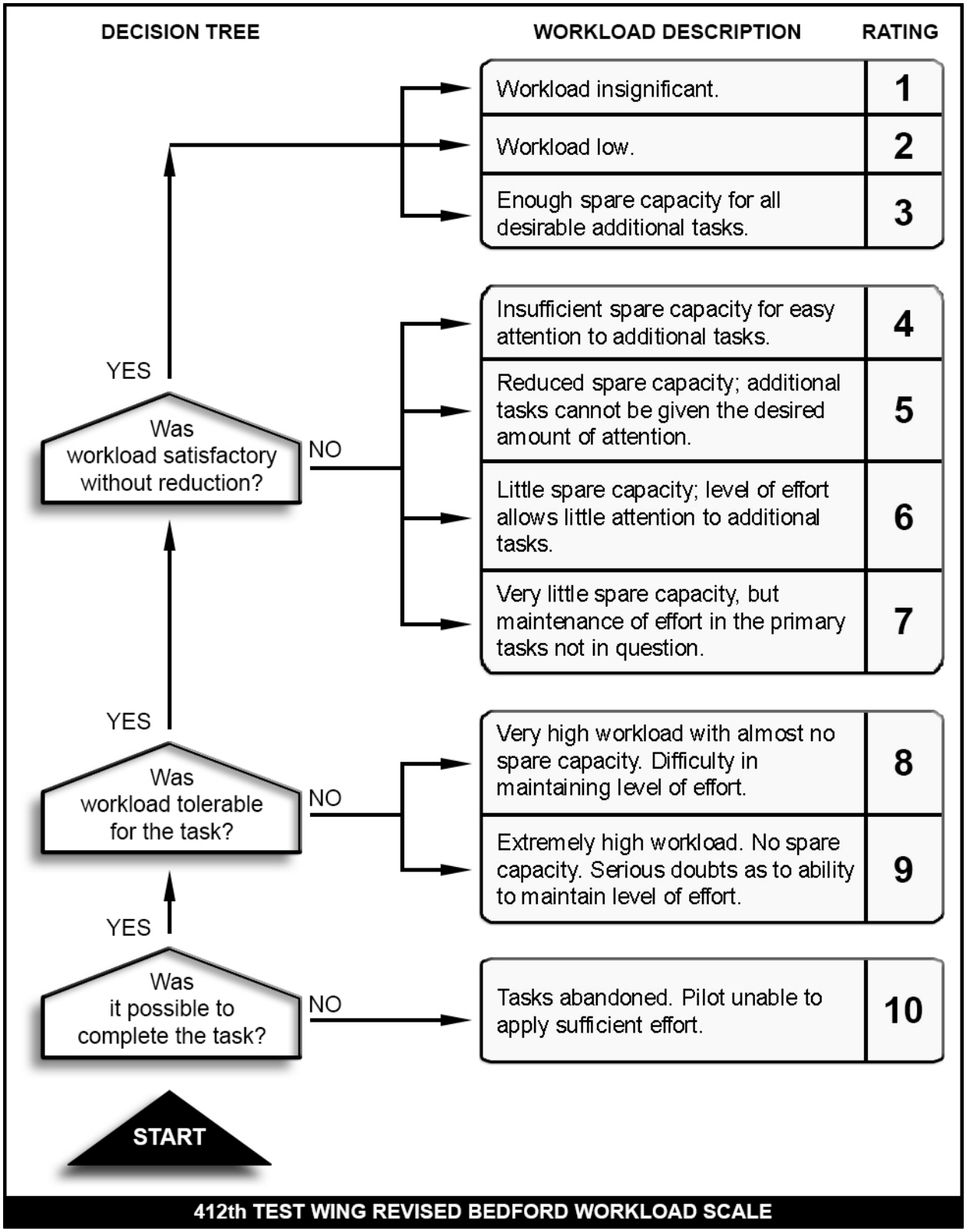

Figure E3 412 TW Revised Bedford Workload Rating Scale

When doing a situation awareness evaluation, the approved tool is the 412 TW Revised Situation Awareness Rating Scale (figure E4). The amount of situation awareness will be described as Insignificant, Low, Medium, Moderate, High, or Significant.

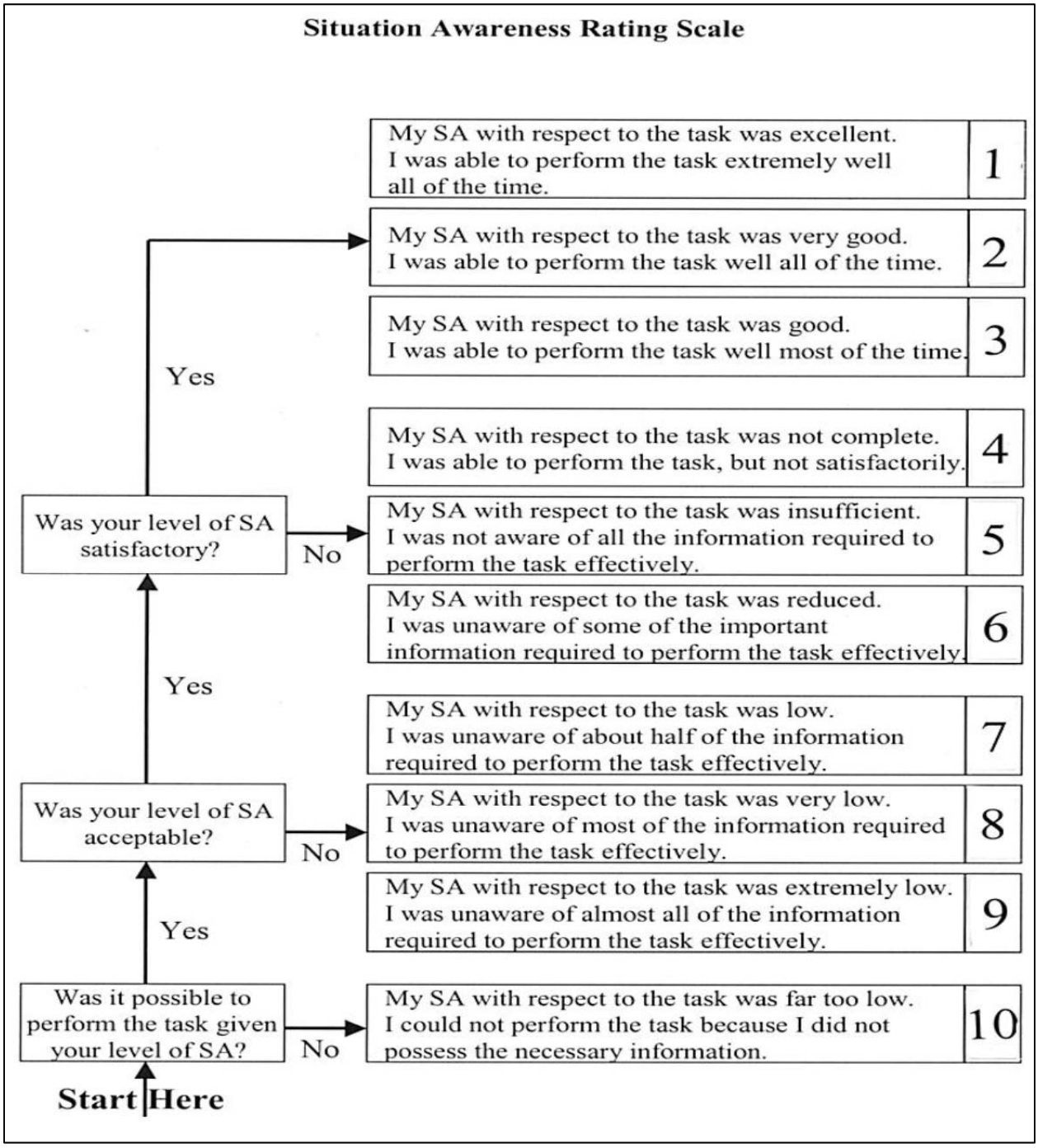

Figure E4 412 TW Revised Situation Awareness Rating Scale

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APPENDIX F – MASTER LIST OF ABBREVIATIONS, ACRONYMS, AND SYMBOLS

The acronyms and abbreviations in this list do not have to be defined on first use in your document. However, they must be defined in your document's list of abbreviations, acronyms, and symbols.

Abbreviation	Definition	Units
3-D	three-dimensional	---
412TW, 412 TW	412th Test Wing	---
6-DOF	six-degrees-of-freedom	---
AAA	anti-aircraft artillery	---
A/A	air-to-air	---
AC, ac	alternating current	---
A/C	aircraft	---
ACC	Air Combat Command	---
AETC	Air Education and Training Command	---
AF	Air Force	---
AFB	Air Force Base	---
AFBI	Air Force Base Instruction	---
AFFTC	Air Force Flight Test Center	---
AFFTCI	Air Force Flight Test Center Instruction	---
AFTC	Air Force Test Center	---
AFI	Air Force Instruction	---
AFLC	Air Force Logistics Command	---
AFM, AFMAN	Air Force Manual	---
AFMC	Air Force Materiel Command	---
AFOSH	Air Force Operational Safety and Health	---
AFOTEC	Air Force Operational Test & Evaluation Center	---
AFR	Air Force Regulation	---
AFSC	Air Force Systems Command; Air Force Specialty Code	---
AFSCM	Air Force Systems Command Manual	---
AFSCR	Air Force System Command Regulation	---
AFTO	Air Force Technical Order	---
A/G	air-to-ground	---
AGL	above ground level	---
ALT, Alt, alt	altitude	ft

Abbreviation	Definition	Units
AM	amplitude modulation	---
AMC	Air Mobility Command	---
amp	amperes	---
ANSI	American National Standards Institute	---
APU	auxiliary power unit	---
ARINC	Aeronautical Radio, Inc or Aircraft Radio Incorporated	---
ASC	Aeronautical Systems Center	---
ASCII	American Standard Code for Information Interchange	---
ATC	Air Training Command	---
AUTO, auto	automatic	---
avg	average	---
AWACS	airborne warning and control system	---
BARO, Baro, baro	barometric	---
BASIC	beginners all-purpose symbolic instruction code	---
BIT	built-in test	---
Blvd.	boulevard	---
C	Centigrade or Celsius	deg
CALOSHA	California Operational Safety and Health Administration	---
CAT	category	---
cc	cubic centimeters	---
CD	compact disc	---
cg	center of gravity	pct MAC
CINC	Commander-In-Chief	---
COBOL	common business oriented language	---
COMM, comm	communications	---
COMSEC	communications security	---
CONOPS	concept of operations	---
CONUS, Conus	Continental United States	---
COTS	commercial off-the-shelf	---
CRT	cathode ray tube	---
CSAF	Chief of Staff Air Force	---
CTF	Combined Test Force	---
CY	calendar year	---

Abbreviation	Definition	Units
dB	decibel	---
DC, dc	direct current	---
deg	degree(s)	---
DME	distance measuring equipment	---
DoD	Department of Defense	---
DoE	Department of Energy	---
DR	deficiency report	---
DT	developmental test	---
DT&E	development test and evaluation	---
DTIC	Defense Technical Information Center	---
DVD	digital video disc	---
E	east	---
EAR	Export Administration Regulations	---
ECCM	electronic counter-countermeasures	---
ECM	electronic countermeasures	---
EL, el	elevation	ft
ELEV, Elev, elev	elevation	ft
ELINT	electronic intelligence	---
EMC	electromagnetic compatibility	---
EMD	engineering and manufacturing development	---
EMI	electromagnetic interference	---
EMI/C	electromagnetic interference/compatibility	---
EO	electro-optical	---
ESC	Electronic Systems Center	---
ETA	estimated time of arrival	---
ETD	estimated time of departure	---
EW	electronic warfare	---
F	Fahrenheit	deg
FAA	Federal Aviation Administration	---
FLIR	forward looking infrared	---
FLT	flight	---
FLTS	Flight Test Squadron	---
FM	frequency modulation	---

Abbreviation	Definition	Units
FOD	foreign object damage	---
fpm	feet per minute	---
fps	feet per second	---
FSD	full scale development	---
FSN	federal stock number	---
ft	feet; foot	---
ft/sec	feet per second	---
FY	fiscal year	---
g	acceleration due to gravity	32.2 fps^2
gal	gallon(s)	---
GCA	ground controlled approach	---
GFE	government-furnished equipment	---
GHz	gigahertz	---
GMT	Greenwich Mean Time	HH:MM:SS
gph	gallons per hour	---
gpm	gallons per minute	---
GPS	global positioning system	---
gps	gallons per second	---
g/m^3	grams per cubic meter	---
HAZMAT	HAZardous MATerial	---
HF	high frequency	---
Hg	mercury	---
HH:MM:SS	hours:minutes:seconds	---
hp	horsepower	550 ft-lb/sec
HQ	headquarters	---
hr	hour(s)	---
H/W	hardware	---
Hz	Hertz	---
IAS	indicated airspeed	kt
IAW	in accordance with	---
ICBM	intercontinental ballistic missile	---
ID	identification	---
IFF	identification friend or foe	---

Abbreviation	Definition	Units
IFR	instrument flight rules	---
ILS	instrument landing system	---
IMC	instrument meteorological conditions	---
IMU	inertial measurement unit	---
in	inch(es)	---
Info	information	---
INMARSAT	International Maritime Satellite	---
INS	inertial navigation system	---
INU	inertial navigation unit	---
IOT&E	initial operational test and evaluation	---
IP	initial point; instructor pilot	---
IR	infrared	---
IRIG	Inter-Range Instrumentation Group	---
ISR	intelligence, surveillance, and reconnaissance	---
ITAR	International Traffic in Arms Regulations	---
JCS	Joint Chiefs of Staff	---
JFS	jet fuel starter	---
JOVIAL	Jules Own Version of the International Algorithmic Language (MIL-STD-1589B)	---
JPEG, jpeg	Joint Photographic Experts Group (a file type)	---
K	thousand	---
KCAS	knots calibrated airspeed	---
KEAS	knots equivalent airspeed	---
kHz	kilohertz	---
KIAS	knots indicated airspeed	---
km	kilometer	---
kt	knot(s)	---
KTAS	knots true airspeed	---
kVA	kilovoltampere	---
kW	kilowatts	---
L	left	---
lat	latitude	deg
lb	pound(s)	---

Abbreviation	Definition	Units
lb/min	pounds per minute	---
lb/sec	pounds per second	---
LF	low frequency	---
long.	longitude	deg
long.	longitudinal	---
LORAN	long-range navigation	---
LOX	liquid oxygen	---
LRU	line replaceable unit	---
m	meter(s)	---
MAC	Military Airlift Command; mean aerodynamic chord	---
MAJCOM	major command	---
MAX, Max, max	maximum	---
Mc	megacycle	---
MED, Med, med	medium	---
MHz	megahertz	---
MIL	military	---
mil	milliradian(s)	---
MIL SPEC	military specification	---
MIL-STD	military standard	---
MIN, Min, min	minute(s); minimum	---
mini	miniature	---
mm	millimeter(s)	---
MPEG, mpeg	Moving Picture Experts Group (a file extension)	---
mph	miles per hour	---
MSL	mean sea level; missile	---
MUX	multiplex	---
N	north	---
N/A, n/a	not applicable	---
NASA	National Aeronautics and Space Administration	---
NATO	North Atlantic Treaty Organization	---
NISPOM	National Industrial Security Program Operating Manual	---
nm, nmi	nautical mile(s)	---
No.	number	---

Abbreviation	Definition	Units
NORAD	North American Aerospace Defense Command	---
NTIS	National Technical Information System	---
O_2	oxygen	---
OFP	operational flight program	---
OI, O.I.	Operating Instruction	---
OMB	Office of Management and Budget	---
Ops	operations	---
OPSEC	operational security	---
OSD	Office of the Secretary of Defense	---
OSHA	Operational Safety and Health Administration	---
OT	operational test	---
OT&E	operational test and evaluation	---
PACAF	Pacific Air Forces	---
PC	personal computer	---
PCMCIA	Personal Computer Memory Card International Association	---
pct	percent	---
PN, P/N	part number	---
POC	point of contact	---
POL	petroleum, oil, and lubricants	---
pph	pounds per hour	---
ppm	pounds per minute; parts per million	---
psf	pounds per square foot	---
psi	pounds per square inch	---
QT&E	qualification test and evaluation	---
R	right	---
RAM	random access memory	---
Rd	road	---
R&D	research and development	---
Ref, ref	reference	---
RESP	responsible	---
Rev, rev	revision	---
RF	radio frequency	---
R&M	reliability and maintainability	---

Abbreviation	Definition	Units
ROM	read only memory	---
rpm	revolutions per minute	---
R&R	remove and replace	---
S	south	---
SAC	Strategic Air Command	---
SATCOM	satellite communications	---
SCSI	small computer system interface	---
sec	second(s)	---
SIPRNET	secret internet protocol router network	---
SN, S/N	serial number	---
SOP	standard operating procedure	---
St	street	---
Std	standard	---
S/W	software	---
TAC	Tactical Air Command; terminal access controller	---
TACAN	tactical air navigation	---
TAS	true airspeed	kt
TBD	to be determined	---
TCTO	time compliance technical order	---
TDY	temporary duty	---
Temp, temp	temperature	deg
T.O.	technical order	---
TV	television	---
UAV	unmanned aerial vehicle	---
UHF	ultrahigh frequency	---
U.S.	United States	---
USA	United States of America; United States Army	---
USAF	United States Air Force	---
USAFE	United States Air Forces Europe	---
USB	universal serial bus	---
U.S.C.	United States Code	---
USMC	United States Marine Corps	---
USN	United States Navy	---

Abbreviation	Definition	Units
Ver, ver	version	---
VFR	visual flight rules	---
VHF	very high frequency	---
VHS	very high speed; video home system	---
VOR	VHF Omnidirectional Range	---
Vs, vs	versus	---
W	west	---
w/	with	---
WGS	World Geodetic Survey	---
WIT	watch item	---
ZULU	Greenwich Mean Time	---
%	percent	---

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