

AD-A099 924

COURSEWARE INC SAN DIEGO CALIF

F/6 5/9

DERIVATION, FORMATTING AND USE OF CRITERION-REFERENCED OBJECTIV--ETC(U)

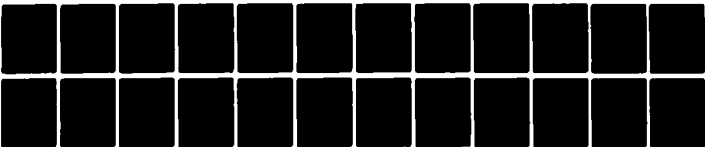
MAR 81 A S GIBBONS, S J ROLNICK

F02604-79-C-8875

NL

UNCLASSIFIED

1 of 1
304
1999.21



END
DATE
FILMED
7-81
DTIC

AD A 099924

LEVEL II

①

E-16 AIRCREW TRAINING DEVELOPMENT PROJECT,

Contract No. F02604-79-C8875 ✓

①

① 12

DERIVATION, FORMATTING AND USE OF
CRITERION-REFERENCED OBJECTIVES (CROs)
AND CRITERION-REFERENCED TESTS (CRTs)

DEVELOPMENT REPORT No. 5
MARCH 1981

**DTIC
ELECTE
S D
JUN 09 1981
E**

Prepared in fulfillment of CDRL no. B010
and partial fulfillment of CDRL no. B015

by

A.S. Gibbons
S.J. Rolnick
Courseware, Inc.

COURSEWARE, INC.
10075 Carroll Canyon Rd.
San Diego, CA 92131
(714) 578-1700

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

JLF

20977 81 6 09 006

ORIGINAL COPY

PREFACE

This report was created for the F-16 Aircrew Training Development Project contract no. F02604-79-C8875 for the Tactical Air Command to comply with the requirements of CDRL nos. B010 & B015. The project entailed the design and development of an instructional system for the F-16 RTU and instructor pilots. During the course of the project, a series of development reports was issued describing processes and products. A list of those reports follows this page. The user is referred to Report No. 34, A Users Guide to the F-16 Training Development Reports, for an overview and explanation of the series, and Report No. 35, F-16 Final Report, for an overview of the Instructional System Development Project.

Accession For	
NTIS	<input checked="" type="checkbox"/>
DTIC	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
<i>form 50 per</i>	
By	
Distribution/	
Availability Codes	
Dist	Special
A	

F-16 AIRCREW TRAINING
DEVELOPMENT PROJECT REPORTS

Copies of these reports may be obtained by writing the Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22314. All reports were reviewed and updated in March 81.

Gibbons, A.S., Rolnick, S.J., Mudrick, D. & Farrow, D.R. Program work plan (F-16 Development Report No. 1). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Thompson, A., Bath, W., & Gibbons, A.S., Previous ISD program review (F-16 Development Report No. 2). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Wild, M., & Farrow, D.R. Data collection and management forms report (F-16 Development Report No. 3). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Gibbons, A.S. Review of existing F-16 task analysis (F-16 Development Report No. 4). San Diego, Calif.: Courseware, Inc., June 1977, March 1981.

Gibbons, A.S., & Rolnick, S.J. Derivation, formatting, and use of criterion-referenced objectives (CROs) and criterion-referenced tests (CRTs) (F-16 Development Report No. 5). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Rolnick, S.J., Mudrick, D., Gibbons, A.S. & Clark, J. F-16 task analysis, criterion-referenced objective, and objectives hierarchy report (F-16 Development Report No. 6). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S. Task analysis methodology report (F-16 Development Report No. 7). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S. Objectives hierarchy analysis methodology report (F-16 Development Report No. 8). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Mudrick, D., Gibbons, A.S., & Schmidt, R.F. Goal analysis report (F-16 Development Report No. 9). San Diego, Calif.: Courseware, Inc., February 1978, March 1981.

Rolnick, S.J., Mudrick, D., & Thompson, E.A. Data base update procedures report (F-16 Development Report No. 10). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Mudrick, D., & Pyrz, K.E. Data automation of task and goal analysis: Existing system review and recommendation (F-16 Development Report No. 11). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

- O'Neal, A.F., & Smith, L.H. Management System needs and design concept analysis (F-16 Development Report No. 12). San Diego, Calif.: Courseware, Inc., December 1977, March 1981.
- Gibbons, A.S., Thompson, E.A., Schmidt, R.F., & Rolnick, S.J. F-16 pilot and instructor pilot target population study (F-16 Development Report No. 13). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.
- Schmidt, R.F., Gibbons, A.S., Jacobs, R. & Faust, G.W. Recommendations for the F-16 performance measurement system (F-16 Development Report No. 14). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- Thompson, E.A., & Gibbons, A.S. Program/system constraints analysis report (F-16 Development Report No. 15). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- Gibbons, A.S., & Rolnick, S.J. A study of media production and reproduction options for the F-16 project (F-16 Development Report No. 16). San Diego, Calif.: Courseware, Inc., February 1978, March 1981.
- O'Neal, A.F., & Kearsley, G.P. Computer managed instruction for the F-16 training program (F-16 Development Report No. 17). San Diego, Calif.: Courseware, Inc., July 1978, March 1981.
- Wilcox, W.C., McNabb, W.J., & Farrow, D.R. F-16 implementation and management plan report (F-16 Development Report No. 18). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- Sudweeks, R.R., Rolnick, S.J., & Gibbons, A.S. Quality control plans, procedures, and rationale for the F-16 pilot training system (F-16 Development Report No. 19). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- Gibbons, A.S., Axtell, R.H., & Hughes, J.A. F-16 media selection and utilization plan report (F-16 Development Report No. 20). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- Thompson, E.A., Kearsley, G.P., Gibbons, A.S., & King, K. F-16 instructional system cost study report (F-16 Development Report No. 21). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- Jacobs, R.S., & Gibbons, A.S. Recommendations for F-16 operational flight trainer (OFT) design improvements (F-16 Development Report No. 22). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- Gibbons, A.S. F-16 instructional sequencing plan report (F-16 Development Report No. 23). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

- Farrow, D.R., & King, K. F-16 coursewares and syllabi delivery schedule (F-16 Development Report No. 24). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.
- Rothstein, L.J., Hibian, J.E., & Mudrick, D. F-16 instructor/course manager training requirements report (F-16 Development Report No. 25). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.
- O'Neal, A.F., & O'Neal, H.L. F-16 pilot media selection (F-16 Development Report No. 26). San Diego, Calif.: Courseware, Inc., March 1979, March 1981.
- Gibbons, A.S. F-16 instructional system design alternatives (F-16 Development Report No. 27). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.
- Gibbons, A.S. F-16 instructional system basing concept (F-16 Development Report No. 28). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.
- O'Neal, H.L., & Rothstein, L.J. Task listings and criterion-referenced objectives for the instructor pilot F-16 training program (F-16 Development Report No. 29). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.
- Bergman, D.W., & Farrow, D.R. F-16 training system media report (F-16 Development Report No. 30). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.
- Gibbons, A.S., O'Neal, A.F., Farrow, D.R., Axtell, R.H., & Hughes, J.A. F-16 training media mix (F-16 Development Report No. 31). San Diego, Calif.: Courseware, Inc. October, 1979, March 1981.
- Farrow, D.R. F-16 training media support requirements (F-16 Development Report No. 32). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.
- Gibbons, A.S. F-16 training media constraints and limitations (F-16 Development Report No. 33). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.
- Farrow, D.R., & Kearsley, G.P. A user's guide to the F-16 training development reports (F-16 Development Report No. 34). San Diego, Calif.: Courseware, Inc., January 1981, March 1981.
- Farrow, D.R., & Clark, J. F-16 Final Report (F-16 Development Report No. 35). San Diego, Calif.: Courseware, Inc., January 1981, March 1981.

EXECUTIVE SUMMARY

An integral part of the F-16 instructional design process involves the development of criterion-referenced objectives (CROs) and criterion-referenced tests (CRTs). This report defines both CRO and CRT as used in the F-16 project. It also specifies procedures and conventions that were used to write them.

There are several benefits associated with the use of CROs and CRTs. By following the procedures described in this report, a team of minimally trained people can produce a clear definition of the contents of a training program. The problems of not knowing where to start, guesswork, and confusion are eliminated when this systematic approach is used.

CROs represent specific behavioral statements about expected student performance after the completion of instruction. The conditions and standards of acceptable performance are also part of this statement. Specifying instructional outcomes in terms of student performance has a number of advantages:

1. CROs are related directly to actual job performance.
2. CROs provide a focus for the student in the form of a statement describing what he should be able to do.
3. CROs provide a source of feedback to the student by offering him a chance to compare his performance with the required performance, which in turn means that a large part of the instruction becomes self-guided.

The CRTs are a logical extension of the CROs. They measure the attainment of the CROs. Since the CROs consist of actual job performance objectives, the CRTs provide the instructor and the student with a profile of the student's strengths and weaknesses on job performance. CRTs for the measurement of CROs have the following minimal characteristics.

1. A description of the environment and equipment required in the test setting.
2. A description of the problem situation.
3. A set of instructions to the student describing the performance expected.

4. A description of the evaluator of the behavior to be measured or noted.
5. A set of evaluation rules for rating each measurement to determine mastery.
6. A method or form for the evaluator to record the results of the measurements.
7. A rule for combining individual measurements in a task or course into a pass/fail statement.

In summary, CROs and CRTs tell all personnel involved in pilot training just exactly what should be taught, what should be learned, and what level of competence is expected.

CONTENTS

	Page
Preface	i
F-16 Aircrew Training Development Project Reports	ii
Executive Summary	v
1.0 INTRODUCTION	1
2.0 DEFINITION OF CRO	2
2.1 CRO Derivation	2
2.2 Benefits of this Method of CRO Definition	5
2.3 The CRO Form	6
2.4 Condition Classes	6
2.5 Standard Classifications	9
2.6 Additional Data	9
3.0 DEFINITION OF CRT	11
3.1 CRT Writing	12
3.2 CRT Administration Procedures	12
Appendix: JOB AID FOR THE AUTHORING OF CROs	A-1

DERIVATION, FORMATTING AND USE OF
CRITERION-REFERENCED OBJECTIVES (CROs)
AND CRITERION-REFERENCED TESTS (CRTs)

1.0 INTRODUCTION

The writing of criterion-referenced objectives (CROs) will be a step in the instructional development process used for the F-16 Aircrew Training Development Project. The purpose of this paper is to (1) define CRO as a term, and (2) specify the procedure which will be used during the F-16 project to write them. In addition, this paper will define and describe criterion-referenced tests (CRTs) and state the conventions that will be observed in writing them.

The term "criterion-referenced objective" grows out of a sister term, "criterion-referenced test". Glaser (1963)¹ coined the term "criterion-referenced test" to make a distinction between two ways of testing behavior: norm-referenced testing (NRT), a long-established methodology, and CRT, a relatively new idea. The concept of CRT has become almost universal among instructional developers. The distinctive feature of a CRT is that student performances are judged adequate or inadequate by comparison with a set standard, or criterion, rather than by comparison with the norm, or the average of other scores. Behind Glaser's thesis is the idea that there must be a statement of behavior standards against which behavior is to be referenced. In current practice, instructional developers state these behavior standards in written objectives. These have been termed "criterion-referenced objectives," and the use of the term has become common in some development communities. In other development circles other terms are used to refer to the same type of objective, because no standard terminology has been found that is acceptable to everyone. Even though developers do use different terms to express what they are doing, they commonly recognize the necessity of a CRO-type construct in their work.

¹Glaser, R. Instructional technology and the measurement of learning outcomes: Some questions. American Psychologist, 1963, 18, 519-521.

2.0 DEFINITION OF CRO

The variety of names for CROs indicates a problem area in instructional development. Developers do not fully agree upon the definition, use, and method of deriving CROs. This paper defines the term CRO for F-16 project purposes. In the development of F-16 aircrew and instructor pilot training, the term CRO will be used to refer to a performance objective formed by adding conditions and standards to a selected set of behaviors taken from an inventory of job performance. To be included in a CRO, a behavior must be of a particular length and complexity to be able to be evaluated. The purpose of CROs is to state the terminal behaviors students will ultimately achieve at the end of training sequences, those conditions under which these behaviors will be performed for testing purposes, and the standards by which adequate performance will be measured. CROs represent the behavior gates through which students must pass at the end of the instructional path in order to be certified competent in job performance.

CROs relate to each other in a manner which creates an upper-level architecture for the training course. Just as certain instructional objectives prepare a student to accomplish these behaviors, CRO behaviors may themselves be preparatory steps for reaching accomplishment of more complex, lengthy, and sophisticated CRO behaviors. Taken together this architecture of CROs represents a progression from less to more job-like behaviors.

2.1 CRO Derivation

The method which will be used to derive F-16 CROs is described below as a sequence of four general steps.

1. Performing a task analysis. The development of CROs begins with an exhaustive inventory of job tasks. Often this task inventory or task analysis is looked upon as a separate instructional development task. It is included as the first step in CRO development to emphasize that the inventory of tasks provides a vital foundation for the CROs--something missing from most CRO lists. For F-16 purposes, the inventory process will be referred to as "task analysis" and the product as "task listing".

The task listing is a layered decomposition of job tasks into component subtasks. At upper levels of the task listing, tasks are inclusive and represent lengthy and complex behaviors. At lower levels, the task listing contains behaviors which are increasingly less complex and less lengthy. Figure 1 is a simple demonstration of the relationships which exist in a complete task listing. Note that there are two types of relations between tasks and their subordinate subtasks: (1) Subtasks may be steps in the task execution (time-sequenced if the task is algorithmic

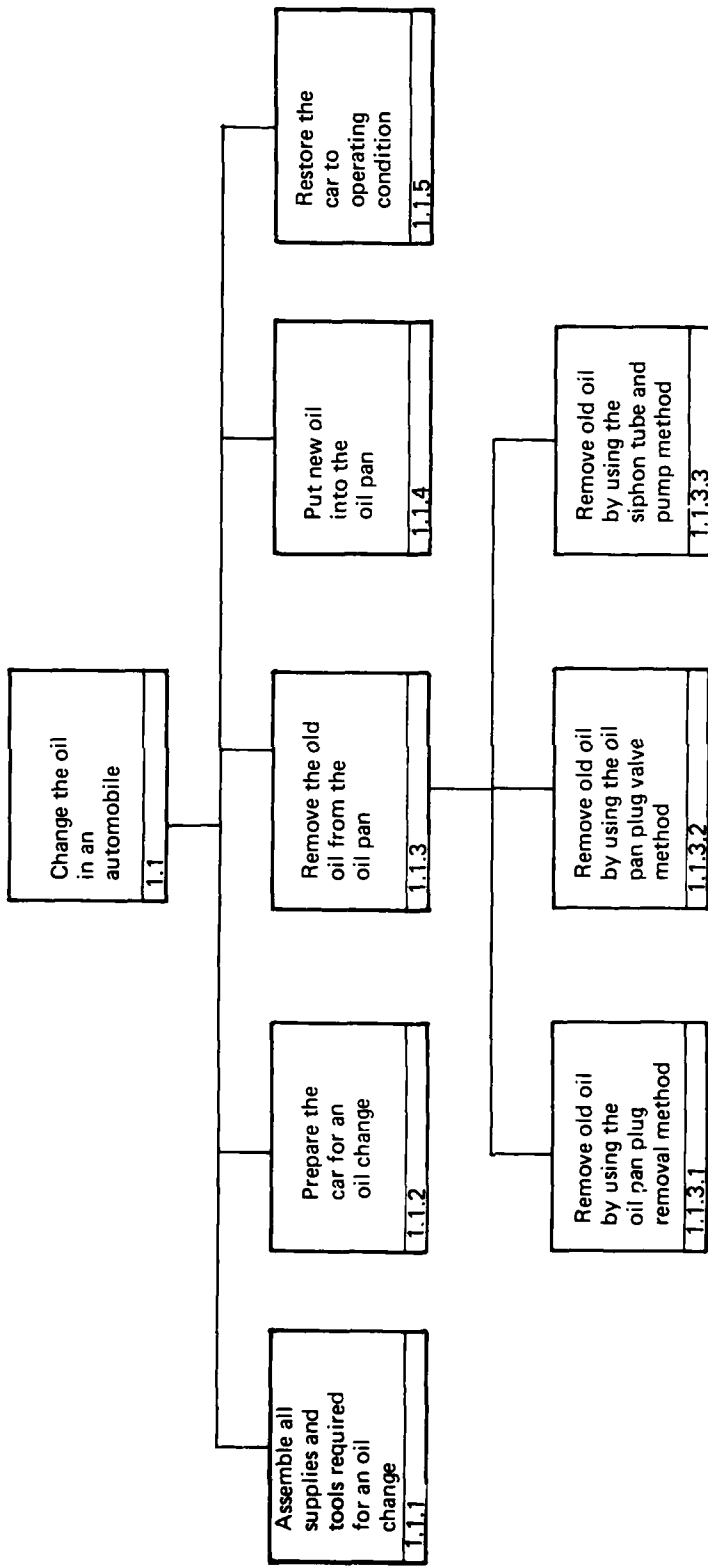


Figure 1 - A Simplified Task Listing

or nonsequenced if the task is a heuristic behavior) or (2) subtasks may be different varieties of a task. In Figure 1, a simplified task listing, subtasks 1.1.1 to 1.1.5 are a time-sequenced set of steps for task 1.1. Subtasks 1.1.3.1 to 1.1.3.3 represent three ways in which subtask 1.1.3 may be accomplished. There are several other task analysis conventions which are discussed at greater length in F-16 Development Report No. 4, "Review of Existing F-16 Task Analysis."

2. Determining the extent of the task listing. The decomposition that takes place during the task analysis process can produce a list of tasks at any predetermined level of detail. Extreme levels can be reached, down to the listing of the performer's individual finger and eye movements. The level of detail sought by the task analyst is guided by the purpose of the analysis. In studying and designing job environments an extreme level of detail is desirable to the human-factors engineer, but not useful to the instructional developer writing CROs.

The second necessary step in CRO writing, which will form its basis, is specifying the desired level of detail to obtain a set of tasks with consistent dimensions of length and complexity. The factors bearing on the decision of where to terminate the task breakdown are practical. CROs give rise to CRTs. It is not practical to set up a testing situation for miniscule, short-duration behaviors. The paperwork involved in specifying tests and keeping records would be prohibitive. CROs are written for tasks of a duration and importance to make it practically feasible and desirable for testing to take place. This feasibility and desirability can be expressed in time limits or number of observation points required during measurement.

3. Selecting tasks for CRO use. During analysis for instructional development purposes, when the preselected level of detail has been reached, task decomposition ceases. Then tasks which will serve as CROs are identified. These consist of (1) all bottom-level tasks of the analysis and (2) selected tasks at the upper levels.

Bottom-level tasks are specifically written to be observable and of sufficient length and coherence to represent a complete performance. This is ensured by the decision made in the previous step on when to terminate the analysis. If a termination level of too fine a detail is selected, the CROs resulting will be very short, incomplete behaviors, and the tests of performance will be multiplied in number and fragmented in size. On the other hand, if not enough detail is obtained in the CROs, the behaviors evaluated in performance tests will be too extensive and complex to perform and probably also complex to evaluate.

Selected tasks at the upper levels of the task listing, whose behaviors are more extensive and complex, are also designated as CRO tasks. Because of the structure of the task list-

ing, these higher-level CROs represent a repetition of behaviors of lower-level CROs in interactions of varying length and complexity. The course architecture is a product of the relationship between higher-level and lower-level CROs. It makes possible a progression from the evaluation of isolated behavior performances to evaluation of task complexes and sequences of performance. Behaviors which are selected as upper-level CROs are limited samplings of actual job performance tasks which provide the evaluator with an indication of student progress through the course. Not all upper-level tasks are selected for use in CROs, only those which (1) are possible and desirable to observe and rate and (2) constitute a collection of lower-level tasks representing a significant job-like performance.

4. Converting tasks to CROs. The CRO-designated tasks from the task listing are converted to CROs through the addition of conditions and standards. Conditions state the setting in which evaluation of the behavior will take place: the stimuli impinging upon the senses and sources of information and interference. Standards define the measures which will be used to discriminate adequate from inadequate task performances: measures of time, distance, precision.

The conditions and standards attached to a task define all of the relevant evaluation parameters for that behavior. To recall the CRO-gate metaphor, the conditions and standards define how narrow and difficult the gate will be as the student passes through.

Where possible the job-orientation of conditions and standards will be retained since the performance tests resulting from CROs are most appropriately tests of job behavior. In some cases extremely dangerous behaviors or behaviors which cannot be enacted in real-life situations are encountered. These CROs will be written into CROs with simulator-based or artificial conditions and standards. This will make possible testing of the behaviors in simulated environments which are more practically suited.

2.2 Benefits of This Method of CRO Definition

The above procedure for defining CROs is consistent with contemporary instructional development practice and theory. It improves that practice, it is felt, by defining in more detail the procedure for deriving CROs and relating CROs back to early development analysis procedures.

1. A standard method for determining CROs. The method described above is a replicable procedure which can be used by teams of minimally trained persons to obtain a relatively standard product. The set of CROs obtained through this method can be maintained and revised by still other persons using the same

thought processes. Deriving CROs in this way also eliminates much guesswork, confusion, and the problem of not knowing where to start or how to proceed, which is sometimes encountered by military and other CRO writers.

2. Usability of thought and logic by subsequent users. The procedure guides the thought processes of the person deriving CROs in a systematic way and ensures that a record is kept of task decomposition decisions and decisions about the relative organization of tasks within the structure of the task listing. Not only are the CROs themselves recorded, but the logical pattern of thought that generated them is recorded as well. This existing framework provides a mechanism to speed and guide the logical process by which the CROs are made.

3. Exhaustive inventory CROs. Deriving CROs through this process is more likely to produce an exhaustive list than deriving them by other means. CROs are embedded in an inventory of all job performance requirements. As the job grows or lessens, the task inventory, and thereby the list of CROs, adjusts accordingly.

4. Building sequence of CROs. This described method (through which the student passes to certified job competency), results not only in a single level of CROs, but in an ordered hierarchy of behaviors as well. Each level upward in the CRO order represents increasingly complex and more job-like performances. This building sequence of CROs not only forms an architecture for upgrading student performance by increments, but, at upper levels, also defines a series of performance tests which can be used for certification and standard evaluation as well.

2.3 The CRO Form

To avoid some of the difficulty of providing consistent quality CROs and to simplify the memory component of the task of writing conditions and standards, a form has been devised (a sample of which is presented in Figure 2). This form enumerates several categories of conditions and standards to guide the writer's thinking. The form has the additional purpose of collecting data relevant to each CRO which will later be used in sorting and media selection operations and in the design of instructional sequences. An item-by-item description of the form follows. (For the benefit of CRO authors, an additional job aid was created, which is included as an appendix to this report.)

2.4 Condition Classes

The classes of conditions which are listed on the CRO form are intended to help the CRO writer specify all conditions under which a performance is to be evaluated. These are essentially the "givens" of the performance environment, the descriptions of

the external conditions, aids, problem characteristics, and assistance provided to the student as he executes his performance. Each category of conditions is elaborated below.

1. Agency. This condition describes any access which a student is given to an agency or organization from which he is to obtain information. Often, on-the-job performance requires that a student consult an agency (such as operations or weather) in the planning or execution of a mission. The agencies which need to be consulted during task execution are entered under this heading, along with the information items which are obtained from the agency.

2. Manuals and publications. Students are also often required to obtain information from manuals or publications as a part of planning or executing a mission. This condition lists those manuals or publications to which the student has access during task execution. It states the specific information items within the manual which the student may require from the manual.

3. Activity. This condition lists ongoing activities at the time of task performance. Several CRO behaviors are isolated parts of a larger activity. Certain air-to-ground combat tasks, for instance, take place in the context of an ongoing air-to-ground attack. Stating this larger context of ongoing activity defines much of the environment in which evaluation of performance must take place, since that evaluation environment will in many cases seek to approximate actual job conditions.

4. External environment. Under this condition all external environment conditions normally present during the execution of the task are written and must be present during evaluation of that task. External environment may include weather, conditions of threat, light or noise conditions, and other external forces.

5. Aids. Under this condition are listed any aids given to the student not covered in previous conditions. This may include special tools or equipment, prompts given by the evaluator, job performance aids used to assist recall, or manuals and check-lists.

6. Product of previous task. Under this condition are stated any products of previous task executions which are available to the student while performing the present task. In sequential tasks, information or decisions from a previous task must very often be given in order for the student to choose actions for the next.

7. Initiation cues. Under this condition are listed specific stimuli to be given to the student as initiation cues for performing the task. For later sorting purposes, we also list the aircraft systems presenting those cues under this condition.

Not included under this list of conditions are conditions of physical or mental stress. It is assumed that the physical stress factors of performance will be kept at a standard level throughout the evaluation of all CROs. It is further assumed that the level of psychological stress present during the evaluation of the given CRO can be adjusted through the manipulation of other conditions which have been stated, for instance, through the manipulation of weather or threat.

2.5 Standard Classifications

Standards have also been classified into main categories. Each is briefly described below.

1. Authority. Under this standard are listed any manuals, regulations, standard operating procedures, or other publications or directives which define a set standard to be observed during evaluation. For performance of checklists, for instance, acceptable performance standards are outlined in detail in pilot manuals. Reference is made under this standard to those manuals which contain a description of acceptable performance, and the location of that description within the manual is also entered.

2. Performance precision. Under this standard are listed the parameters which are to be observed during performance of the behaviors and the acceptable range of variation. These standards may include time, distance, relative angle, and standards of rate or rate of change and will not only state the critical key value, but the tolerance limits as well.

3. Computational accuracy. Under this standard are placed the limits of acceptability which are defined by computational accuracy, i.e., the amount of error which can be tolerated in an answer.

2.6 Additional Data

The plan for task analysis and CRO development for the F-16 project includes the accumulation of data which can be used in later stages of development for sorting and decision-making purposes. It is important that sorting data be collected so that revisions to the aircraft systems or procedures which will cause revisions to the task can be registered quickly and with full coordination of all documents. It is important that decision-making data also be gathered at time of CRO writing. This will avoid recycling through the task analysis to gather those data at a later date and will consequently avoid the problems attendant to refreshing memories which would come with that process. The data items to be collected for each CRO are described below.

1. Systems presenting cues. Under this data item are listed the names of systems which present cues both during performance of the task and at task completion.

2. Systems receiving manipulations. Here are listed names of systems which are manipulated by the performer during the behavior.

3. Enabling tasks. Under this heading are listed all tasks which are subordinate and prerequisite to performance of the present task.

4. Criticality of correct performance. Incorrect performance or nonperformance of a task may endanger any or all of the following: the mission, the aircraft, or the life of the pilot. Under this heading the danger related to a performance is recorded.

5. Difficulty. The difficulty of the performance is stated here on a 4-point scale. This includes difficulty of psychomotor coordinations and difficulty attendant to heavy cognitive loads or interference.

6. Reference source. Under this heading are listed the exact manual references, including page numbers and paragraphs, dealing with the behaviors. This information will be a key factor in keeping task statements current with changes in doctrinal publications. Two subheadings exist for this data item: Actual indicates the actual document in which the reference is presently found or presently planned to be included. Recommended will include the recommendations of the instructional systems development (ISD) team for placement of the data referenced by the behavior.

7. Common mistakes. Under this data item are recorded common mistakes made by students while learning to perform the task. The level of danger attendant to making each mistake is also recorded.

8. Steps. Under this heading are recorded the actual steps in the execution of the behavior. In later stages of development this will become the core idea for instruction, i.e., the idea around which instruction will center.

3.0 DEFINITION OF CRT

A CRT is a test resulting from a CRO. It is convenient to speak of two types of CRTs: (1) CRTs which measure attainment of knowledge or intellectual skill objectives and (2) CRTs which measure attainment of actual job performance objectives (CROs). All of the CRTs resulting from the F-16 CROs will be this second type, since these CROs arise out of an inventory of actual job performances. The focus of this paper is on those CRTs arising out of CROs. All of them will be performance tests of actual job-like behaviors.

CRTs of the performance variety consist of at least the following:

1. A description of the environment and equipment required as parts of the test setting.
2. A description of the particular problem situation (if any) to be presented to the student.
3. A set of instructions to be given to the student on what performance is expected (this may be just a simple instruction to perform a behavior or an entire brief on how and when, as in a mission plan).
4. A description for the evaluator of the behavior to be monitored and a listing of the specific points at which he is to take a measurement or note behavior.
5. A set of rules for the evaluator on rating performance at each measurement or observation point, i.e., a statement for measuring if the student has met the criteria.
6. A mechanism or data form for the evaluator both to record individual observations and to summarize the evaluations.
7. A rule of combining individual measurements into a summary pass/fail statement.

These are the minimum requirements for a CRT of the performance variety. Because the results of CRTs can also be used to diagnose weaknesses in student performance and to prescribe instructional treatments to correct deficiencies, the following CRT characteristics are often added:

8. A diagnostic capability to identify the specific portions of the performance which were deficient.

9. A reference to specific instructional materials and events related to failed portions of the test and which can be used to correct the deficiencies.

There is a high likelihood that these last two items will also occur in the F-16 testing system, although that final decision will be made later.

3.1 CRT Writing

CRTs are developed by using all applicable components listed above. Exact procedures for writing and using CRTs will be specified at a later point in the F-16 project. In an evolving weapons system such as the F-16, many aircraft subsystems and procedures for using them will remain unspecified until a later date. This means that important instruction and testing content is unavailable until late in the process and continues to change even after it is obtained. For this purpose, the writing of CRTs is coupled with the writing of instruction. To write CRTs at any earlier stage would not be beneficial to the instructional system and would create a body of work certain to be almost completely revised or replaced.

3.2 CRT Administration Procedures

CRTs will be administered in accordance with the conditions statement of the CRO and will be evaluated according to the expressed CRO standard. The exact procedures for carrying out CRTs will be elaborated in training management documents.

Appendix

JOB AID FOR THE
AUTHORING OF CROs

INTRODUCTION

This job aid for writing and reviewing CROs is prepared to simplify what otherwise might be a difficult task. It is intended for use with the CRO writing procedures and standards expressed in F-16 Aircrew Training Development Project Report No. 5 "Derivation, Formatting, and Use of Criterion-referenced Objectives (CROs) and Criterion-referenced Tests (CRTs)". It is hoped that subject matter experts will be able to use this aid to write CROs of a consistently high quality. The headings that follow refer to the appropriate sections of the CRO form. (See Figure 2.)

REFERENCE TASK

If the present task is exactly the same as another task elsewhere in the task listing and if a CRO has been written for that task, enter that task name here followed in parentheses by the reference task's higher level activity. (See item 3, "Activity" below.) Then proceed to "Conditions: 3. Activity" and fill in the activity during which the present task will be performed. Leave the rest of the form blank.

EXAMPLE:

Task number: 1.5.1.1.3.5.1

Reference Task: Verify position using DR NAV data
(during INS nav)

Behavior: Verify position using dead reckoning
navigation

Conditions: 3. Activity: Navigate using ACFT RDR in
ground mapping mode

CONDITIONS The responses to items 1 through 7 constitute statements of the conditions which will exist as the student executes the task.

1. **Agency.** If the student will be required to contact and/or obtain information from an agency or organization during task execution, enter the agency or organization name here.

EXAMPLES

Intel
Wx
Ops

NONEXAMPLES

Other ACFT
FAA or TAC as info
source for regs

Info Source For. Specify the items of information the student is expected to obtain.

EXAMPLES

Takeoff time
Required personal
equipment
Target position and
vector
Safe area location

NONEXAMPLES

Applicable data
Appropriate INFO
Regs
Procedures

2. Manuals and Pubs. If the student must be given any manuals or publications for use in and during task execution, list them here.

EXAMPLES

-1
-34
FLIP
Phase Manual

NONEXAMPLES

Pubs, regs, etc.
which provide
authority for per-
formance of task,
but which student
does not use during
task execution

Info Source For. List the specific information items the student will be expected to use in the manual or pub.

EXAMPLES

Drag indexes
Weather minimums
Engine operating
limitations
Secure voice procedures

NONEXAMPLES

Appropriate chart
Required items
Required INFO
Procedures

3. Activity. Enter here the main higher-level task which is being executed as the student performs. This will be the main task of which the task he is performing is a part. Most often this will be the next higher task in the task listing.

EXAMPLES

For task = Turn on secure voice system

Perform fence checks
for A-S combat

For task = Calculate MIL setting

Determine manual
delivery data (A-S)

NONEXAMPLES

Secure voice
communication

Permission

4. Ext. Environment. List here specific conditions affecting task performance which may be present outside the aircraft as the student performs the task. Consider weather, visibility, light, threat, noise, or other external forces.

EXAMPLES

Day VMC
ECM environment

NONEXAMPLES

ACFT location
Season of year

5. Aids. If the student will be given job aids of any kind (other than manuals or pubs), list them here.

EXAMPLES

Plotters
Map
Recon photos
Bingo fuel chart

NONEXAMPLES

F-16 ACFT
SIM
EPT
TACAN
HUD
GCI
AWACS

6. Product of Previous Task. If a condition at the beginning of task execution is the product of a previous task, specify the name of the previous task here, and name the condition.

EXAMPLES

TASK	CONDITION
Prepare Enroute map	Map annotated with alternate airfields
Determine egress profile	Number of passes
Use radio comm from GCI/AWACS to determine general A-A threat	Threat call
Assess fuel situation of other friendly ACFT	Decision to attack
Perform radar lock on	Target lock on symbology (diamond)

NONEXAMPLES

Prerequisite tasks or tasks listed earlier in the task

NONEXAMPLES (cont.)

listing not resulting in product used in present task

7. Initiation Cues. Name the specific cues which tell the student to begin task execution.

EXAMPLES

Master Caution light illumination
Red or Fuel QTY guage
TGT lock-on symbology on HUD
Clearance from boomer operator
Directive commentary from GCI

NONEXAMPLES

Fence checks
Perceived necessity
HUD
FCNP

Systems Presenting Cues. Name the aircraft systems which deliver the initiation cues to the student.

EXAMPLES

HUD
FCNP
REO
UHF Radio

NONEXAMPLES

GCI
AWACS
Armament switches
Leader
Chart

STANDARD The next three entries define the standard as a statement of how well the task must be executed.

1. Authority.

(a) If the task standard can already be found in a pub, manual, reg, etc., enter the name and exact page and paragraph location here. Also enter the change date of the page.

(b) If a publication or manual states the proper procedure the student must execute and that is to be the performance standard, enter the pub name and the page and paragraph designation. Also enter the change date of the page.

EXAMPLES

-1 p. 3-7 (Chg 2)
-34 (Chg 1)
TACR 55-16 (DTD 1 Jan 71)

NONEXAMPLES

Phase Manual
Intel reports
Command operating

EXAMPLES

NONEXAMPLES

3-1 (DTD 1 Feb 72)
AFR 60-15
IP judgment (when
IP judgment is the only
authority for adequacy of
performance and when no
specific timing, position,
accuracy, or standards can
be identified.)

procedures

2. Performance Precision. If specific parameters are to be involved in measurement as well as the procedure steps, enter the acceptable range of variation for each parameter. Leave blank if "IP judgment" is entered above.

EXAMPLES

NONEXAMPLES

Maintain +/- 200 FT
of altitude
+/- 2 NM of desired
course
+/- .5 AOA
Accurately (or 100%
accuracy) IAW -1
procedures

Smoothly
Accurately
Completely
Correctly
IAW command direc-
tives
-34
FLIP
90% accuracy

3. Computational Accuracy. If a computation is involved in task execution, enter here the amount of error which will be tolerated in the answer.

EXAMPLES

NONEXAMPLES

Computed answer +/- XXX

Switches properly
configured; required
indications on HUD;
accurately

DATA Additional data are collected here to be used for sorting and decision-making purposes.

1. Systems Presenting Cues. List here the names of systems which present cues both during task performance and at task completion.
2. Systems Receiving Manipulations. List here the names of systems which are manipulated by the pilot during performance of the task.

3. Enabling Tasks. List here any tasks found elsewhere in the task listing (other than entry level tasks) that contain a skill necessary to the performance of the present task. (This is not necessarily the same as "Product of Previous Task.")

EXAMPLE

Behavior: Identify and respond to main generator failure.

Enabling task: Monitor EPU operation

NONEXAMPLE

Behavior: Perform precautionary landing

Enabling task: Identify and respond to engine malfunction enroute.

4. Criticality of Correct Performance. If incorrect performance or nonperformance of a task may endanger the mission, the aircraft, or the life of the pilot, check the appropriate box here. Otherwise check "None".
5. Difficulty. Check the box corresponding to the level of task difficulty (4 = high to 1 = low). That is, if the task is complex and the student will require a great deal of practice before the task is performed correctly, check "4". If the task is simple and can be mastered with minimal effort on the student's part, check "1".
6. Reference Source.
Actual. If a description of or standard for the behavior is presently found or presently planned to be included in a document, enter the name of that document here. If the document exists, specify page numbers, paragraph numbers and the change date.
Recommended. List here the name of any documents in which you recommend placement of data relative to the behavior. If there is no change from Actual to Recommended, enter "No change".
7. Common Mistakes. List common mistakes made by students while learning to perform the task. Also check the level of danger attendant to making each mistake (high or low).
8. Steps. Write out the actual steps in the execution of the behavior. If a document presently exists which clearly lists the steps, you can substitute the document reference, including page and paragraph number and change date.

NOTE Every data field on the CRO form must contain an entry.

If the data are unknown at the present time, enter TBD
(To Be Determined).

If there are no data to be entered in a field, and there
will not be any, write None.

If for a particular task a data field has no meaning or
does not apply, enter N/A (for Not Applicable).

REFERENCES

When citing AF documents, use only the following
designations:

- 1
- Class -1
- 1 checklist
- 25
- 25 checklist
- 34
- Class -34
- 34 checklist
- Tech Order 1-1C-1-30
- 3-1
- AFM 3-16
- AFM 51-37
- 51-50 Vol 8
- 55-16
- TACR 55-200
- 60-2
- AFR 60-15
- AFR 60-16
- TACR 501-1
- FLIP
- Phase Manual

ABBREVIATIONS

To facilitate data searches and sorts, use the following standardized terms. When abbreviations exist, use those instead of writing out the full term. (This list is consistent with TACM 51-50, Chapter 7, and when possible with the F-16-1).

<u>USE</u>	<u>FOR</u>
A/A	Air-to-Air
AAA	Anti-Aircraft Artillery
AAR	Air-to-Air Refueling
AB	Afterburner
ACCEL	Acceleration
ACFT	Aircraft
ACM	Air Combat Maneuvers
ACT	Air Combat Tactics
ACBT	Air Combat Training
ADC	Air Data Converter
ADI	Attitude Direction Indicator
ADF	Automatic Direction Finder
AGL	Above Ground Level
AHC	Advanced Handling Characteristics
AI	Airborne Interception
AIM	Air Intercept Missile
AL	Aft Left
ALT	Altitude
ALT	Alternate
ALT CAL	Altitude Calibration
AOA	Angle of Attack
AOB	Air Order of Battle
APPROX	Approximately
AR	Armed Reconnaissance
ARA	Airborne Radar Approach
AC	Area Cover
AS	Area Search
ARF	Air Reserve Forces
ARM	Armament
ARI	Aileron Rudder Interconnect
ARP	Attack Reference Point
ARTCC	Air Route Traffic Control Center
A/S	Air-to-Surface (do not use Air-to-Ground)
AS	Airspeed
AS	Alert Scramble
AS	Air Support
AST	Air Support Tactics
ATA	Actual Time of Arrival
ATT	Attitude
AUTO	Automatic
AWACS	Airborne Warning and Control System
AZ	Azimuth
BATT	Battery
BIT	Built-in-Test
BFM	Basic Fighter Maneuvers

USE

BVR
°C
CADL
CAS
CAS
CAS
CCIP
CCRP
C/DU
CENC
CG
CFT

CHAN
CIU
CIVV
COMM-JAM
CPT
CT
CS
DACM
DACT
DB
DCM
DEG
DH
DISC
DISC
DME
DRD
DSC
DTA
ECA
ECCM
ECM
ECS
EEC
EEI
EGTS
EMER
EMI
ENG
EO
EPU
EW
EWO
EWR
EXT
°F
FAC
FC

FOR

Beyond Visual Range
Degrees Celsius
Central Air Data Computer
Close Air Support
Calibrated Airspeed
Command Augmentation System
Continuously Computed Impact Point
Continuously Computed Release Point
Control/Display Unit
Convergent Exhaust Nozzle Control
Center of Gravity
Composite Force Training; Cockpit
Familiarization Trainer

Channel
Central Interface Unit
Compressor Inlet Variable Vanes
Communications Jamming
Cockpit Procedures Trainer
Continuation Training
Cross Scan
Dissimilar Air Combat Maneuvers
Dissimilar Air Combat Tactics
Dive Bomb
Defensive Counter Maneuvering
Degrees
Decision Height
Disconnect
Discharge
Distance Measurement Equipment
Depressed Reticle Dive
Direct Strike Control
Detonation Transfer Assembly
Electronic Component Assembly
Electronic Counter-Countermeasures
Electronic Countermeasures
Environmental Control System
Engine Electronic Control
Essential Elements of Information
Effective GCC Training Sortie
Emergency
Electro-Magnetic Interference
Engine
Electro-optical
Emergency Power Unit
Electronic Warfare
Electronic Warfare Officer
Electronic Warfare Range
External
Degrees Farenheit
Forward Air Controller
Fire Control

USEFOR

FCC	Fire Control Computer
FCMS	Force Capability Management System
FCNP	Fire Control/Navigation Panel
F/C/P	Front Cockpit (B model)
FCR	Fire Control Radar
FT	Fixed Target
FT	Fleeting Target
FFP	Fuel Flow Proportioner
FLIGHTREP	Inflight Report
FLR	Forward Looking Radar
FOB	Forward Oblique
FC	Formal Course
FID/C	Formation Instrument Departure/Recovery
FPM	Feet Per Minute
FPS	Feet Per Second
FR	Forward Right
FSO	Flight Surgeon Officer
FSWD	Full Scale Weapons Delivery
FT	Feet
FTIT	Fan Turbine Inlet Temperature
FWD	Forward
G	Acceleration of Gravity
GCA	Ground Controlled Approach
GCC	Graduated Combat Capability
GCI	Ground Controlled Intercept
GEN	Generator
GM	Ground Map
GND	Ground
GS	Glide Slope
GW	Gross Weight
HADB	High Altitude Dive Bomb
HAP	High Altitude Panoramic
HDG SEL	Heading Select
HR	Hour
HSI	Horizontal Situation Indicator
HUD	Heads-up-Display
HYD	Hydraulic
HZ	Hertz
IAW	In Accordance With
ID	Identification
IEWO	Instructor Electronic Warfare Officer
IFF	Identification Friend or Foe
IFR	Instrument Flight Rules
IFT	In-Flight Target
IIRS	Inertial Instrument Reference System
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMS	Inertial Measurement System
INCL	Including
INFO	Information
INS	Inertial Navigation System
INTEL	Intelligence

USEFOR

IT	Intercept Training
IP	Instructor Pilot
I/P	Identification of Position
IP	Initial Point
IQT	Initial Qualification Training
IR	Infrared
IR VPP	Infrared Vertical Pinpoint
ISC	Indirect Strike Control
ISD	Instructional Systems Development
IT	Interdiction Tactics
IWSO	Instructor Weapons System Officer
JETT	Jettison
JFS	Jet Fuel Starter
Knots CAS	Knots Calibrated Airspeed
Knots EAS	Knots Equivalent Airspeed
Knots IAS	Knots Indicated Airspeed
Knots TAS	Knots True Airspeed
KVA	Kilovolt-Ampere
LAB	Low Angle Bomb
LADD	Low Altitude Drogue Delivery
LALD	Low Angle Low Drag
LAP	Low Altitude Panoramic
LATN	Low Altitude Tactical Navigation
LB(S)	Pound(s)
LCOS	Lead Computing Optical Sight
LE	Leading Edge
LEF	Leading Edge Flaps
LG	Landing Gear
LGB	Laser Guided Bomb
LOB	Left Oblique
LOCS	Line of Communications Search
--	Low Level Navigation Training
LORAN	Long Range Navigation
M	Mach Number
MAL	Malfunction
MTA	Manual Terrain Avoidance
MAP	Minimum Attack Parameter
MAX	Maximum
MDA	Minimum Descent Altitude
MEA	Minimum Enroute Altitude
MFL	Maintenance Fault List
MHZ	Megahertz
MIC	Microphone
MIL	Military
MILS	Milliradians
MIN	Minute
MIN	Minimum
MISREP	Mission Report

USEFOR

MLG	Main Landing Gear
MON	Monitor
MQT	Mission Qualification Training
MR	Mission Ready
MRK BCN	Marker Beacon
MS	Mission Support
MS	Mutual Support
MSL	Missile
MSU	Mode Select Unit
NAV	Navigation
NLG	Nose Landing Gear
NM	Nautical Mile(s)
NS	Night Sortie
NOZ POZ	Nozzle Position
NVPP	Night Vertical Pinpoint
NWS	Nosewheel Steering
OV	Offensive Vector
OI	Operating Instructions
OPA	Overhead Precautionary Approach
OPS	Operations
OPT	Optimum
OSST	Ocean Ship Surveillance Training
PFL	Pilot's Fault List
PIO	Pilot Induced Oscillations
PQI	Professional Qualification Index
PMG	Permanent Magnet Generator
PNEU	Pneumatic
PS	Pave Spike (AN/ASQ-153 Lower Target Designator)
PSA	Pneumatic Sensor Assembly
PSI	Pounds per Square Inch
PUP	Pop-Up Point
PWR	Power
PWSO	Pilot Weapons System Officer
RST	Radio Silent Training
RCP	Radio Control Panel
R/C/P	Rear Cockpit (B model)
RCR	Runway Condition Reading
RCVV	Rear Compressor Variable Vanes
RDL	Radar Lay Down
RDR	Radar
REN	Rendezvous Point
REO	Radar/Electro-Optical
REOD	Radar/Electro-Optical Display
RET SRCH	Return to Search
RIE	Radar Intercept Event
RIT	Redyced Idle Thrust
RIU	Remote Interface Unit
RLADD	Radar Low Angle Drogue Delivery
ROB	Right Oblique

<u>USE</u>	<u>FOR</u>
ROR	Release on Range
RPM	Revolutions Per Minute
RR	Route Reconnaissance
RS	Reconnaissance Strip
RSP	Radar Scope Photography
RSVR	Reservoir
R/T	Receiver/Transmitter
RWR	Radar Warning Receiver (do not use RHAW)
SAR	Search and Rescue
SAS	Stability Augmentation System
SAT	Surface Attack Tactics
SCAR	Strike Control and Reconnaissance
SCP	Stores Control Panel
SCP	Simulated Combat Profile
SEC	Seconds
SEFE	Standardization Evaluation Flight Examiner
SFO	Simulated Flameout
SIF	Selective Identification System
SIM	Simulator
SL	Sea Level
SLAR	Side Looking Airborne Radar
SMS	Stores Management System
SNVPP	Simulated Night Vertical Pinpoint
SOB	Side Oblique
STP	Specialized Training Program
SPD BRK	Speed Brake
SRCP	Simulated Reconnaissance Combat Profiles
STA	Station
STAN/EVAL	Standardization/Evaluation
STBY	Standby
SCA	Strike Control Authority
STD	Standard
TACAN	Tactical Air Navigation System (do not use TCN)
TF	Tactical Formations
TAO	Terrain Avoidance Override
T.D. BOX	HUD Target Designator Box
TE	Trailing Edge
TEF	Trailing Edge Flaps
TEMP	Temperature
TEREC	Tactical Electronic Reconnaissance
TFO	Terrain Following Override
TISEO	Target Identification System Electro-Optical
TISL	Target Identification Set Laser
TFR	Terrain Following Radar
TG	Terminal Guidance
T.O.	Takeoff
TO	Tech Order
TOT	Time Over Target
TD	Trail Departure
<u>USE</u>	<u>FOR</u>
TUOC	Tactical Unit Operation Center

TT	Transient Target
UC	Unified Control
UCMS	Unit Capability Measurement System
UE	Unit Equipped
UHF	Ultra High Frequency
US	United States
VFR	Visual Flight Rules
VHF	Very High Frequency
VID	Visual Identification Mode
VLADD	Visual Low Angle Drogue Delivery
VLD	Visual Lay Down
VMAX	Maximum Power
VMC	Visual Meteorological Conditions
VPP	Vertical Pinpoint
VR	Visual Reconnaissance
VTR	Videotape Recorder
VTRR	Visual Target Radar Ranging
VVI	Vertical Velocity Indicator
WORD	Wind-Oriented Rock Deployment
WPN REL	Weapons Release
WRCS	Weapon(s) Release Computer Set (System)
WSO	Weapons System Office
WT	Weight
WVR	Within Visual Range
WW	Wild Weasel
WX	Weather