Methodology for setting up questions and managing question data banks for examination purpose (Pilots and licensed maintenance staff)

Content

A - Setting up Questions for FCL and Part-66 Question Bank

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1 Computer Compatible Question Design

There is a direct relationship between the qualification of staff and the safety in aviation. Therefore a high level of knowledge and the right transfer of knowledge are imperative prerequisites. To prove their ability and knowledge all applicants should pass an examination.

The rapid increase in technology requires constant updating of staff knowledge. For effective and fast integration of this knowledge, an effective examination data base and examining system by computer is needed.

Today's modern computerised examinations allow the competent authority to use advanced elements and methods to check the applicants. Especially in the area of technical training and examination graphic elements and vivid representations instead of pure text are very important. Therefore this guideline considers already the possibility of future orientated methods for exclusive computer based examinations.
The use of multi-media elements and good database architecture will raise the quality of the questions and the examinations.

1.1. Background Information

Main elements of computer assisted Examination Question Bank System

Control-Software

In order to administrate the question bank also a program is needed. The main tasks are to support the question design and the question management. It also must provide examination pattern for written examinations and for computer based examinations. It must not have any functionality to run an examination or to control the applicants' license data.

Question-Database

A question-database includes the entire information. It is the base of the examination development and the controlling system. A well organised question-bank is a fundamental prerequisite for the quality insurance of examinations.

Library (Help tools)

Dictionary / Technical Terms[1]

Considering that today probably every author use a computer to type questions and take the language problem into consideration it is very helpful to have access to an English Dictionary which contains also the usual technical terms for all modules.

Abbreviation lists[2]

In addition to the dictionary a common and module specific abbreviation list should be available for the question setup process as well as for the examination.

Graphic collection

Desirable is a sample of copyright free graphics, maps, technical drawings, charts, technical forms etc.

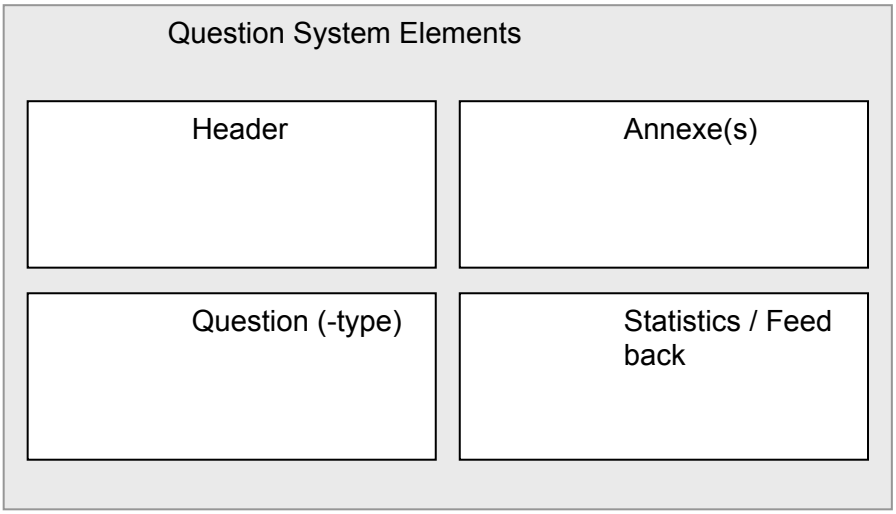
[1] Refer to attachment 1
[2] Refer to attachment 2

1.2. Formal construction at computer compatible questions

1.2.1. Standard question elements

For each question the following construction is defined as standard:

Element 1: Header (General data)
Element 2: Question (-type)
Element 3: Annexe(s) (to the specific question)
Element 4: Statistics / Feed back



1.2.1.1. Question Header

The header of a question describes all existential information behind the question (and answer) text. They are necessary for an effective and time saving administration of larger data bases[3]. Examples are …

- Question ID,
- Creation Date,
- Last Update Date,
- Status flag,
- Reference to learning objective,
- Reference to module and syllabus paragraph / subparagraph, Level, Category,
- Scheduled working time,
- Difficulty Level.

1.2.1.2. Question Types

Following question types are allowed to be used:

- Multiple-choice question with 4 answers and 1 correct answer
- Essay questions (for Part 66)

1.2.1.3. Annexe(s)

In this context, an Annex refers to a document that is needed to solve the question(s). One or more Annexes may be needed to solve a particular question.[4.]

[3] Refer to the question bank management for a detailed list of fields
[4] Please refer to chapter 5 'Use of Diagrams' for more details

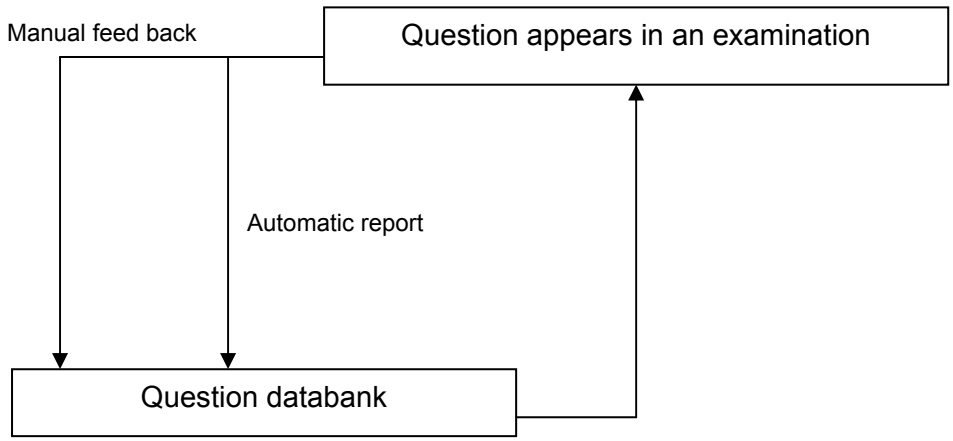
Annexes should not be larger than DIN A 4 and in good clear quality and suitable for the purpose of solving the question. They can be used as prints as well as digitised documents in the format jpg, gif or png for computer based examinations.

1.2.1.4. Feed back information (Quality circle)

(a) Automatic report (Self assessment of questions)
The future of examining is in computer based examinations, which will also make possible the reporting back of candidates' inputs as an automatic and ongoing procedure. Each time a question appears in an examination the software will create a new entry in the feed back list.
With this function, it can be recognised if the question fulfils the expected value (for example, not too easy and not too difficult, or if the question has a misleading nature).
If the software in use supports the functions, the feed back can lead to an automatic assessment of the questions.

(b) Manual feed back
As an additional function, it is possible to enable candidates to type in comments concerning the unsuitability of the current question. This would enable to access the candidates' comments in this regard.

(c) Overview feed back quality circle



2 Requirements

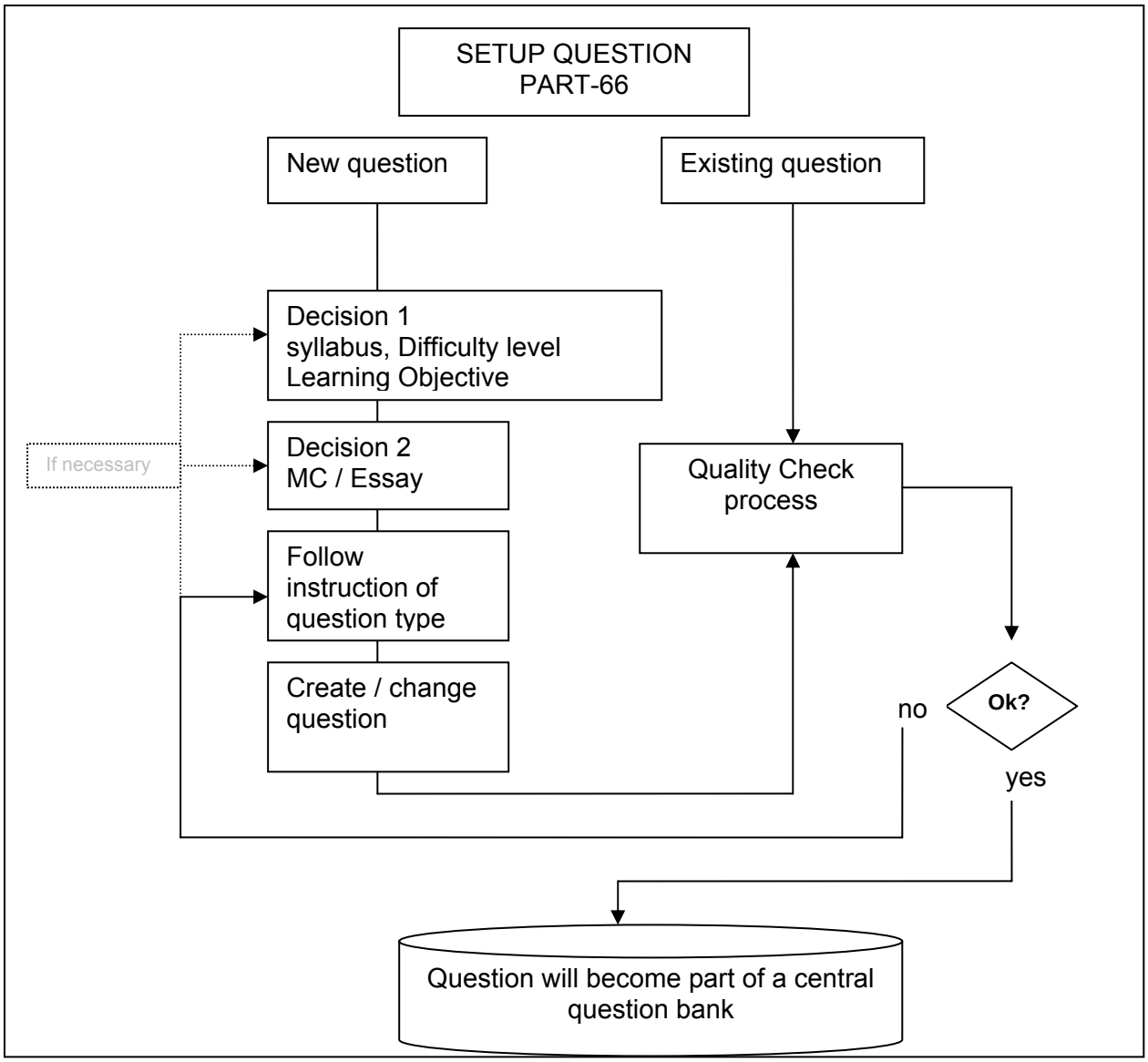
2.1. Principal requirements

(a) Questions must be written in Aviation language.
(b) Questions that require specialised knowledge of specific aircraft types should not be asked in a basic licence examination.
(c) Multiple-choice question must have four alternative answers of which only one must be the correct answer and the candidate must be allowed a time per module which is based upon a nominal average of 75 seconds per question.
(d) (Only applicable for Part 66) The primary purpose of essay questions is to determine that the candidate can express themselves in a clear and concise manner and can prepare a concise technical report for the maintenance record, which is why only a few essay questions are required. The candidate must be allowed a time per essay question of 20 minutes.
(e) The examination should measure clearly formulated goals. Therefore the field and depth of knowledge to be measured by each question must be fully identified.
(f) For pass mark purposes, the essay questions should be considered as separate from the multiple-choice questions.
(g) For a better descriptiveness and in order to remain close to reality, the use of diagrams is particularly suitable. The use of diagrams in questions must follow to the rules of the appendix "Using Diagrams".
(h) Calculators are not allowed during examination. Therefore all calculations should be feasible without a calculator. Where a question involves calculations not feasible without a calculator, such as $\sqrt{10}$, then the question should specify the approximate value of $\sqrt{10}$.
(i) The use of abbreviations, and acronyms should generally be avoided. However where needed, only internationally recognised abbreviations, acronyms should be used. In case of doubt use the full form, e.g. angle of attack = 12 degrees instead of a= 12°. This means, for example, that only abbreviations commonly employed in the specialist field are used, without an additional spelled-out explanation in brackets.
(j) The use of units must follow the international rules and style conventions[5].
(k) Questions must be referred to the syllabus, the category and the learning objectives.
(l) The layout of question should be homogenous. Only one font may be used for the question and the answer text. For the better optical distinction the additional elements like statements, situations or scenarios should be distinguished homogeneously by using different colours. The direct question text should be of course identifiable. It should be separated from opening text by an empty line, always begin at a new line and positioned at the end of the question text.

2.2. Quality Circle Setup and Review Questions

The picture below shows the general workflow which should be followed when setting up new questions or reviewing existing questions. The use of the diagram shall also support the aim to get a common quality level of questions.

[5] - A PDF file of units of measurement can be found at http://ts.nist.gov/WeightsAndMeasures/Metric/upload/EUMetricDirective2010.pdf
- Refer also to SI Unit rules and style conventions, National Institute of Standards and Technology (NIST), [Docket No. 980430113-8113-01]


SETUP QUESTION
PART-66
New question
Existing question
Decision 1
syllabus, Difficulty level
Learning Objective
If necessary
Decision 2
MC / Essay
Follow
instruction of
question type
Create / change
question
Quality Check
process
Ok?
no
yes
Question will become part of a central
question bank

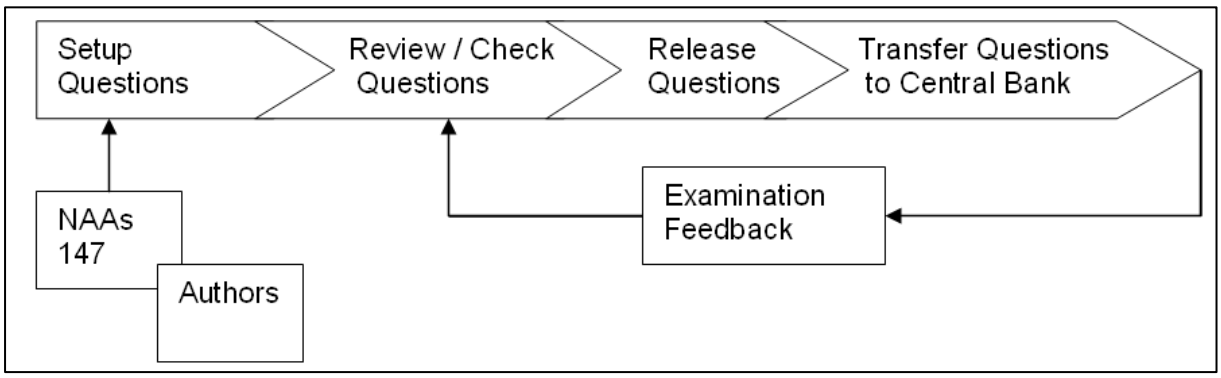
2.3. Ongoing Quality Circle

Before a question appears in an examination it should be checked by one or more Module Experts and by students in the advanced stage. Their judgment guarantees the clear understanding of the meaning of a question and its reply. The figure below shows the standard quality process.

Workflow

1. Author(s) write questions
2. Experts review Questions
3. Experts decide and release the question when it is ok
4. Question appears in exam
5. Feed back:
   5.1 If the question is ok
   Question stays in the bank
   5.2 If the question is not ok
   Go to 1 and 2

Process



2.4. Question Review Checklist

The main purpose of the question review checklist is to help evaluating existing question against the basic requirements described in this methodology. Most existing questions are likely to be reviewed by using software on a personal computer which allows a more comfortable working method compared with paper based working. But if no such system is available this checklist can support the evaluation process.
Hereafter an example for Part 66 requirements:

EASA	Part-66	Question Review Checklist		
Name		Module	Date	

Question Number	Relevance to Part-66 Syllabus	Conformaty with Part-66 Level and Category	Content check and justification of false answers	Conformity with Part-66 formal question standard	Conformity with Part-66 wording question standard	Simplicity and correctness of the English language	Remark	Proposal	Validation
	1	2	3	4	5	6			
1	☐	☐	☐	☐	☐	☐			☐
2	☐	☐	☐	☐	☐	☐			☐
3	☐	☐	☐	☐	☐	☐			☐
4	☐	☐	☐	☐	☐	☐			☐
5	☐	☐	☐	☐	☐	☐			☐
6	☐	☐	☐	☐	☐	☐			☐
7	☐	☐	☐	☐	☐	☐			☐
8	☐	☐	☐	☐	☐	☐			☐
9	☐	☐	☐	☐	☐	☐			☐
10	☐	☐	☐	☐	☐	☐			☐
11	☐	☐	☐	☐	☐	☐			☐
12	☐	☐	☐	☐	☐	☐			☐
13	☐	☐	☐	☐	☐	☐			☐
14	☐	☐	☐	☐	☐	☐			☐
15	☐	☐	☐	☐	☐	☐			☐
16	☐	☐	☐	☐	☐	☐			☐
17	☐	☐	☐	☐	☐	☐			☐
18	☐	☐	☐	☐	☐	☐			☐
19	☐	☐	☐	☐	☐	☐			☐
20	☐	☐	☐	☐	☐	☐			☐
21	☐	☐	☐	☐	☐	☐			☐
22	☐	☐	☐	☐	☐	☐			☐
23	☐	☐	☐	☐	☐	☐			☐
24	☐	☐	☐	☐	☐	☐			☐
25	☐	☐	☐	☐	☐	☐			☐

3 Setup Multiple-choice Questions

3.1. Preface

Multiple-choice questions are not a panacea. They have advantages and limitations just as any other type of question. Authors of questions need to be aware of these characteristics in order to use multiple-choice questions effectively.
Multiple-choice questions are appropriate for use in each syllabus[6] , and can be used to measure a great variety of educational objectives. They are adaptable to the learning objectives[7], from simple recall of knowledge to more complex levels, such as the applicants' ability to:

- analyze phenomena,
- apply principles to new situations,
- comprehend concepts and principles,
- discriminate between fact and opinion,
- interpret cause-and-effect relationships,
- interpret charts and graphs,
- judge the relevance of information,
- make inferences from given data,
- solve problems.

The difficulty level of multiple-choice questions can be ensured by rephrasing the answers and/or changing the order of the alternatives.

3.1.1. Validity

In general, it takes much longer to respond to an essay test question than it does to respond to a multiple-choice question, since the composing and recording of an essay answer is such a slow process. A candidate is therefore able to answer many multiple-choice questions in the time it would take to answer a single essay question. This feature enables to test a broader sample of the syllabus in a given amount of testing time. Consequently, the test is likely to be more representative of the candidates overall achievement.

Ultimately, the validity (and reliability) of the examination depends on the quality of the individual questions. Questions are most likely to be suitable for use in an examination when they fulfil the criteria below. The following principles should be observed when developing multiple-choice questions.

A question will contribute to the validity of the examination, if following conditions are considered:

(a) The chosen subject matter of the questions is relevant to the practical work. Splitting hairs should be avoided, as should be trivialities.

(b) The level is correct.
An examination which is primarily intended to test the understanding and application competence of knowledge should not consist of questions that merely require the availability of memorised individual facts.

(c) It focuses on a clearly defined content or problem and is a self-contained entity.

(d) There is clearly one true solution.
Content on which there are controversial scholarly opinions are unsuitable for

[6] Example for Part 66: refer to Appendix I, (2.)
[7] Example: refer to chapter **Error! Reference source not found.** and to Part-66, Appendix I, (1.)

the multiple-choice method, unless a specific scholarly opinion is expressly asked for.

3.1.2. Reliability

Well-written multiple-choice questions compare favourably with other question types on the issue of reliability. Since multiple-choice questions are objectively scored, they are not affected by scorer inconsistencies as are essay questions and they are essentially immune to the influence of bluffing and writing ability factors, both of which lower the reliability of essay can test scores.

A question contributes to the reliability of the examination if it differentiates in the sense of the examination, i.e. when it is selective. Following conditions should be considered:

(a) The question is appropriate with regard to the difficulty of the category. Questions which are too difficult and leave even good candidates guessing are particularly problematic.

(b) The question is clearly phrased.
The question should test candidates' knowledge rather than their understanding of language or how lucky they are in finding the right interpretation.

(c) The question does not contain any unintended pointers to the solution (cues). It is supposed to test knowledge and not experience in multiple-choice exams or the ability to crack tests.

The guessing factor reduces the reliability of multiple-choice question scores somewhat, but increasing the number of questions on the test offsets this reduction in reliability.
The following table illustrates this principle.

Number of Questions (4 alternative answers, 1 correct answer)	Chance of Scoring 70% or higher by blind guessing alone
2	1 out of 16
5	1 out of 64
10	1 out of 285
15	1 out of 8,670
20	1 out of 33,885
25	1 out of 942,651

For example, if the test includes a section with only two multiple-choice questions of 4 alternatives each *(a b c d),* you can expect 1 out of 16 of your candidates to correctly answer both questions by guessing blindly. On the other hand if a section has 15 multiple-choice questions of 4 alternatives each, you can expect only 1 out of 8,670 of your candidates to score 70% or more on that section by guessing blindly.

3.1.3. Efficiency

Multiple-choice questions are amenable to rapid scoring, which is often done by using a master-solution template for *paper&pencil* (written) examinations or by computer based examinations. This expedites the notification of test results to the candidates.

3.1.4. Difficulty of Construction

Good multiple-choice questions are generally more difficult and time-consuming to write than other types of questions. Coming up with plausible alternative answers require a certain amount of skill. This skill, however, may be increased through study, practice, and experience.

3.2. Writing Multiple-choice Questions

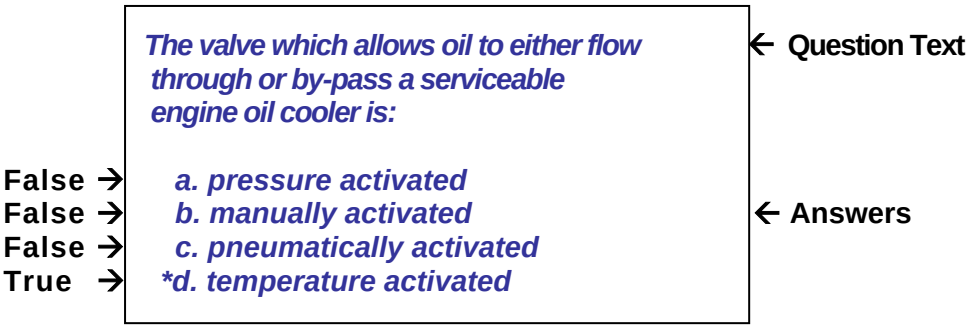
These instructions describe the methodology to be followed when writing multiple-choice questions. Behind a description of general rules, correct phrasing and avoidance of unintended cues, the instructions are illustrated as far as possible with question examples. Whenever necessary an example will illustrate the use of the relevant rule, by comparison of a poor solution with a better solution.
Please do not use any of the example questions for a real examination. The used examples in this guidance manual are only designed to show the principles of the relevant rule.
It needs to be emphasised here that the present instructions neither replace experience nor do they save the time commitment required to produce good multiple-choice elements.
New authors are recommended to learn writing and revising multiple-choice elements at a workshop lasting at least one day (see also 5.2). Ideally, authors should furthermore be regularly kept up to date about the results of their reviewed questions so that they are able to learn from their mistakes (see also 1.2.1.4.).
Producing questions takes time: even practised authors take at least one hour to produce a multiple-choice question (see also 5.)

3.2.1. Anatomy of a Multiple-choice Questions

A multiple-choice question consists of two basic parts:

- The question text, which can be just a question or a problem (situation/scenario). The problem may be in the form of either a direct question or an incomplete statement.
- The list of answers. It has one true answer and three incorrect answers.

Multiple-choice Question



3.2.2. Multiple-choice question types

Multiple-choice “1 from 4” can be raised as

- Positive single choice out of four answers to choose from
- Negative single choice out of four answers to choose from

Often the positive form of multiple-choice questions is as well suited as the negatively phrased type, with regard to validity as well as reliability.

3.2.3. Principals of writing Multiple-choice Questions

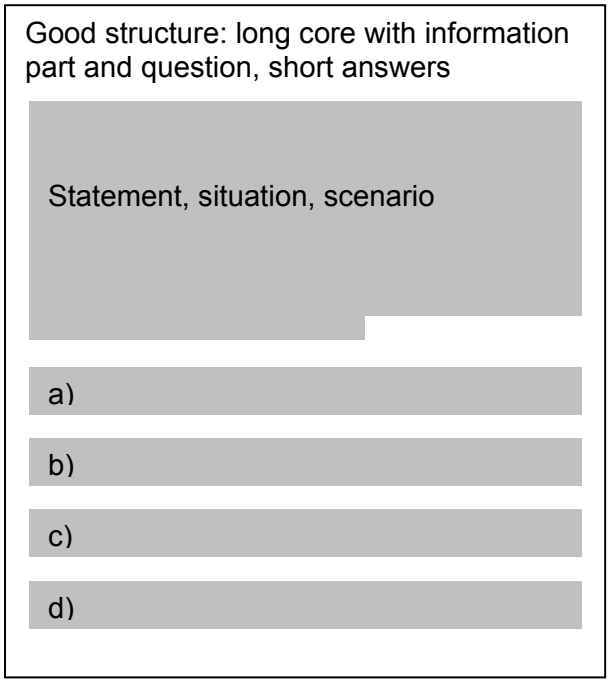
When devising multiple-choice elements as a part of a multiple-choice question the questions thus produced should, as a rule, test more than mere factual knowledge and be largely free from formal errors. They should be good enough to ensure the validity and reliability of an examination.
If multiple-choice questions are to test more than factual knowledge, complex problems need to be presented which contain several pieces of information that

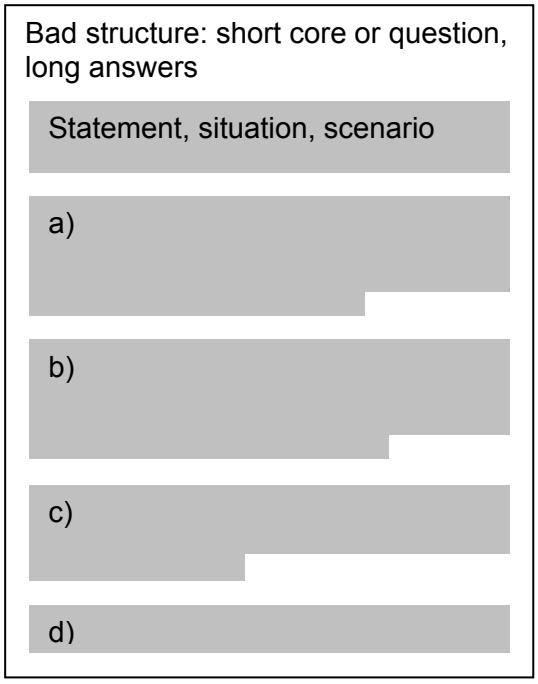
need to be interpreted and integrated. Good questions therefore frequently require an elaborate core.

The following principals should be observed when developing multiple-choice questions:

3.2.3.1. Specifications to write Multiple-choice Question Text

(a) In multiple-choice questions, answers will often have to be weighed. In almost all cases, this is only possible if they are short and clear.
The question formulation (statement, situation, scenario) may be long, but the answers should be short!





(b) Questions and answers should be formulated as simply as possible: the examination is not a test of language. Complex sentences, unusual grammar and double negatives should be avoided. Questions should not deliberately be made complicated or intentionally designed as trick questions.

When phrasing questions you should ensure that the question text

- contains all the information required for the answer so that no additional information needs to be given in the answer,
- does not, as a rule, contain superfluous information:
  The exception is a question intended to test the ability to filter out relevant information. But otherwise precious time would be wasted by including unnecessary text,
- should always be phrased positively:
  Negative questions are not desirable from a validity point of view. A negative phrasing of the question text will invariably result in confusing double negatives.

(c) The difficulty of a question should be determined by the complexity of the underlying problem, the level (understanding, problem solving), and the subtlety of the required differentiation (proximity of the possible answers to each other). It is unfair and certainly contrary to the intention of the test to use formal tricks in order to make a simple question more difficult.

What does the subject matter of the question aim at?

The syllabi specify the topics on which questions must be written. Questions should always refer to a narrow aspect, i.e. at the lowest level. This avoids questions that are too abstract.

If the following question is asked on a Part 66 Module 1 subject:

"Which of the following statements about percentage calculation applies?"

The subject is certainly too broad and too heterogeneous for a multiple-choice question.

Relevant questions within a topic are derived mainly from the detailed aspects

- a maintenance technician is most frequently faced with,
- where errors may have grave consequences,
- where erroneous views are widespread.

To check the relevance of the intended topic one may ask the question:

"How important is it that the candidate is able to solve this problem independently or answer the resulting question correctly?"

Starting from your own experience or from a specific non-binding request from a non-specialist can produce extremely application-based and relevant questions.

However, care should be taken not to pick "interesting" special cases.

It is important to use textbooks to verify and document the factual accuracy of a question and the true answer(s). Textbooks may also be helpful for finding good false answers. However, their usefulness as a source of inspiration for questions is limited. Although, whenever the intention is to test theoretical knowledge in the narrower sense (basic knowledge), textbooks do have a place in assisting to phrase or copy questions to test learning objectives. However, this procedure often produces purely academic questions, the suitability of which for testing competence is doubtful.

Check the relevance of the intended topics to the application by asking the question:

"Will an applicant be faced with this problem/question in practice?"

Question texts can consist of a single question:

Which of the following item influences the operation of an automatic fuel control unit on a turbojet engine?

Or a statement:

The active clearance control (ACC) portion of an EEC system increases turbine engine efficiency by:

Although it is possible to test relevant knowledge using such texts, they merely test factual knowledge as a rule.

But multiple-choice questions can be and should be also used to test the ability to interpret and to integrate information, and to apply theoretical knowledge to a specific problem.

For this, the question texts should present information about a problem. This, for example, could be a technical case study (fault, repair measures to be taken, etc).

The concrete short question follows separately:

> ***You find that there is exterior damage to a light-alloy propeller blade. The damage consists of slight indentations and notches caused by stones.***
>
> ***What is the correct assessment?***

The information section can contain illustrations, e.g. photographs, graphics, or checklists etc.

3.2.3.2. Specifications to write Multiple-choice Answer Text

Badly chosen and/or phrased answers in a relevant problem situation frequently result in entirely unsuitable questions. To contribute to the validity and reliability of a test, finding the right answer should only depend on whether the knowledge to be tested is available, if possible. To achieve this, the possible answers need to meet a series of content, formal and linguistic criteria.

(a) A question should comprise one complete positive answer.

(b) The correct answer should be absolutely correct and complete or, without doubt, the most preferable. Responses that are so essentially similar that the choice is a matter of opinion rather than a matter of fact should be avoided. The main interest in multiple-choice questions is that they can be quickly performed: this is not achieved if doubt exists about the correct answer. The right answer should definitely be the only correct one.

(c) Each possible answer should be short and only contain one statement.

(d) All possible answers should fall into the same category, i.e. they should be homogenous in content (e.g. all measurement units, all diagnoses, all causes, all steps/measures, etc.).

(e) There should be good reasons for any false answer. For example, these may be frequent erroneous opinions, wrong concepts, outdated views, etc. There should at least be a clearly understandable relationship with the question subject matter. A justification for each false answer should be written.

(f) Even bad candidates will be able to immediately exclude such implausible, trivial or totally nonsensical false answers. This increases the chance to guess the right answer. It makes no sense at all to provide an absurdity as a false answer.

(g) Overlapping answers should only be used if the underlying problem requires it. They should not be used to intentionally make a question more difficult.

(h) Phrases such as “All the above” or answers such as “Both B as well as C are right” should not be used. If this is the intended right answer, then more than one right answer exists and a matching question should be taken in mind.

(i) The false alternatives should seem equally plausible to anyone ignorant of the subject. All of the alternatives should be clearly related to the question and of similar vocabulary, grammatical construction and length. In numerical questions, the incorrect answers should correspond to procedural errors such as corrections applied in the wrong sense or incorrect unit conversions: they should not be mere random numbers.
False answers do not need to differentiate themselves from the right answer in an obvious way. It is possible to ask candidates to weigh up various different shades of grey.

(j) The answers should be randomised in an individual examination[8].

3.2.3.3. Formal aspects

Formal criteria are mainly about avoiding any unintended hints at the solution, the "cues". Cues enable MC experienced candidates to identify the correct answer even without any specialist knowledge, or to eliminate incorrect answers thus improving their chance of guessing the correct one. The second objective is to minimize the influence of particular answering trends by candidates. The following examples will illustrate the most important and most frequent cues by these nonsense questions.
Therefore, do not attempt to answer the following questions with regard to the content:

(a) False answers should be almost of the same length and have the same level of differentiation as the correct answer.

Example of an *incorrect* phrasing

How often can a locknut with fibre ring be used?
a. twice
b. always once only
c. three times
d. four times

Authors are obviously focused on the correct answer and they try to phrase this as precisely as possible. Little attention is paid to the false answer, which is perceived as a mere "background noise". Candidates who are experienced in tests would have a good chance of success by selecting answer "***b.***". It is not always possible to produce answers that are of equivalent length and complexity. However, authors should ensure that the correct answer does not stand out.

[8] This means, the same question will have a different sequence in any individual examination it appears. Even when printing a paper&pencil examination pattern it can be generated with randomized answers.

(b) All answers should fit the question text grammatically.

Example of an *incorrect* phrasing

> ***The information is part of an***
> ***a. Annex***
> ***b. Book***
> ***c. Picture***
> ***d. Video***

For reasons of grammar (an Annex, a Book, a Picture, a Video), only (a.) can be the correct answer. It probably happens rarely that two answers can be eliminated, but it will frequently happen that some will not be considered. To check, authors should read each answer together with the question when checking consistency.

(c) Avoid verbal associations between question text and correct answer.

Example of an *incorrect* phrasing

> ***The characteristic of a T-tail unit is…***
>
> ***a. Rudder and elevator form a U***
> ***b. Rudder and elevator form a T***
> ***c. Rudder and elevator form a V***
> ***d. Rudder and elevator form a Y***

S

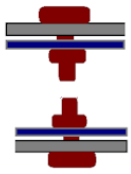
Since the letter T appears in both (question text and answer B), it will increase the likelihood of it being the correct answer. The guessing can be avoided by re-phrasing it or by adding an illustration:

Example of a *better* presentation of the question

> ***The tail unit of the shown aircraft is ...***
>
> ***a. a cross tail unit***
> ***b. a T-tail unit***
> ***c. a V tail unit***
> ***c. a M tail unit***
>
> 

(d) Hidden clues to the right answer should be avoided.

Example of an *incorrect* phrasing

> ***A connection screw can be installed in two different positions. Which location is correct from safety point of view?***
>
> ***a. The nut must be installed at the bottom, because the bolt will not fall out even when the nut is lost.***
>
> ***b. The nut must be installed at the top, because it is easier to tighten it.***
>
> ***c. The nut can be installed as desired, depending on the working position.***
>
> ***d. The nut can be installed as desired, depending on the size of the nut.***
>
> 

Answer ‘a.’ will be identified as right even without specialist knowledge since it comes complete with a safety reason.

(e) Absolute terms such as “never”, “always” should not be used in order to make statements clearly false. Such absolutes often enable false answers to be identified intuitively. The desired statement is usually clear even without the addition of absolutes.

Example of an *incorrect* phrasing

a. The nut must be installed at the bottom.
b. The nut must always be installed at the top.
c. The nut may be installed as desired.
d. The nut may not be installed at any position.

3.2.3.4. Measuring Higher-Level Objectives with Multiple-choice Questions

Multiple-choice questions are frequently used to measure lower-level objectives, such as those based on knowledge of terms, facts, methods, and principles like knowledge level 1[9]. The real value of multiple-choice questions, however, is their applicability in measuring higher-level objectives, such as those based in comprehension, application, and analysis like knowledge level 2 and 3 of Part-66[10].

(a) Comprehension

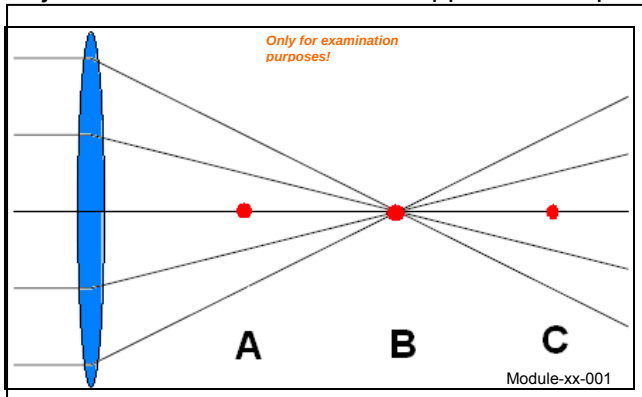
Objective: Identifies the effect of changing a parameter (rule using).

A pendulum consists of a sphere hanging from a string. What will happen to the period of the pendulum if the mass of the sphere is doubled? (Assume that the effects of air friction and the mass of the string are negligible, and that the sphere traces an arc of 20° in a plane as it swings.)

a. It will increase.
b. It will decrease to half of it.
**c. It will remain unchanged.*
d. It will decrease to zero.

(b) Application

Objective: Identifies the correct application of principle (problem solving).



In the diagram above, parallel light rays pass through a convex lens and converge to a focus. They can be made parallel again by placing a:

a. Concave lens at point B.
b. Concave lens at point C.
c. Second convex lens at point B
**d. Second convex lens at point C*

[9] Refer to **Error! Reference source not found.** and Part 66 Appendix I (1.)
[10] Refer to **Error! Reference source not found.** and Part 66 Appendix I (1.)

(c) Analysis

Objective: Analyzes manual text and identifies patterns and relationships.

[The manual text is included here.]

The chief purpose of statement XY is to:

a. show relation between part 7 and instruction XY
** b. show relation between part 9 and instruction XY*
c. show relation between part 10 and instruction XY
d. show relation between part 12 and instruction XY

3.2.4. Examples

3.2.4.1. Example 1: Positive single choice from four answers to choose from

Definition**:**

Four possible answers or additions to a question or incomplete statement, from which the only right answer should be selected.

Question:

In an aircraft with an empty weight of 2100 lbs and an empty weight CG position of +32.5 inches the following changes were made:

a. Two 18 lbs passenger seats at station +73 were removed.

b. A modification to the structure was performed at station +77 which increases the weight by 17 lbs.

c. A seat including safety belt weighing a total of 25 lbs were installed at station +74.5.

d. An additional NAV device weighing 35 lbs was installed at station +95.

...and the appropriate question in the form of a question,

What is the new empty weight CG?

... or an alternative statement.

The new empty weight CG is:

There is only one right answer amongst the four answers to choose from. The other three serve as false answers.

a. 30.01
b. 33.68
c. 34.65
d. 34.85

3.2.4.2. Example 2: Negative single choice from four answers to choose from

Definition:

A question or incomplete statement is followed by four answers or additions from which to choose the exception or the least applicable. The negation should be either bolded or underlined.

This question type can be used in those rare cases where knowledge of an important exception is essential. What is actually being tested is the knowledge of the three positive answers. The “right” answer is merely a by-product of the solutions.

However, you should always ask yourself whether a positively formulated question, e.g. knowledge of key (facts/important regulations, right results, most likely consequences) might not be more relevant and more in line with actual use.

Question:

In an aircraft with an empty weight of 2100 lbs and an empty weight CG position of +32.5 inches the following changes were made:

1. Two 18 lbs passenger seats at station +73 were removed.

2. A modification to the structure was performed at station +77 which increases the weight by 17 lbs.

3. A seat including safety belt weighing a total of 25 lbs were installed at station +74.5.

4. A NAV device weighing 35 lbs was repaired at station +95.

...and the appropriate question in the form of a question or a statement,

Which item is <u>NOT</u> relevant?

… or alternative

<u>NOT</u> relevant is:

There is only one true answer amongst the four answers to choose from. The other three serve as false answers.

a. 1
b. 2
c. 3
d. 4

*Which of the following is **<u>NOT</u>** a good argument in a conflict situation about the correct repair ?*

**a. “I am the chief, follow my instructions!”*
b. “Follow the instructions of the textbook!”
c. “Ask a colleague to get more information!”
d. “Explain your reasons to me!”

For most educational objectives, candidates achievement is more effectively measured by having him or her identify a correct answer rather than an incorrect answer. Just because the candidate knows an incorrect answer does not necessarily imply that he or she knows the correct answer. For this reason, questions of the negative variety are not recommended for general use. Occasionally, negative questions are appropriate for objectives dealing with safety issues, where knowing what not to do is important. In these situations, negative questions should be carefully worded to avoid confusing the candidate. The negative word should be placed in the question text, not in the alternatives. In addition, each of the alternatives should be phrased positively to avoid forming a confusing double negative with the question text.

Poor Example

*All of the following are correct actions for putting out a fire in a pan on the stove **EXCEPT**:*

a. Do not move the pan.
**b. Pour water into the pan.*
c. Slide a fitted lid onto the pan.
d. Don't panic.

Better Example

*All of the following are correct actions for putting out a fire in a pan on the stove **EXCEPT:***

a. Leave the pan where it is.
**b. Pour water into the pan.*
c. Slide a fitted lid onto the pan.
d. Keep cool.

3.2.4.3. Example 3: Matching

In matching questions, candidates must select more than one correct element or statement. These elements are numbered and each multiple-choice answer presents a set of numbers.

Poor Example

The candidate is directed to identify the correct answer or answers by selecting one of a set of numbers, each of which represent a combination of alternatives. In the example below, a candidate can identify combination "e.**"** as the correct response simply by knowing that element 4 is correct.

Which Elements belongs to a Truss Wing Structure?

1. Nose Rib
2. N Girder
3. Laminates
4. Rear Spar

The correct answer is:

a. 1 and 2
b. 2 and 3
**c. 1 and 4*
d. 1 and 3

Better Example

Which Elements belongs to a Truss Wing Structure?

1. Nose Rib
2. N Girder
3. Laminates
4. Rear Spar

The correct answer is:

a. 1 and 2
b. 2 and 3
**c. 1 and 4*
d. 3 and 4

3.2.4.4. Example 4: Each question assess a single written objective

Questions that are not written with a specific objective in mind often end up measuring lower-level objectives exclusively, or covering trivial material that is of little educational worth.
Often a situation is the foundation of the question. After reading the situation, the candidate should know exactly what the problem is and what he or she is expected to do to solve it. If the candidate has to infer what the problem is, the question will likely measure the candidate's ability to draw inferences from vague descriptions rather than his or her achievement of a module objective.

Objective: Applicant knows the chief difference between production of lift of helicopters and airplanes.

Poor Example

Helicopters:

**a. Need a rotor.*
b. Need wings.
c. Need a long runway.
d. Need more speed.

Better Example

In order to fly there is a difference in principle between helicopters and airplanes to produce lift. What is the correct answer ?

a. Helicopters use a rotor system; airplanes use vertical jet propulsion.
b. Helicopters use a rotor system; airplanes use a vertical propeller system.
**c. Helicopters use a rotor system; airplanes use wings.*
d. Helicopters use a rotor to increase horizontal speed; airplane use flaps.

3.2.4.5. Examples 5: Direct Question

As illustrated in the following examples, the questions may consist of either a direct question or an incomplete sentence, whichever presents the problem more clearly and concisely.

In the vast majority of civilian airplanes in which seat does the pilot in command sit ?
**a. Left-hand.*
b. Right-hand.
c. Back seat.
d. Preferred seat.

I

f the question is opened by a statement or a scenario the direct question should be separated clearly from the preliminary information by a following empty line. The direct question should begin in a new line and should – if possible – appear in a different colour.

Poor Example

For most FMS the Fuel prediction function, which computes the remaining fuel along the flight plan, takes into account the following situations:
1- the additional drag resulting in a flight carried out with the landing gear extended.
2- the current wind computed or the resulting ground speed.
3- the additional drag resulting in a flight carried out with the flaps stucked, partly extended.
4- the additional drag resulting in a missing fuselage or wing element in compliance with the CDL. What is the correct combination?

Better Example

For most FMS the Fuel prediction function, which computes the remaining fuel along the flight plan, takes into account the following situations:
1- the additional drag resulting in a flight carried out with the landing gear extended.
2- the current wind computed or the resulting ground speed.
3- the additional drag resulting in a flight carried out with the flaps stucked, partly extended.
4- the additional drag resulting in a missing fuselage or wing element in compliance with the CDL.

What is the correct combination?

3.2.4.6. Example 6: Incomplete Sentence

The pilot in command sits in the vast majority of civilian airplanes in ?

**a. the Left-hand seat.*
b. the Right-hand seat.
c. the Back seat.
d. no specific seat.

3.2.4.7. Example 8: Optimization of question text phrasing

Excess material in the question text that is not essential to answering the problem increases the reading burden and adds to candidates confusion over what he or she is being asked to do.

Poor Example

Suppose you are a mathematics professor who wants to determine whether or not your teaching of the unit on probability has had a significant effect on your candidates. You decide to analyze their scores from a test they took before the instruction and their scores from another exam taken after the instruction. Which of the following t-tests is appropriate to use in this situation?

**a. Dependent samples.*
b. Independent samples.
c. Heterogeneous samples.
d. Homogeneous samples.

Better Example

When analyzing your candidates' pre-test and post-test scores to determine if your teaching has had a significant effect, an appropriate statistic to use is the t-test for:

**a. Dependent samples.*
b. Independent samples.
c. Heterogeneous samples.
d. Homogeneous samples.

The question text of the poor example above is excessively long for the problem it is presenting. The question text of the better example has been reworded to exclude most of the irrelevant material, and is less than half as long.

3.2.4.8. Example 7: Optimization of answer text phrasing

Include as much of the question as possible in the question text, but do not include irrelevant material.

Rather than repeating redundant words or phrases in each of the alternatives, place such material in the question text to decrease the reading burden and more clearly define the problem in the question text.

Poor Example

If the pressure of a certain amount of gas is held constant, what will happen if its volume is increased?

a. The temperature of the gas will decrease.
**b. The temperature of the gas will increase.*
**c. The temperature of the gas will become zero.*
d. The temperature of the gas will remain the same.

Better Example

If you increase the volume of a certain amount of gas while holding its pressure constant, its temperature will:

a. Decrease.
**b. Increase.*
c. become zero.
d. Remain the same.

Notice how the underlined words are repeated in each of the alternatives in the poor example above. This problem is fixed in the better example, where the question text has been reworded to include the words common to all of the alternatives.

3.2.4.9. Example 8: Keep the answers mutually exclusive

Answers that overlap create undesirable situations. Some of the overlapping answers maybe easily identified as false answers. On the other hand, if the overlap includes the intended answer, there may be more than one answer that can be successfully defended as being the answer.

Poor Example

If an 80 ohm coaxial cable is connected to an 80 ohm dipole aerial, resistance would be:

a. more than 60 ohm
b. less than 160 ohm
c. 40 ohm
d. 80 ohm

Better Example

If an 80 ohm coaxial cable is connected to an 80 ohm dipole aerial, resistance would be.

a. 60 ohm
b. 160 ohm
c. 40 ohm
d. 80 ohm

In the poor example above, all the answers overlap. In the better example, the answers have been rewritten to be mutually exclusive.

3.2.4.10. Example 9: Keep the answers homogeneous in content

If the answers consist of a potpourri of statements related to the question text but unrelated to each other, the candidate's task becomes unnecessarily confusing. Answers that are parallel in content help the question present a clear-cut problem more capable of measuring the attainment of a specific objective.

Poor Example

Boeing 747 is widely known as:

**a. The airplane called "Jumbo-Jet".*
b. The airplane with a good reliability.
c. Best-selling airlines airplane.
d. Best-selling military airplane.

Better Example

Boeing 747 is widely known as:

**a. "Jumbo-Jet".*
b. "Walrus-Jet".
c. "Elephant-Jet".
d. "Rhinoceros-Jet".

The poor example contains answers testing knowledge of maintenance aspects (reliability), market position (best selling) and nicknames. If the applicant misses the question, it does not tell the examiner in which of the four areas the candidate is weak. In the better example, all of the answers refer to nick names, so if the candidate misses the question, it tells the examiner that the candidate has a weakness in that area.

3.2.4.11. Example 10: Keep the grammar of each answer consistent with the question text.

Candidates often assume that inconsistent grammar is the sign of a false answer, and they are generally right.

Poor Example

A word used to describe a noun is called an:

**a. Adjective.*
b. Conjunction.
c. Pronoun.
d. Verb.

Better Example

A word used to describe a noun is called:

**a. an adjective.*
b. a conjunction.
c. a pronoun.
d. a Verb.

3.2.4.12. Example 10: Keep the answers similar in length

An answer noticeably longer or shorter than the other is frequently assumed to be the answer, and not without good reason.

Poor Example

If the static source of an altimeter becomes blocked during a descent the instrument will:

**a. continue to display the reading at which the blockage occurred.*
b. gradually indicate zero.
c. under-read.
d. gradually indicate 20% less.

Better Example

If the static source of an altimeter becomes blocked during a descent the instrument will:

**a. continue to display the reading at which the blockage occurred.*
b. gradually indicate zero shortly after which the blockage occurred.
c. under-read shortly after which the blockage occurred.
d. gradually indicate 20% less after which the blockage occurred.

Notice how the answer stands out in the poor example above. The false answers have been reworded in the better example to make the answer lengths more uniform.

3.2.4.13. Example 11: Avoid the use of specific determiners

When words such as *never*, *always*, and *only* are included in false answers in order to make them false, they serve as flags to the alert candidate.

Poor Example

A lead-acid battery is considered to be fully charged
a. always when the SG reaches 1.180.
**b. always when cells begin to gas freely.*
c. when SG and voltage never remain constant.
d. only when voltage remain constant.

Better Example

A lead-acid battery is considered to be fully charged when the
a. SG reaches 1.180.
**b. cells begin to gas freely.*
c. SG and voltage remain constant.
d. voltage remain constant.

In the poor example above, the underlined word in each of the false answers is a specific determiner. These words have been removed from the better example by rewording both the question text and the false answers.

3.2.5. General Checklist Multiple-choice

It is recommended to use a check-list when drafting a multiple-choice question. Example for Part 66:

EASA Part-66	**General Checklist Multiple-choice**
Item	**Check**
Learning Objective(s)	☐ Identification of the assigned learning objective(s)
Relevance to Part-66 Appendix 1 syllabus:	☐ Consistency between proposed question and Part-66 module/subject ☐ Consistency between Module/Subject and Category ☐ Conformity with Appendix 1 examination level
Conformity with question standard	☐ Wording of the question in compliance with the setting up methodology ☐ Format of the question in compliance with the setting up methodology ☐ Abbreviations in compliance with the setting up methodology ☐ The use of unit in compliance with international and national rules and style conventions[11]
Clarity and correctness of the language	The specification ASD-STE-100 (Aerospace and Defence, Industries Association of Europe) European Community Trade Mark No. 004901195) may be used. http://www.asd-europe.org http://www.asd-stan.org/sales/asdocs.asp

[11] - A PDF file of units of measurement can be found at http://ts.nist.gov/WeightsAndMeasures/Metric/upload/EUMetricDirective2010.pdf
- Refer also to SI Unit rules and style conventions, National Institute of Standards and Technology (NIST), [Docket No. 980430113-8113-01]

3.2.6. Wording Checklist Multiple-choice

EASA	Wording Checklist Multiple-choice
Item	**Check**
Content	☐ Is the question really relevant? ☐ Is the knowledge level adequate? ☐ Is the content indisputable? ☐ Is the information sufficient? ☐ Is the wording clear and unequivocal? ☐ Are all abbreviations, technical terms and foreign words known by the target group?
Question	☐ Can one find the correct answer without reading the alternative answers? ☐ Are negations highlighted? ☐ Isn't the Question a catch question?
Answers	☐ Is the true answer clearly recognizable? ☐ Are the false answers plausible and justified? ☐ Are the choice answers homogeneous with regard to text length and grammar? ☐ Are double negations avoided? ☐ Are absolute statements avoided ("always", "all", never")? ☐ Are word repetitions avoided from the problem description?
If necessary Embedded diagrams	☐ are all graphics available in the correct version? ☐ are all graphics in readable conditions?
If necessary Annexes	☐ are all annexes available in the correct version? ☐ are all annexes in readable conditions?

4 Use of Diagrams

4.1. General

Due to the technical content of all modules, the use of diagrams for examinations makes sense. For the evaluation of technical components next to a technical test procedure an optical testing is very important. In this respect the use of sketches, abstracts, engine element drawings, diagrams and photos as part of examination questions for certifying staff is an adequate mean of knowledge verification.
It is not always decisive if the exercise can only be solved by interpretation of the used graphic(s). In many cases diagrams are an indicator for achieving a higher clarity of a relevant problem.

The conditions for the use of diagrams are the following:

- Graphic objects should be provided digitally. Hence they are saved electronically as files.
- Electronic display becomes effective with generation –possibly also in examination situations – on colour screens with a resolution of at least 1024*768.
- With output as paper print the maximum format implied is DIN A 4 (21* 29.7 cm).
- Formats should be compatible with industry standards.

4.2. Diagram Types

In principle diagram types can be differentiated between:

- Black and white drawings.
- Black and white photos.
- Coloured drawings.
- Coloured photos.

4.3. Diagram Formats

As a rule, nowadays graphic objects are saved as digital data. In the following only the most common graphic formats are described since they are sufficient for illustrations:

(a) JPEG (JPG)

JPEG is the abbreviation for Joint Photographic Experts Groups, Board of ITU and ISO, which was named after its developed standard for compression of fixed images (similar to MPEG for moving images).

The JPEG format is the quasi-standard for digital photos. With compression procedures data volume of a JPEG picture can be minimized to a fractional amount, although this procedure leads to justifiable losing of picture quality.

(b) GIF

The GIF-format (Graphics Interchange Format) is mainly suitable for drawings or ClipArts. A GIF-image can contain a maximum of 256 colours and is hence not suitable for the illustration of photos.
Still, a GIF-image offers other advantages like the generation of GIF-animations or the configuration of transparent areas within an image. Furthermore it can be saved interlaced. That means when loading, the picture is build up in layers but not line by line. This attribute is especially helpful when loading websites.

(c) PNG

PNG stand for Portable Network Graphics. It unites the advantages of .GIF and .JPG-files. PNG graphics can reach a colour depth up to 16.7 million colours, they save transparency information (allow transparent image parts) and compress without loss.
Blurring and artefacts, a special problem of JPEG, do not occur, but the file size exceeds the JPEG file size considerably. That is the reason why PNG is seen mainly as the successor of the GIF-format, which seems to be troubled with licence and patent problems. Still, the file size is rather big and the PNG-format cannot be displayed on older browsers. Furthermore, the PNG-format offers the option of saving images interlaced.

The decision of format application for certain diagrams depends on requirements of size (concerning memory requirements) and quality of objects. Especially the size should be kept in mind if examinations via Internet are planned. The quality shall always be flawless in order to guarantee detect ability and explicit interpretation.
In any case, for processing graphic objects a graphics program which can save files in the three described formats shall be used. Following rule can be retained:

- When saving photos, normally JPEG or PNG formats are ideal,
- When saving graphics, normally GIF-format is ideal.

4.4. Set Up of diagrams

(a) Copying[12]

The easiest way to set up graphics is the copying of already existing files. Sources, amongst others, are:

- the Internet, with partly open source image files for download,
- scanned images from textbooks, manuals or other technical descriptions,
- copies from CBT/WBT[13] e-learning programs.

(b) Own photos

The more and more applied digital cameras are a very powerful and effective instrument for exercise-authors in order to enrich their questions with demonstrative images. The transfer into computer files is very easy since the standard format of photo files is JPG.

(c) Self generation or edition of drawings, photos, etc.

When generating own drawings or editing existing objects it has to be ensured that according software is available, and that authors are sufficiently qualified. At selection of software, in principle vector orientated graphic programs[14] are preferred. Still, in most cases also standard low cost programs or programs integrated in the system software are sufficient. Following rules apply:

- Standardization of labelling method

  All graphics/images should preferably be displayed as „look & feel“. This can be reached with uniform labelling methods. Often certain areas or elements of an image have to be separately marked to establish a relation with the task. To mark such elements of a graphic, uniform symbols have

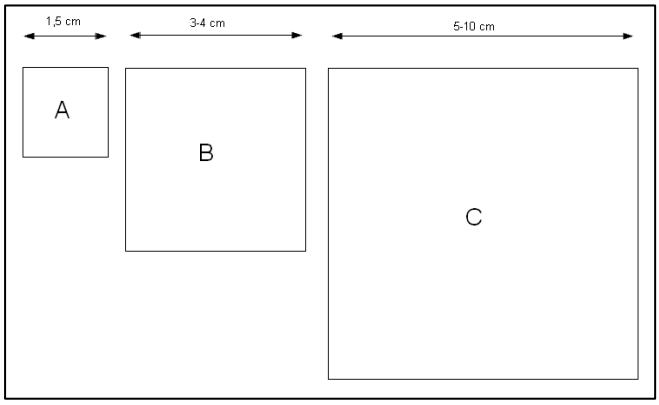
[12] The copy rights have to be preserved.
[13] CBT = Computer Based Training, WBT = Web Based Training
[14] Next to pixel orientated graphic programs which are also called image editing programs, so called vector graphic programs are available. Such programs allow a loss free edition of measures.

to be applied, f. e. specified arrows, frames, flags, etc. Diversity and display of symbols should be uniform and continuous.

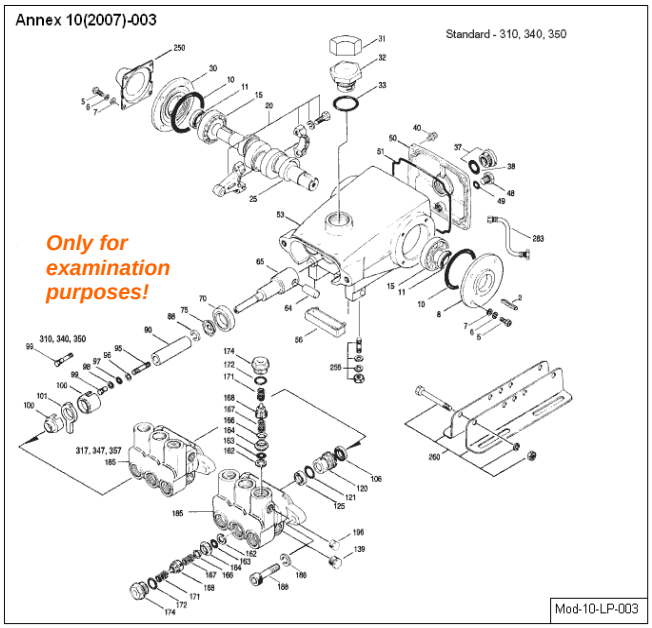
- If a measurement has to be made from a graphic, the scale of this graphic should be specified in the diagram.
- Standardization of graphic sizes

  According to content and purpose of used graphics and images certain size ranges can be defined. When saving graphics defined size ranges shall be kept. The use of certain sizes should not cause blurring. The consideration of certain widths proved of value. The respective height depends on according content. If graphics are directly located on the exercise text they are called embedded graphics.

  Following illustration shows different size ranges for embedded graphics.



Bigger diagrams, f. e. phantom drawings, are saved as attachments (annex). Such diagrams are shown in a separate window during the examination on the PC, or are printed on a separate page at the end of *paper & pencil* examinations.



Printed out attachments shall not exceed the size DIN A 4. Authors have to guarantee that the exercise indicates the graphic to be used. The entry shall read as follows: “For this exercise please use *<Attachment Name>!*”

4.5. Saving diagrams

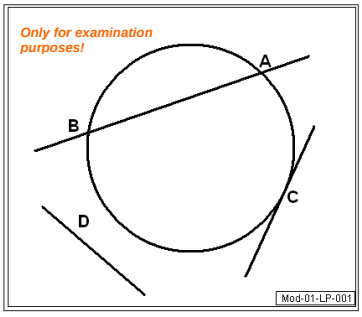
Following rules apply when saving graphic objects.

(a) Graphics/images have to be saved in sizes (measurements) which correspond to the favoured size of screen presentation or print out size. It has to be ensured that all graphic elements which are connected to the question can be identified clearly and distinctly.

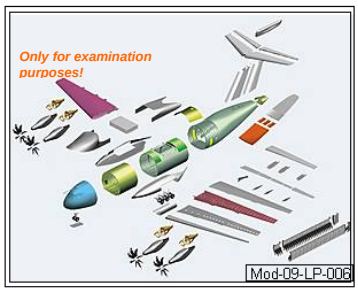
(b) If allowed by facts to be shown, images or graphics shall be sized in such way, an embedment directly next or underneath the text of the exercise is possible. This facilitates a fast identification of the exercise, and unnecessary browsing - scrolling or switching between windows or pages can be avoided. It should to be possible to use more than just one diagram per question.

(c) Optimization of graphic objects
More and more, examinations are performed on personal computers in linked surroundings (training rooms/class rooms). It is also possible that examinations are provided via internet. In order to avoid shortages in data transfer it is beneficial to keep the amount of data as small as possible. In comparison with text files, graphic files are relatively big. In consideration of following standards the memory demand is optimised. Still, the already mentioned rule applies that in principle graphic objects have to be saved in their final size. The use of scaling (zoom in, zoom out) may cause extensive loss of quality with the danger of miss interpretations. If an already saved (scanned) image is available, its size shall not be amended since the quality would decrease considerably.

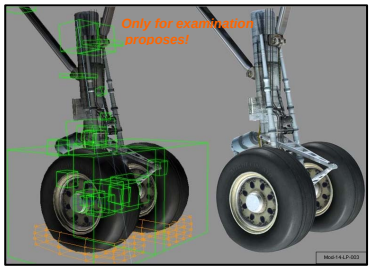
- If not absolutely necessary, illustrations shall not be coloured. Simpler drawings can be saved as black and white graphics as GIF file (transparent or with background colour).



- If a coloured illustration becomes necessary, the colour depth has to be defined. In most cases a display with a maximum of 256 colours is sufficient. Such objects can be saved as GIF files (transparent or with background colour).



- If a very detailed illustration becomes necessary (f. e. a colour photo), its measures shall be as small as possible. Such objects have to be saved as JPEGs or PNG files.



4.6. Labelling of Graphics

(a) File name
All used graphic files shall be named distinctively and the names shall be explicite. The identification of the files (JPG, GIF, PNG, etc) shall not be changed. File names shall be built up as follows (example):

part1: module labelling	part2: distinct identification	part 3: file type
Part-66-Modul-01	-carburettor-001	.jpg

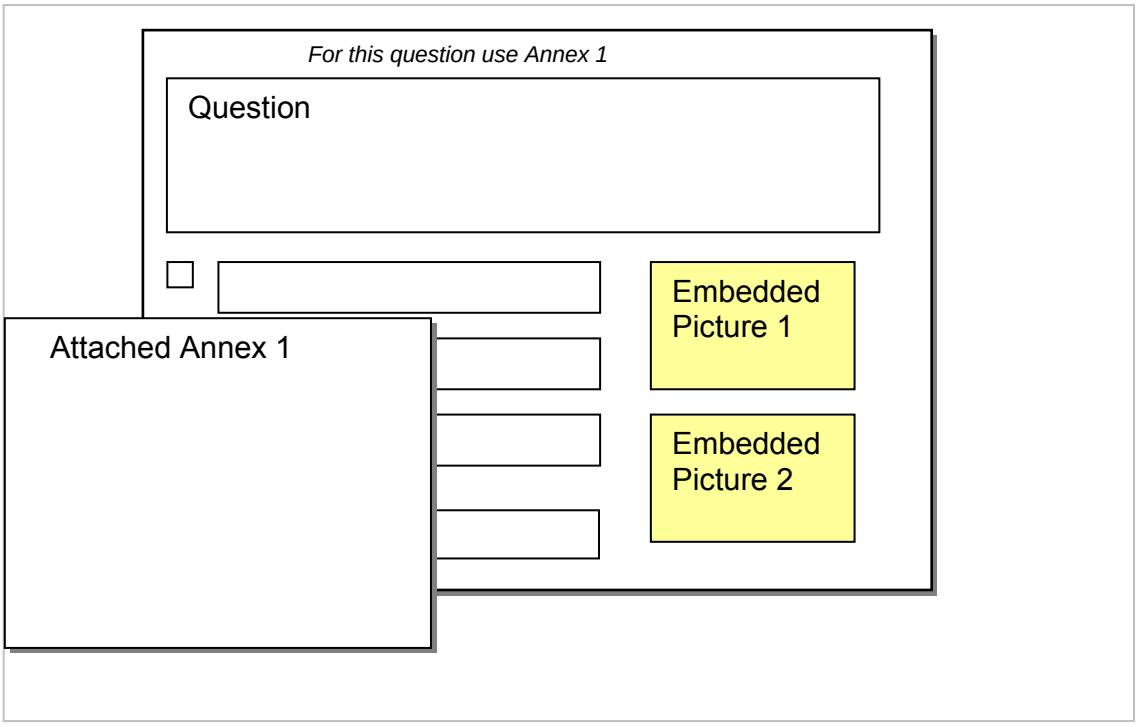
File name: Part-66-Module-01-carburettor-001.jpg

(b) Version description (visible stamp)
All used graphics shall get a distinctive version description. This version description shall indicate module and version. Advantageous is also an author's code and/or copyright notice. Version description shall preferably be readably located at the lower right corner of the graphic (font size 6 pt, font type Arial, colour black – on dark background - white).

(c) Utilization advice
All used graphics have to be clearly endorsed:
„***Only for examination purposes!"***
A formatting with water-marks shall be avoided, since the readability might be affected.

(d) A list of all diagrams should become part of the question development system. In case the windows file properties don't show the specific information for a question management system there should be a specific table like shown in chapter 4.9. It should be created and maintained by the responsible author(s) and it can be organised as one for each module or as total.

4.7. Schematic display of questions with graphic objects



4.8. Check list “Using diagrams”

EASA	Checklist Diagrams
☐	Copy right conditions?
☐	Does the graphic match the question?
☐	Are all relevant elements clearly identifiable?
☐	Sufficient labelling?
☐	Saving of the correct size?
☐	Saving of the correct format?
☐	Do measures match defined size ranges?
☐	Flawless quality of display?
☐	Correct file name according to requirements?
☐	Entry of version description (visible stamp)?
☐	Utilization advice added?
☐	If a diagram is attached: does the question include an appropriate note?

4.9. Example: List of Diagrams in Part-66 Question Bank

Part-66 Question Bank
Graphics and Annexes
Last Update <date>

File Name	(E)mbedded (A)nnex	Description	Root	Last Update	In Use
Part-66-Modul-15-Fuel System-001.jpg	E	Simple NT and EGT Limiter	Self made	09.12.2004	X
Part-66-Modul-15-Fuel System-002.gif	E	Fuel Flow Distributors	Lernbook Mod. 15 page 213	19.11.2004	X
Part-66-Modul-15-Fuel System-003.jpg	E	Kinetic Spill Valve Operations	Handbook Gas Turbine page 210	26.08.2005	X
Part-66-Modul-15-Fuel System-004.htm	A	Torque Motor Spill Valve	Self made	11.08.2004	X
[illegible]	A	[illegible]	Self made	[illegible]	[illegible]
[illegible]	A	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A	[illegible]	[illegible]	[illegible]	[illegible]

5 Qualification / Training

5.1. Criteria to select authors

Attention should be paid to the qualification of the involved authors in order to ensure a high quality level of examination.

Although personal experience and pedagogical talent may play a leading part for teaching it needs more to design and formulate good questions for examinations of maintenance applicants.

To be qualified as an author, the four following criteria should be met:

(a) Has professional education in one of the relevant subject area (Ex: modules for Part 66), proved by a completion of a course or similar.

(b) Has at least one year experience as a teacher in an aviation company or as a teacher in a public or private education facility (university / vocational school etc) – relevant to the specific module. He or she has to be a specialist in the subject area and should be able to distinguish the different levels of training.

(c) Has attended a seminar for setting up questions.

(d) Is ready for further permanent autodidactic education to stay up to date in the dynamic field of aviation technology.

5.2. Training for Authors

It is important for the quality of education and examinations that the involved staff get a professional guideline and permanent information about standards, new developments and modern methods in their pedagogical field of work.
Seminars can ensure a common qualification level and help in understanding the intents of the methodology. Seminars are also supportive to create and to maintain motivation.
Today's modern technical communication instruments can help to increase the information exchange and transfer (e.g. establishing a web site for question authors with chat and file transfer features).

5.2.1. Basic and Experts Seminars for Authors and Examiners

A seminar could study pedagogical and didactical aspects to set up question banks.
- Question design and question management -
Topics:

- General rules for good question design,
- Text optimization,
- Typical errors,
- Professional tips & tricks,
- Examples for each part of the syllabus,
- Modern instruments for innovative question design,
- Using graphics and annexes,
- Evaluation Criteria,
- Question Management,
- Etc.

Participants: all interested experts and especially teachers in the relevant fields.

5.2.2. WEB based training and information portal

A web site may be developed in order to accompany active authors during their question drafting. Features of the portal could be:

- Manuals for question design,
- Ongoing update of examples questions,
- New technologies and methods,
- Chat forum for exchange of views,
- Dictionary,
- Graphics,
- Experience reports,
- Links to relevant web sites (e.g. ATA, EAMTC, NIST etc.)
- Etc.

B Managing Question Databank

6 Preface

(a) In addition to the generally accepted rules for the development of databases, the methodology for creating and administrating a question database should also take into account the examination requirements for technical personnel;

(b) Authorised organisations should take into account the rules and requirements described here in order to ensure a reliable and effective database for the examinations.
Observance of the recommendations will enable the standardisation of form and content;

(c) It is important that a complete, performance-oriented and forward-looking concept is created for the methodology, since subsequent structural changes to the database are, as a rule, extremely costly. The architecture of the database should stay open for expected changes of basic elements of the examination syllabuses (e.g. additional categories of licence);

(d) It is assumed that the authorised agencies will store the questions in an electronic database to ensure timely and efficient work.
The following methodology shows the general requirements for the creation and administration of a database in the above sense. The sequence of the presentation is structured according to logical criteria.

7 Requirements regarding the qualification of developers

(a) The method described below for the creation and administration of a question database for the purpose of the basic examinations should be implemented by qualified personnel. Adequate qualifications are normally evidenced by the successful completion of a professional IT training course specialising in database programming. For the programming of the user interface, detailed knowledge of a programming language (Visual Basic, C++, C#, or similar), is required. In addition, the full control of professional data security, data protection and documentation methods are particularly important for ensuring the long-term usability of the database;
In order to ensure maximum motivation and to minimise the time spent in user training, knowledge and mastery of, as well as compliance with the standards for graphical user interfaces (GUI[15]) taking into account quality assurance standards in accordance with EU norms (EN 29 000-29 004), are essential;

(b) If the appropriate personnel are not available, the following specification may form the basis of a development order placed with a specialised and qualified external company.

8 Choice of a suitable database development system

(a) Which of the database systems available on the market is to be used?
All common relational database systems are suitable. Relational databases are characterised by the fact that all the information is stored in tables. The rows of the tables contain the data records, while the columns contain the relevant fields of a data record. The data records of the various tables may be linked (i.e. they are related to each other). Linking records in this way avoids undesirable data redundancies and enables quick access to filtered information;

(b) For the creation of the database, standard products such as Microsoft Access (from version 2.0), SQL in its various variants, Oracle, etc.) are recommended. Other software which is already available at government

[15] GUI (Graphical User Interface)

authorities may also be suitable, provided that it meets the following specifications;

(c) To ensure a high degree of (forward-looking) compatibility and a cost-effective implementation, a current version of Microsoft Access or the compatible database software from Open Office should, if possible, be used.

9 General requirements regarding the overall system

The requirements for the database system take into account all the information (data) and functions (programs) which:

(a) are required for the computerised capture and administration of examination questions;

(b) enable the creation of paper and pencil examinations and the conducting of examinations with a personal computer (including on the Internet) in accordance with the examination rules;

(c) are required for the integration of question databases captured decentralise into a central database;

(d) are required for future expanded question types.
Complex types of questions are becoming increasingly common in examinations. In order to be prepared for future developments, the potential requirements for future expansions of the current question types, multiple-choice (1 out of 3), and essay question, should also be taken into account in the methodology.

10 Methodology to set up the Information Structure for a Question Database

(a) In order to store all the information required of a database fully and with as little redundancy as possible, it is imperative to develop a professional database. This involves setting up a database structure which defines which information is stored where and how. This could, for example, involve making distinctions between elementary data and metadata. Elementary data is the information which is required for performing the core functions (e.g. displaying the question text). Metadata is data which is required for the implementation of background functions (e.g. the filtering of subsets);

(b) The structure of the database determines the structure of the data records of a database. The design of the structure depends on the information needed for the creation and administration of the question database, as well as on the specific content type. The required data records and their data fields are implemented in the structure of the tables of the relational database.

10.1. Information (data) of a Question Database

(a) Conventions

When setting up the database structure for an electronic database, the following items need to be clarified:

- the importance,
- the type, and
- the functions

of the information (data).
The following definitions serve to simplify the readability of the following tables. The agreed definitions are universally applicable and highly simplified. They may differ depending on the database system used. For practical reasons, the sometimes customary differentiation between input and output data is dispensed with.

Designation	Explanation	Abbreviation
Importance: elementary data	Data which is imperative in order to develop and present an examination question.	E
Importance: metadata	Data which is necessary or helpful for electronically administering a question database.	M
Type: numeric	This data is defined as numeric values.	N
Type: text	This data is defined alpha-numerically.	T, Date
Function: explanatory	This data serves primarily to explain the information.	I
Function: controlling	This data is (also) used to control the information.	C

(b) Relevant information or data areas

When setting up a question database, the following three information areas are distinguished:

- **Question elements**
- **Statistics elements**, and

- **Supporting elements (auxiliary data)**
  The supporting elements are, to a large extent, external components. A detailed description of the data elements is therefore not provided. Chapter 10.2.3 provides more detailed information on the application of this area.

10.1.1. Breakdown of the question elements

This area comprises all the information (data/fields) which are directly relevant for the nature of the questions and their use in an examination.

Designation	Explanation	Importance, Type, Function
Question number User[16]	Input of a number to control the display sequence for question writers.	E, N, C
Question (text) User	A text field for entering and displaying the question. This field needs to be able to store, display, and print all common fonts, symbols, and special characters. At a font size of 11 pt, the field size should not exceed half an A4 page. Multi-lingual.	E, T, I
Response field User	These fields need to be able to store, display, and print all common fonts, symbols, and special characters. Multi-lingual. The following options should be taken into account for the question types.	E, T, N, I, C
Multiple-choice	(a) A maximum of four text fields per question for entering and displaying multiple-choice answers. (b) Switch to allow or block randomizing the position of answers (c) As only one answer is correct, the fields should be presented in the form of radio buttons.	
Essay	(a) A text field for entering the solution. At a font size of 11 pt, the field size should not exceed half an A4 page. (b) A sample answer field for storing key terms.	

[16] Who is allowed to edit the content (**U**ser or **S**ystem or **B**oth)

Designation(s) User	A text field for entering and displaying additional designations. This field needs to be able to store, display, and print all common fonts, symbols, and special characters.	E, T, I
Explanatory text(s) User	A text field for entering and displaying during the examination.	E, T, I
Graphic(s)/image(s) User	Field(s) for displaying graphics or images embedded in the questions. Up to 5 graphics/images per question should be possible.	E, T, I, C
Objects User	Field(s) for displaying multimedia objects attached to questions. Up to 5 objects per question should be possible.	E, T, I, C
Attachment(s) User	Field(s) for displaying graphics or images attached to questions. Up to 10 attachments per question should be possible.	E, T, I, C
File attachment User	Field for entering a template file (worksheet).	E, T, I, C
Sample solution file User	Field for entering a sample solution file.	E, T, I, C
File storage User	Checkbox for indicating that a file is expected from the candidate as part of this question in the examination.	E, T, I, C
Author note User	Text field for entering author's notes to the candidate.	E, T, I
Module, subject assignment User	Reference entry for assigning a question to a module subject.	E, T, I, C
Learning objective assignment User	Reference entry for assigning a question to a learning objective	E, T, I, C
Category assignment User	Reference entry for assigning a question to a category	E, T, I, C
Level assignment User	Reference entry for assigning a question to a level	E, T, I, C
Intended answering time User	Input field to fix the answering time for the question in seconds	E, N, I, C
Achievable points User / System	Numeric input field to fix the maximum number of points awarded for the question	E, N, I, C

Date created System	Date field for automatically copying the system date for the initial capture of the question	M, Date, I
Last change date User/System	Date field for automatically or manually copying the system date when changes are made to a question	M, Date, I
ATA Reference User	Data field for entries of ATA breakdown[17] manual reference	M, T, I

Status System	Enables the assignment of a status to a question. For example, one important status would be the fact that the question is blocked	M, T, I, C
Internal ID System	Numeric field which contains the unique identification within the database (data record number)	M, N, C
UNIQUE ID System	Numeric field which contains the unique identification within and outside of the database (random number)	M, N, C
Import designation User/system	This field stores information about the origin of questions imported from external databases.	M, T / N, I, C
Reference User	Text field for entering the source of the question, e.g. a textbook	M, T, I, C
Author's name User	Reference or text field for entering the name of the author of the question	M, T, I, C
Internal note User	Text field for entering internal notes on the question	M, T, I, C

10.1.2. Breakdown of the statistics elements

The elements of this area are used to ensure the quality of the question database. The option of storing and visualising candidates' comments enables comprehension problems to be addressed. It also, however, let candidates' become part of the quality assurance process.

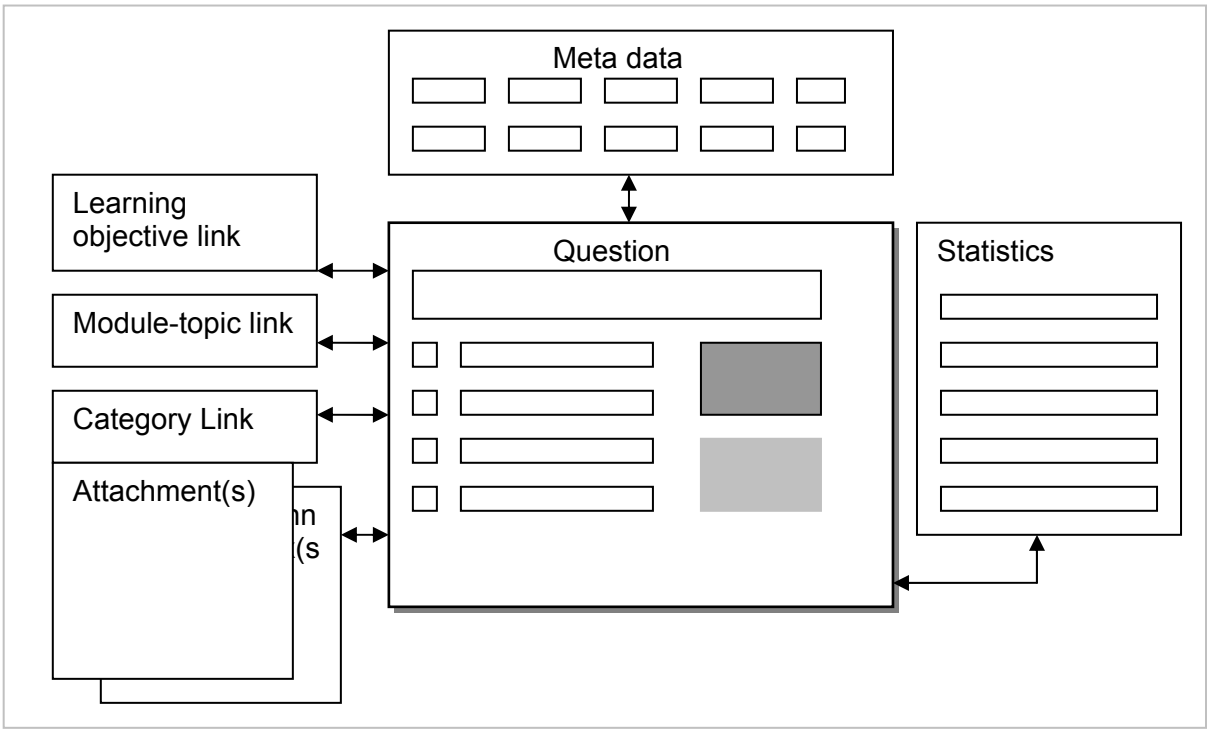
Automatically linking results information directly to the question it selves enables to derive information about the question's clarity and difficulty level. If a sufficient number of examination events[18] is available, the question can, at best, categorise itself using the *feedback*.

[17] ATA = Air Transport Association
[18] An examination event means the appearance of a question in a specific examination. (The candidate's entries and the result of the analysis are fed back to the question).

Feedback field for candidates System	This field enables candidates to comment on questions whilst the examination is in progress.	M, T, I,
Examination date System	Field for copying the calendar dates on which the question appeared in an examination	M, Date, I, C
Examination result System	Field for copying the points achieved	M, N, I, C
Candidate's entries System	Field for copying candidates' entries	M, T / N, I, C

10.1.3. Schematic representation of the elements of a question

The diagram below provides a schematic representation of all the elements (including optional ones) which fully describe a question.



10.2. Functions (programs) of a question database (user interface)

Authorised organisations accessing the database will do so using their own specialist personnel and/or training staff, as well as employees from training providers. This group of people will not, normally, have an extensive knowledge of IT. To ensure effective, purposeful and user-friendly use of the database, therefore, a user interface should be provided which enables non-IT-specialists to independently administer the questions after an acceptable amount of training. In order for this to be possible, a program environment should be created with a user interface which meets the current standards of user software and takes into account the special requirements involved in developing the questions.
The main components (modules[19]) of the user software are:

- Data input (question design),
- Data administration (question management),
- Support functions,
- Data security, data protection.

The individual components are specified below. The functionality described comprises the standard requirements. Other options are also possible and may further increase the performance of the programs.

10.2.1. Data input (question design)

The development of examination questions is the most demanding and time-consuming part of the question catalogue development process. To increase author motivation and achieve quality standards, ergonomic aspects and support are particularly important when programming the input program. Using the following list of criteria will ensure successful results.

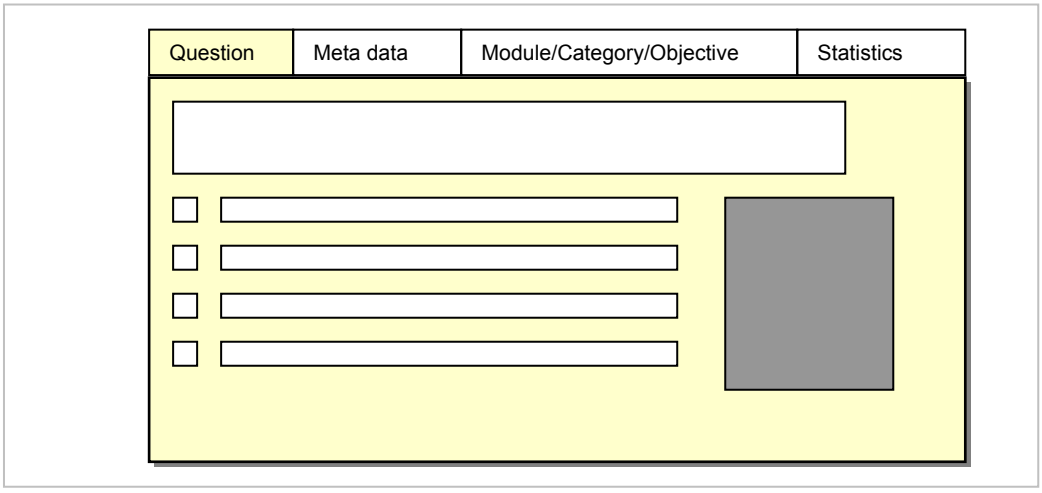
(a) Criteria for user-friendly data entry

No.	Feature	The program needs to...
1	**Text formats** for: question text answer text designations	... provide the usual text formatting functions. It would be desirable to use templates to speed up and standardise text formatting.
2	**Symbols**	... enable the insertion and display (printing) of special characters (mathematical quantities, etc.).
3	**Formulas**	... permit the embedding of formula editor objects to depict mathematical formulas.
4	**Copying functions** for texts (cut, move, insert)	... permit the usual standards for the copying of text via the clipboard.
5	**Copy questions**	... enable the copying of questions. It should optionally be possible to: (a) copy the entire question, copy only the layout of the question, or copy only the assignments with the metadata (b) copy (stacks of) questions from other catalogues (including all information and assignments).

[19] The term *module* which is commonly use for program components in this context will not be used in the following since it may be confused with the learning modules of Part-66 (Appendix I).

6	**Templates**	... provide the option to create templates for all question types. These templates should be selectable via a selection menu when a new question is created.
7	**Graphics/images**	... provide the option to: (a) use the mouse to select up to four graphics or images for each question from a list and to freely position these in the question (b) freely scale the graphics or pictures (c) support the common graphics formats GIF, JPG and PNG.
8	**Multimedia objects**	... provide the option to: (a) use the mouse to select up to four multimedia objects for each question from a list and freely position them in the question (b) freely scale the multimedia objects (c) support the common media formats WAF, AVI, MP3, MOV.
9	**Attachments**	... provide the option to: (a) use the mouse to select up to five large-format attachments for each question from a list and to link these to the question (b) support the common HTML browser-related formats in attachments.
10	**General requirements for data input**	... provide the option to: - (a) undo every action (b) automatically replace words or cohesive text with a new text (c) disassociate questions from each other (d) use the mouse to link the current question with a learning objective (e) use the mouse to link the current question with a module subject (f) use the mouse to link the current question with a category (g) call a module-related abbreviations list (h) call a module-related specialist word list (i) call an English Dictionary (j) enable multi-lingual text
11	**Display of the data areas on screen**	...be able to display the different data areas clearly separated from each other. It is suggested that this be implemented by means of tabs, i.e. four different dialogue windows should be able to be displayed for each question: (a) the question text (b) the meta data (c) the learning objective, subject, and category assignment (d) the statistics

(b) Schematic diagram of a question screen



10.2.2. Data management (question management)

The question database comprises the examination questions of several subject areas, each of them split into a different number of paragraphs and sub-paragraphs. The individual subjects often require questions at different levels. To generate variable examinations from the question catalogues, a significant number of examination questions need to be administered. It is assumed that the database could contain 10.000 questions as a minimum for each Part (66 and FCL). For the administration of those quantities the following functions for the database management should be provided.

No.	Feature	The program needs to...
1	**Subject areas editing (separation/merging)**	... provide the possibility to (a) edit individual syllabi separately (decentralised editing). This will ensure that different authors at different locations can access modules or parts of approved subjects. (b) subsequently merge subject areas. This is to ensure that a centralised questions catalogue can be created later, although question creation is decentralised.
2	**Data import**	... provide import interfaces for the following third-party formats: (a) text format (unformatted) (b) XML (c) XLS (d) DOC (formatted)
3	**Data export**	... provide export interfaces for the following third-party formats: (a) text format (unformatted) (b) XML (c) XLS (d) DOC (formatted)
4	**Data management** **File management**	... have clearly structured file management with the following features: (a) separation of development environment and examination environment (b) clearly structured separation of the question elements (question, graphics, multi-media objects, attachments), (c) overviews of all existing files (d) file copy, rename, delete, and create functions (e) clearly identifiable version number of the data (f) clear indication as to whether the data was saved (changed)

5	**Navigation in the catalogue**	...provide functions for fast and purposeful (optionally filter-based) navigation. This includes, amongst others, the following options: (a) browse forwards and backwards through the question catalogue (b) display the selected questions in a table with sorting into the key columns (question number, question type, number of points, editing time) and, optionally, direct access to the highlighted line (= question) (c) direct retrieval of a question via question number or search term.
6	**Filtering**	... provide filtering functions. The following options should be available: (a) filtering to the status of questions (e.g. blocked questions, (b) filtering to categories (c) filtering to subjects (Ex: Module/ Sub-Module / Sub-Sub-Module) (d) filtering to levels (e) filtering to authors, (f) combined filtering of subjects and status, category, level, etc. (cross checking).
7	**Sorting**	... provide sorting functions. The following options should be available: (a) sorting by question number (permanent) (b) sorting by internal number (ID) (permanent) (c) sorting by subject area (permanent) (d) sorting by question type (temporary) (e) sorting by number of points (temporary) (f) sorting by editing time (temporary). (g) Sorting by ATA
8	**Analysis**	... provide analysis functions. The following options should be available: (a) number of questions in total (b) number of questions per subject (including sub-subjects) (c) number of questions per category (d) number of questions per level of difficulty (level) (e) number blocked questions (f) combined analysis of subject and status, category, level etc. (dragnet).

9	**Statistics**	... provide statistical functions. The following options should be available: (a) date of creation, date of last change (b) complete overview (question type grouped by level of difficulty) (c) number of real examinations for each question (version-related) (d) number of real examinations for each question (correct result) (e) number of real examinations for each question (incorrect result) (f) standard deviation analysis (g) automatic status ascertainment for each question (too easy, too difficult, as expected).

10	**Pattern (*paper*)**[20]	... provide setting functions which enable the definition of examination pattern for the automatic compilation of examinations (*paper*). A paper contains the selection criteria for the automated compilation of individual examinations. For example, the paper will state, how many questions are to appear from what subject area at what level of difficulty in an examination. Flexibility is particularly important when creating the papers. The following parameters need to be able to be set: (a) unrestricted entering of designations for paper (b) unlimited number of papers for each module (c) subject based display of all available applicable questions related to the pre-set category (d) any setting of the number of questions per subject (e) any setting of the number of questions per level (f) alternative setting of cluster questions (in the examination one cluster is selected by the program from several question clusters) (g) optional fixing of the total examination time (h) optional fixing of the total number of examination questions

[20] Paper and pattern is often used synonymous. In this guidance pattern means the function to create paper. A paper contains the specification to generate an examination. The pattern is the function; the paper is the result of using this function of the database.

11	**Printing**	... fulfil the following printing functions: (a) documentation printing: filter-/paper-based printing of all question information (b) question printing: filter-/paper-based printing of questions as examination paper (c) answer sheet printing: filter-/paper-based printing of a blank answer sheet for paper and pencil examinations (d) exemplary solution printing: filter-/paper-based printing of an exemplary solution for paper and pencil examinations (e) list printing of all attachments and graphics used, sorted by objects or questions (f) list printing of the module syllabuses (g) filter-/paper-based printing of candidate comments (h) filter-/paper-based printing of notes

12	**Documentation**	... provide functions for the thorough documentation of the development of the data (questions). This essentially includes an automated version numbering of all changes to questions.
13	**Authorisations**	... have an user administration which ensures that only authorised persons can open and edit the question database. It should be possible to set up two user authorisations: (a) user right – users with this authorisation are allowed to edit the content of the question areas (modules) available to them (b) owner rights – similar to , but with the additional authorisation to authorise new users (team members).

10.2.3. Support functions

Whenever possible the question bank software should offer plausibility checks and help functions to support authors with a maximum aid to type in questions and to manage a large number of questions.

(a) Plausibility checks

Plausibility checks are designed to prevent errors in the forms from leading to incomplete questions.
For example, when entering and managing examination questions, the system should identify some of the formal rules and display a corresponding warning:

- Display of a warning message if the length of the answers is not homogenous.
- Display of a warning message if the length of an answer text exceed the acceptable length.

… and if all essential elements of a question are present. The most important of these are:

- Display of a warning message if the number of false answers for multiple-choice questions (three, as a rule) is wrong.
- Control the definition of one correct answer.
- Control the availability of any graphics and/or attachments which are needed for the question.
- Control the right assignment to module subject, category, and level.
- Check for the availability of a sufficient number of questions for each module and required categories and levels in accordance with the guidelines on basic examinations (see Attachments)

(b) Auxiliary information

In particular, high quality questions can be achieved if authors comply with the suggested rules when they compile the questions. For this reason, and to increase motivation, it is useful to provide effective auxiliary information during the entire writing process. The control program therefore needs to offer the respective support functions, the most important of which are[21]:

- a function which enables the use of the specified question layouts for the standard question types,
- a function which enables permanent access to the syllabuses,
- a function which enables permanent access to the expandable list of abbreviations,
- a function which enables permanent access to a expandable technical terms list,
- a function which enables permanent access to the rules for the creation of questions,
- a function which enables the permanent access to a spell-checker (English),
- a function which enables the permanent access to a dictionary (English).

The support functions should have the usual features typical of content viewers. The most important are:

- browser-oriented interface,
- full text search function,
- simple navigation of the pages.

[21] All of the functions are for online assistance, meaning the required information should be available as electronic, digital data.

The spell-checker and the dictionary can be available via linking to a third-party program.

10.2.4. Data security, data protection

To protect the database the authorised agency needs to have an automatic backup system for the daily backup of the question catalogues in operation.
The databases should be protected from theft, loss, or misuse of any kind by any common professional data security protection system.
Suitable protective measures are:

- restriction of the number of authorised persons,
- password protected computers and program modules,
- automatic closing of files when idle time limit is exceeded,
- regular scanning of the relevant data media for malicious software.

11 Summary: Procedure to set up the question bank

The entire procedure to setup a question bank is shown in the following overview:

11.1. Step 1: Entering Meta Data[22]

If the database system is installed and the staff is qualified to work with it, the following meta data should be entered in the system (see also page 43 'Breakdown of the question elements') for each rules (Part 66 and FCL):

(a) Syllabus
(b) Categories);
(c) Levels);
(d) Integration of status flags (refer page 45,);
(e) Integration of checklist items[23] as status flags (refer to pages 10 / 30 / 37).

11.2. Step 2: If necessary: Import of existing questions

Existing questions in digitised format should be imported through an interface. Because the import interface should fit together with the specific data format of the existing questions it is impossible to make direct advices here. Most used and compatible formats today are CSV[24]. If an automatic interface is used it is important to ensure that information concerning the root (e.g. the "old" question number) stays recognisable in the new system. It should be stored in the field 'Import Designation' of the question bank (refer to page 45).

11.3. Step 3: Development of new questions

A meaningful and plausible examination system "lives and dies" with the quality of the available questions. Developing new questions it the most time-consuming part of the process. Therefore it is essential to optimise the development process as much as possible. Authors should concentrate upon the development of questions and a good question bank system should take care of the rest.
In order to increase the quality of the examinations and therefore to increase the safety in the aviation field it is recommended to make use of the three main suggestions as described in this guidance:

- Strict consideration of the rules and the methods to setup questions like described it in the chapter A of this guidance.
- Use of as much as possible assistance of the well designed question bank system like described earlier in this chapter.
- Qualification and experience of authors.

In addition to the above basic prerequisites it is recommended to ask at least one more specialist to review new and existing questions. If therefore no computer based system provides access to questions, the review checklist as shown in chapter 2.4 is an effectual instrument for co authors.

11.4. Ongoing Quality check

Even if the basic stock of questions is well written and prove to be of good quality in most examinations an ongoing quality check system is required.

[22] Meta data at this step means all necessary information to initialize the working system (e.g. to assign a new question to a paragraph, the syllabus must exist in the databank)
[23] The checkpoints must be an integrative part of the system and should be present at each question editing feature. This enables authors to ensure the complete use of the rules to setup questions.
[24] CSV = **C**omma **S**eparated **V**alue

Reasons are:

(a) Even questions written by careful authors can have content errors or may have a misleading nature. For a quick recognition a good question bank system should be able to record comments by candidates and report comments concerning the misinterpretations back to the question database;

(b) Through an ongoing automatic feed back from examination finished any existing misinterpretation of the difficulty level of a question should be recognised and fixed as quick as possible. Obviously bad questions should be blocked (if possible with an integrated automatic function by the software). As shown in chapter 1.2.1.4 (a) the question can “learn” it’s level of difficulty. For the entire quality check process please refer to chapter 2.2 and to the next topic 11.5.

(c) If no such a computer based quality check is available the review checklist as shown in chapters 2.4 can be an effective instrument to review questions;

(d) With time, questions will become more and more well known and could loose their reliability for the candidates examination result. To avoid this problem the question bank should be revised continuously. A number of older questions should be taken out of the data bank.

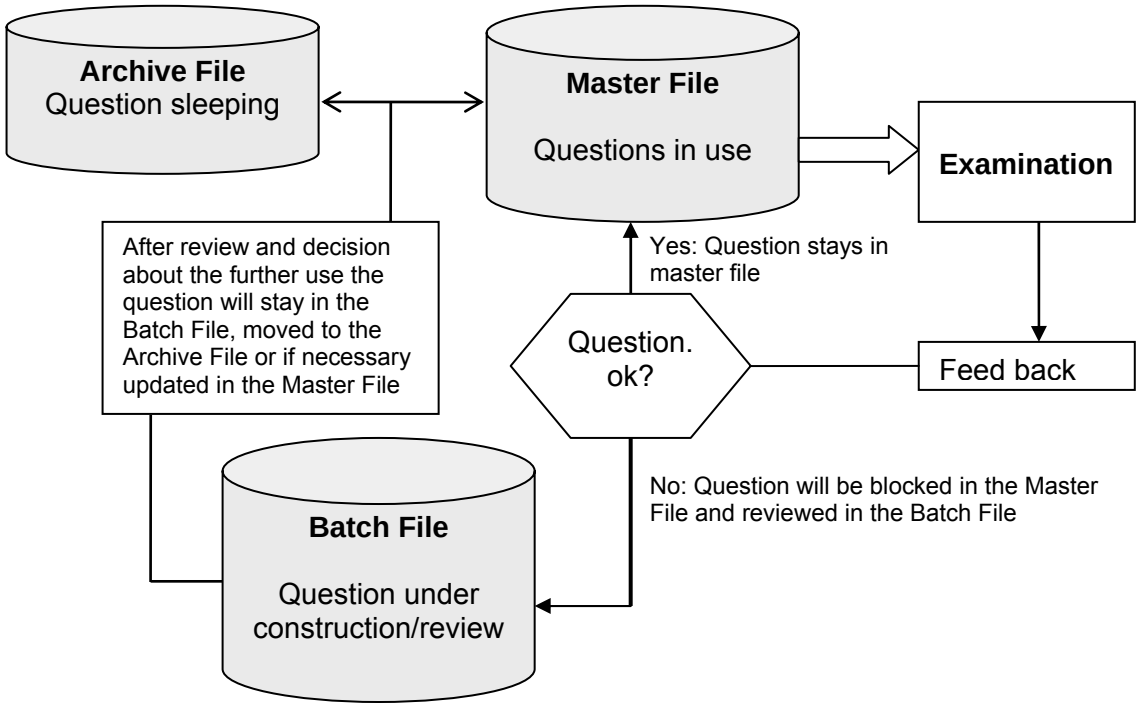
11.5. Maintenance of the Question Bank

The above shown problems about the quality or the question bank the following organisation is recommended to keep the question bank up to date and in a perfect level of quality:
It is useful to keep three different kind of questions separate:

(a) Master File
The Master File contains questions which are in use for examination. Only out of this file examinations can be produced. If a feed back gives a reason to review the question it will be blocked in the Master File[25];

(b) Batch File
Question which are under construction, like new questions within the initial process (not released yet) or questions from the master file which are blocked cause of a negative feed back (see above (a)) are content of the Batch File;

(c) Archive File
Question which have been taken out of the Master File or Batch File for any reason are no longer in the development circle but might become relevant later again. These questions are content of the Archive File.



[25] The Master File must keep enough questions to fulfil the number of questions defined in the paper. The question bank system should control the sufficient number and show a warning message in case of any shortcoming.

12 Attachment 1: Part-66 Terms

The following list is a sample of terms taken out of handbooks and technical training documents. It is suggested to compare the descriptions with the relevant specialists books or refer to “Common Support Data Dictionary published by Air Transport Association of America, Inc.,1301 Pennsylvania Avenue, NW - Suite 1100, Washington, DC 20004-1707,USA”, admin@ataebiz.org

EASA Part-66	Terms
Term	**Description**
Abradable Seal	A general description of 'knife edge’ seals which can wear away slightly and still function
Abrasion	A roughened area caused by the presence of fine foreign material between moving surfaces
Acceleration	Rate of change of velocity Velocity + Time or Distance + Time²
Accessories	Components driven from the engine to assist the function of the aircraft
Adaptor	A connection for joining two components through which a fluid or electricity can be transferred from one section or component to the other
Adiabatic	A process in which no heat is received or lost. This is the ideal compression process
Advance per Revolution	The effective pitch or the actual distance moved forwards by a propeller in one complete revolution taking account of slip. It is the geometric pitch less slip.
Adverse Yaw	A tendency of an aircraft to yaw in a direction that is opposite to the direction of a controlled turn as a result of an imbalance in induced drag created by deflection of the ailerons.
Aeration	The introduction of air into a liquid
Aerodynamic Balance	Achieved when the thrust forces produced by each of the blades are equal and the torque forces produced by each of the blades are equal. No residual periodic out of balance forces will be produced when the propeller is rotating.
Aerodynamic Centre	A reference point on the chord-line of a wing, about which the pitching moment remains constant regardless of the angle of attack
Aerodynamic Correction Factor (AOF)	The amount in degrees and minutes to be added or subtracted from the basic blade angle setting when installing each blade on a variable pitch propeller. The procedure is described as individual 'blade indexing' and is carried out to achieve the correct aerodynamic balance. An AOF value preceded by the letter T indicates thrust balance, when preceded by the letter Q it indicates torque balance.
Aerodynamic Turning Moment (ATM)	A turning moment that tries to turn a propeller blade towards coarse pitch. The force is the result of the aerodynamic reaction acting on the blade centre of pressure. The moment arm is the distance between the centre of pressure position and the blade pitch change axis. It is weaker than the Centrifugal Turning Moment (CTM). During the 'windmill' condition, the ATM reverses to try and turn the blade towards fine pitch.
Aerofoil	A body shaped so as to produce an aerodynamic reaction called lift that acts perpendicular to its direction of motion or line of flight
Aerofoil	Shape of blade section formed to give lift
Aerofoil	A body shaped so as to produce an aerodynamic reaction normal to its direction of travel.
Aileron	The control surface used for lateral control

Air Density	The mass of air per unit volume. Normally expressed in kilograms per cubic metre. An increase in air density will increase thrust and torque.
Airspeed	The speed of an aircraft relative to the air
Allowance	Permitted difference in dimensions to allow for various fits
Aluminised	Coated with aluminium to resist corrosion
Ambient Pressure	The pressure of the air immediately surrounding an object
Aneroid capsule	A metal Container from which most of the air has been exhausted. It is sensitive to the variations of outside pressure
Angle of Advance	The angle formed between the plane of rotation and the relative airflow. The angle of advance subtends the effective pitch. It is also referred to as the helix angle.
Angle of Attack	The angle formed between the chord line of an aerofoil and the relative airflow direction
Angle of Attack	The angle that the chord line makes with the direction of airflow
Angle of Attack	The angle formed between the chord line of a blade and the relative airflow. The ideal effective angle of attack is between 3 and 4°. The angle of attack subtends the propeller's slip. If there were no slip, there would be no angle of attack.
Angle of Incidence	The constructed angle formed between the longitudinal datum of the fuselage and the chord line of the wing
Anhedral	The downward slope of a wing relative to the horizontal plane designed to reduce lateral stability
Anti-icing	The prevention of ice formation on a surface.
Anticipator	A system incorporated in the control run to the Propeller Control Unit and the Fuel Control Unit on some turbo-propeller engines. The system instigates a slight reduction in blade angle during engine acceleration and a slight increase in blade angle during engine deceleration. The objective is to improve the engine acceleration and deceleration times respectively.
Annular	Circular, ring formation round a component
Annulus	Opening between two concentric rings
Approach Minimum	Minimum engine speed for landing aircraft
Aspect Ratio	The ratio of the wing span to the average or mean chord. Can also be the ratio of the square of the wing span to the total wing planform area.
Aspect Ratio	The ratio between the mean chord width of a blade and its span. A high aspect ratio produces a long, narrow blade. The same ratio can be calculated by dividing the square of the blade length by the area of the face side.
Atomisation	The formation of a liquid into a spray
Attenuator	A means of stopping fuel flow fluctuation
Automatic	Self-operating
Auto-coarsen	A system that will automatically coarsen the propeller to prevent over-speeding if the hub switch closes in flight. Closure of the hub switch in flight will only occur if the FFPS has failed to prevent the propeller entering the ground range. The hub switch energises the 'valve lift solenoid', otherwise known as the 'increase pitch solenoid valve'. The pilot valve in the PCU is raised to direct governor oil pressure to increase pitch. The system deactivates again as soon as the hub switch breaks. The Below Stop Warning Light will flash ON and OFF when the system is activated. Otherwise known as the Electro-Hydraulic Pitch Stop.

Auto-feather	A system that uses the engine torque indication system to sense an engine failure and then automatically feathers the propeller. If low torque is sensed, a low torque switch will close and the system energises the "valve lift solenoid', otherwise known as the 'increase pitch solenoid valve', in the PCU and also energises the feathering motor. The pilot valve in the PCU governor is raised to direct feathering oil to the pitch change mechanism. The system is only active when the power lever has advanced to the cruise position. This is necessary because the system would pose a risk at low power settings on approach. Otherwise known as the 'automatic drag limiting system' (ADLS).
Auxiliary	Something, which is helpful to something else
Axial Flow Engine	An engine in which the gas flow travels along the centre line of the engine from front to rear
Axis	A line about which the aircraft rotates
Axis of Rotation	The centre line around which the propeller rotates. It is at right angles to the plane of rotation.
Backlash	The working clearance, measured at the pitch circles of any two gears in mesh
Baffles	Plates fitted to prevent or control the movement of a fluid in the direction, which it would otherwise flow
Balancing	Adjusting the size and position of weights to bring a rotating assembly into static and dynamic balance
Bank	The attitude adopted by an aircraft in a turn where the lift supplies a component towards the centre of the turn called centripetal force
Barometric Pressure	A pressure created by the weight of the atmosphere. It is reduced with an increase of altitude
Bearing	The part of a mechanism in which a rotating shaft revolves and is supported
Below Stop Warning Light	A warning light activated by the hub switch that comes ON whenever the blade angle reduces below Flight Fine Pitch. The objective is to give warning that the propeller is in the ground range. The light remains on throughout the Beta range. Otherwise known as the 'Beta Warning Light'.
Bending Forces	The bending forces acting on a blade. The thrust bending force tries to bend the blade forward. The torque bending force tries to bend the blade against its direction of rotation.
Bernoulli's Theorem	States that the total energy contained in an incompressible flow of air through a venturi will remain constant
Beta Range	The ground range of a propeller's operation. The blade angle range below the flight fine pitch angle, reserved for ground operations such as: engine starting, taxiing and braking. The range cannot be used in flight. The blade angle movement is under the direct control of the power lever whilst in the ground range. The range consists of a maximum in beta positive angle limit, moving back through zero pitch to a maximum negative blade angle limit at Full Reverse.
Bevel	An angle other than a right angle
Bit	A bit is the smallest unit of information in computer and communication theory, representing a logic '1' or logic '0'. It is derived from contracting the terms binary bit.
Blade Angle	The angle between the chord line and the plane of rotation
Blade Angle	The angle formed between the chord line of a blade and the plane of rotation measured at the master station. The angle is the sum of the angle of attack and the angle of advance or helix angle. The blade angle subtends the geometric pitch.

Blade Cuff	An extended fairing incorporated onto the trailing edge of the thickened blade root to improve efficiency and direct more air over the engine, giving better reciprocating engine cooling and improved turbo-propeller intake airflow.
Blade Element	A chord-wise cross-section of a propeller blade taken at any point.
Blade Flutter	A cyclic movement of a blade in its hub fixture that results from excessive play in the blade bearings. The oscillating movement is caused by variations in the aerodynamic and centrifugal forces. The condition is avoided by blade bearing pre-loading during assembly.
Blade Path	The actual helical path of a propeller blade in flight, resolved from its radial and axial movements.
Blade Pre-load	A fixed loading that is placed on to the blade bearings during assembly. The load is set by use of pre-load shims and torque loading on the blade retention nut. The objective of 'pre-loading' is to avoid 'blade flutter".
Blade Station	A position on a blade measured in inches from the blade root. Used as a reference when measuring blade angles or identifying repair areas. The blade angle is usually measured at a 'Master Station' that is positioned about 0.75 of the blade length from the root.
Blade Track	The path followed by a blade when the aircraft is stationary. All parts of the blade should take up a path that is aligned within the plane of rotation.
Blade Twist	The blade angle is gradually reduced from the blade root to its tip to maintain the same angle of attack along the length of the blade. The rotational speed of a blade increases with its distance from the axis of rotation but the forward speed of all parts of the blade is the same so the direction of the relative airflow will van/ along the blade. This makes it necessary to reduce the blade angle from the root to the tip.
Bleed	The removal of air, or air contaminated liquid, from a System
Blending Out	The process where minor damage on a blade is removed to leave a smooth, crack free depression that will avoid any build up of stress. It is a process of converting rough or sharp edges into smooth rounded depressions.
Blisk	A forged one-piece blade and disk
Blueing Check	A pre-installation check that is carried out to confirm the location cone seating area contact. The indicator used is described as being either 'Prussian' or "Engineer's" Blue. The minimum acceptable contact area is 80%.
Bonding	Linking together all the metal parts of an aircraft to obtain positive electrical continuity
Bore	The internal diameter of a cylindrical part
Borescope	An optical tool with which a Visual inspection can be made inside an area which is otherwise impossible to see
Boss	The centre region of a fixed pitch propeller.
Boundary Layer	The layer of air flowing over a surface where shearing action takes place between the surface and the free stream air velocity that retards the flow as the surface is approached
Brake Horse Power	The actual horsepower delivered to the propeller shaft of the engine
Brazing	Uniting two metals by means of molten brass
Breather	A duct connecting the crankcase to the atmosphere that prevents the build-up of crankcase pressure
Brinelling (false)	A satin finish or a series of shallow depressions in the surface of ball or roller bearing braces
Brinelling (true)	A shadow indentation sometimes found at one location on the surface of ball or roller bearing braces
British Thermal	The amount of heat required to raise the temperature of one pound

Unit (Btu)	of water by 1°F
Brittleness	The liability of a metal to fracture on receiving a blow or shock
Brush Gear Housing	A component mounted at the rear of the propeller, or on the engine casing, that holds the carbon brushes in contact with the slip rings that transmit electrical power for propeller and spinner ice protection. It is a requirement that the brushes have a minimum contact area with the slip ring of 80%.
Bulkhead	A transverse partition which separates one compartment from another
Burning	An injury to the surface caused by excessive heat
Burnishing	A mechanical smoothing of a metal surface by rubbing
Burr	A rough, sharp ridge or projection at the edges of a part after it has been worked or machined
Bush	A hollow cylinder one piece bearing usually phosphor bronze or cast iron
By pass Ratio	Mass airflow flowing through the by-pass duct divided by that passing through the core engine
Byte	The basic unit of information used in practical computer storage and processing. A byte consists of eight (S) adjacent binary bits and this string of bits is processed as one unit by a computer; they are the smallest operable units of storage in computer technology. An individual byte can represent the equivalent of a single character, such as the letter B, a comma, or a percentage sign (%); or it can represent a number from 0 to 255. Because a byte contains so little information, the processing and storage capacities of computer hardware are usually given in kilobytes (1,024 bytes) or megabytes (1,048,576 bytes).
Calibrate	To measure or check against a known true master tool or instument
Cam	An eccentric projection on a revolving shaft designed to change rotary motion into reciprocating motion
Camber	The curvature of an aerofoil represented by a line drawn equidistant from the upper and lower surfaces
Camber Side	The curved side of the aerofoil cross-section of a blade that forms the blade back.
Capillary	A tube processing a hair-like bore
Casting	Pouring molten metal into a mould in which it is allowed to solidify. The resultant shape is a casting
Catalyst	A material used to bring about a change, but does not actually enter into a change itself
Centistoke	A unit of viscosity measurement of both fuels and oils
Centre of Gravity	The point through which the weight of a body acts whatever position the body may be in
Centre of Pressure	The position on the chord at which the resultant of all the lift forces acts
Centre of Pressure (CP)	The point on the chord line of a blade where the resultant of all the thrust forces on the blade is said to act. The point is normally forward of the blade s pitch change axis.
Centrifugal	The throwing out action of a revolving mass
Centrifugal Force	A force that acts on a blade as the result of the blade mass rotating. The force creates maximum stress in the blade root sections.
Centrifugal Latch	A latch that mechanically locks the pitch change piston in a low pitch position when the propeller is not rotating. The latch is incorporated in to single-acting counterweight propellers to prevent them from being forced into feather by the 'feathering spring' after engine shut down. The latches are engaged by spring pressure and are disengaged by centrifugal force.

Centrifugal Turning Moment (CTM)	A powerful turning moment that tries to turn a blade towards fine pitch. The force is centrifugal. The moment is the distance that the mass of the blade leading and trailing sections project forward or to the rear of the plane of rotation. CTM is always greater than ATM.
Centripetal Force	The continuous force that keeps a body travelling in a circular path
Ceramic	Clay-like material composed primarily of magnesium and aluminium oxide, which may have been moulded and fired to produce an excellent insulating material
Chafing	A rubbing action between two parts, which have a limited relative motion
Check	To make a comparison of a measurement of time, temperature, size, pressure or any other quantity with the correct figure for that measurement
Chipping	Breaking out small pieces
Choked	A condition where airflow from a convergent nozzle is at Mach 1 and cannot be further accelerated regardless of pressure applied.
Choo-Choo	A mild compressor surge condition
Chord	A straight line that joins the centre of curvature of the leading edge of an aerofoil section to the centre of curvature or apex of the trailing edge
Chord	An imaginary straight line which passes through an aerofoil or wing section from the leading edge to the trailing edge
Chord	A straight line that joins the centre of curvature of a blade aerofoil section leading edge to the centre of curvature of its trailing edge. On many propeller blades, the face side is flat and its width is coincident with the chord of the blade.
Chrome-Alumel	Bimetallic metal used in the exhaust temperature indicating system
Chugging	Low frequency oscillations of airflow within the engine
Clearance	The space provided between two working parts to allow for freedom of movement
Clutch	A device by which to shafts or rotating members may be connected or disconnected while at rest or in relative motion
Co-axial	Shafts or gears having the same centre line
Co-axial Propellers	Two Counter-rotating propellers that are mounted on the same rotational axis but are driven by separate engines.
Coarse Pitch	Largest blade angle normally used
Coarse Pitch	A high blade angle.
Coefficient	A numerical constant that is used as a multiplier when calculating a variable quantity such as lift or drag
Combustible	Liable to burn, to spring suddenly into flame
Combustion	A chemical process in which a material is united which oxygen at such a rate that light and heat are released
Combustion Chamber	Section of the engine in which fuel is injected and burned
Comparator	A unit incorporated into an engine synchronisation or synchrophase system that compares signals from a "master" engine to those from slave" engines and then transmits signals to the 'slave' engines to correct their RPM or phase.
Compound Engine	A configuration of turbo-prop engine that has two shafts, a Gas Generator shaft that drives a high-pressure compressor, and a Power Turbine shaft that drives a low-pressure compressor and the propeller. The engine has the flexibility and ease of starting features of a twin-spool engine but does not have the flexibility of a free-turbine engine.
Compression Ratio	The ratio of volume before compression to the volume after compression

Compressibility Effect	The loss of efficiency caused by the formation of a shock wave when a blade tip reaches sonic airflow velocity. Torque increases, thrust reduces and a lot of noise is generated and the tip loss component of propeller efficiency increases. Caused by high blade tip velocities.
Compressor Stall	The abrupt loss of the efficiency of the axial flow compressor in a turbine engine when the angle of attack of the compressor blades becomes excessive
Concentric	Having a common centre
Conductivity	The ease with which a substance transmits electricity
Cone	Conical seating used to locate and centralise a propeller on to its drive shaft. Two cones are used. A two-piece, steel front cone and a split bronze rear cone. The conical section permits a greater contact area. Minimum permissible contact area is 80% as proven by a pre-installation "blueing check".
Constant Speed	Pitch varies to maintain a constant propeller rotational speed. The reason for doing this is to maintain an effective blade angle of attack throughout all aircraft and engine speed variations.
Constant Speed Unit (CSU)	An automatic governor that is sensitive to engine rpm and will alter the angle of the blades to maintain a pre-selected engine RPM and blade angle of attack when changes in aircraft speed and engine RPM occur. The unit takes its drive from the engine reduction gearing so that the governor speed is directly related to propeller speed. The name CSU is used to describe the unit fitted to a reciprocating engine propeller control system. When related to a turbo-propeller system, the unit is more complex and is described as a Propeller Control Unit (PCU).
Contra-rotating Propeller	Two propellers mounted on the same shaft but rotating in opposite directions. The rear propeller is driven directly by the shaft whilst the front propeller is driven through a gearbox. It is a means of improving solidity and absorbing engine power.
Convection Cooling	Refers to internal cooling air which escapes through small holes and slots
Convection Current	The movement set-up in heated air or a fluid due to a part of the substance moving away from the source of heat and taking the heat with it
Convergent	A convergent duct is one that has a gradual reduetion in the size of the bore
Convergent-Divergent Duct	Afterburner design, a supersonic exhaust duct
Corrected RPM	An rpm obtained by correcting an observed rpm
Corrosion	Breakdown of the surface by chemical action
Corrugated	Having a ridged or wrinkled surface
Counterweight	A weight that is attached to the blade root of each blade on a single-acting variable pitch propeller to overcome CTM and use centrifugal force to turn the blades towards coarse pitch. Propeller control oil pressure can then be used to move the blades to fine pitch. A failure in propeller control oil pressure will result in the blades moving coarse towards feather rather than fine pitch.
Couple	Two equal and opposite forces that act on a body that are not in the same straight line but whose moment about any point in the plane is always the same. A single force cannot balance a couple. It can only be balanced by an opposing couple of equal magnitude.
Creep	A condition of permanent elongation in rotating airfoils from thermal stress and centrifugal loadings
Critical Range	The range of engine RPM where vibration is known to occur. It is normally displayed with a red arc on the engine RPM indicator. Sustained operation in this range is normally prohibited.

Cropping	The removal of a section of a blade tip within specified limits. Done to remove damage. To preserve balance, all blades on a propeller must be cropped by a similar amount. The maximum amount a blade can be cropped is normally one inch.
Cruise	A moderate speed of travel at optimum speed for sustained flight
Cruise Control	Engine operation procedures that allow the best efficiency for power and fuel consumption during flight
Cruise Power	Used for fuel economy and engine life during cruising flight
Cruise Stops	Stops that are used to prevent blades fining off when the aircraft is travelling at high speed. The steps on all the propellers are automatically engaged by solenoids that are signalled by hub switches at cruise RPM. They will automatically withdraw if all engine power levers are pulled back together. If one propeller control system fails, the related step will prevent the propeller fining off. The cruise stop warning light extinguishes when the stops are engaged.
Curvic Coupling	A circular set of gear-like teeth on each of two mating flanges which provide engagement when meshed together and bolted
Cut-off	To sever an object or step flow
Cyclic Timer	The timer used in conjunction with electrical ice protection systems. The timer has two speeds - FAST and SLOW. The fast cycle is selected in the higher ambient temperature range -6°C to +10°C. The slow cycle is selected in the lower ambient temperature range below -6°C.
Dashpot	A mechanical damper used to cushion or slow down movement by restricting the flow of a viscous liquid
Datum	A quantity, condition, fact, or other premise, given to be admitted, from which other things or results may be found
De-icing	Application of a liquid or heat to a component to break up and/or prevent the formation of ice
De-icing	The removal of ice from a surface after it has formed.
De-Inhibit	To remove the inhibitor from an item before being put into service
Dead Throttle Movement	Movement of the throttle lever with no corresponding response from the engine
Deceleration	The rate of decrease of velocity
Defect	Any imperfection, fault, flaw or blemish which may require repair or replacement
Density	The mass per unit volume of a material; expressed as grams/cm³ or kilograms/m³
Density	Mass per unit volume
Density Altitude	That altitude in standard air, which compares with existing air density
Depression	A pressure below standard atmospheric pressure
Detent	A pin, catch or lever forming a check to the mechanism
Diaphragm	A flexible partition used to transmit force
Differential Pressure Switch	A diaphragm and electrical micro switch arrangement, which receives two pressure senses
Diffuser	1. A duct used on a centrifugal-flow turbine engine to reduce the velocity of the air and increase its pressure 2. The divergent section of the gas turbine engine used to convert energy of the compressor discharge air to pressure energy
Dihedral (Lateral)	The upward slope of a wing relative to the horizontal plane designed to increase lateral stability
Dihedral (Longitudinal)	The angle between the chord of the tail plane and the chord of the main plane designed to give longitudinal stability

Direct-coupled Engine	A configuration off turbo-prop engine that has a single shaft. The turbine shaft drives the compressor and the propeller. The principle is described as 'gear coupled' because of the mechanical connection between the compressor and propeller drive. The engine offers good acceleration and deceleration characteristics but does not have the flexibility or ease of starting offered by twin spool compound and free-turbine engines.
Direction of Rotation	The direction of rotation of a propeller as viewed from the rear. A clockwise rotation is described as being RIGHT HAND. An anti-clockwise rotation is described as being LEFT HAND.
Directional Stability	The ability of an aircraft to regain its original position following a divergence in yaw around normal axis. Stability is provided by the keel surface aft of the CG.
Disc Area	The area of a circle circumscribed by a blade tip
Disconnect	Uncouple or detach pipelines, controls, cables, etc
Displacement	This is the total distance travelled by the vibrating body from one peak to rest. It is the amplitude of the perodic movement.
Divergent	A divergent duct is one that has a gradual increase in size of the bore, a passage, which widens in the direction of the flow
Dowel	A small diameter raised plug which fits into a matching hole, used for locating items
Drag	The force that opposes the forward motion of a body through the air
Drag	Air resistance. An aerodynamic force on a body acting parallel and opposite to the relative wind
Drag	The resistance force that is created by a body moving through the air. It acts in direct opposition to the movement of a blade and is referred to as the torque.
Drain	A small hole or pipeline leading from a component to atmosphere, to allow fluid to vent, or to empty a tank, cavity or sump
Duct	A cast or drilled hole forming a passage to convey air, oil, and fuel through engine parts
Dutch Roll	A roll and yaw motion. Occurs when lateral stability is higher than directional stability particularly on swept back wing aircraft
Dynamic Balance	Achieved when the centre of gravity of the propeller lies within the plane of its rotation and no periodic out of balance moments are created by centrifugal force when it is rotating.
Dynamic Stability	The ability of an aircraft to return to its original Position after a disturbance without oscillating around that position
Elasticity	The capacity of a material to return to its original dimensions on the removal of distorting forces
Empirical	Relying on observation or experiment, not on theory
End Float	The axial movement of a gear or shaft mounted in bearings
Endurance	The ability to remain in the air for the longest possible time
Energy	The capacity to do work
Engine Pressure Ratio (EPR)	The ratio of turbine discharge pressure divided by compressor inlet pressure
Epicyclic Gear	Where a gear or train of gears revolve round the circumference of a larger gear
Epicyclic Reduction Gear	The reduction gearing used on turbo-prop engines and some types of reciprocating engine. Consists of a sun and planet gears that rotate within a fixed or rotating annulus depending on type. The gear reduces the rotational speed of the propeller drive shaft relative to the engine speed, producing high torque and reducing propeller blade tip speeds. Compound epicyclic reduction gearing used on turbo-prop engines may have engine/propeller speed ratios in the order of 22:1.

EPR Rated Engine	A gas turbine engine whose "rated thrust" is guaranteed to occur at a certain engine pressure ratio setting
Equilibrium	The State of even balance where all opposing forces and turning moments neutralise each other
Equivalent Airspeed (EAS)	The airspeed calculated from the measured pressure difference between ambient and sea level ISA
Equivalent Shaft Horsepower (ESHP)	A turbo-prop engine power rating that is the sum of the shaft horsepower (SHP) and the engine residual jet thrust horsepower (THP). Residual jet thrust is converted to thrust horsepower by assuming that 2.51b of residual jet thrust is equivalent to one shaft horsepower.
Equivalent specific fuel consumption (ESFC)	A means of comparison for turboprops and some turbo shafts where: ESFC = $W_f \div$ ESHP
Evacuated bellows	A set of bellows from which all of the air has been removed and the bellows sealed
Examine	To make a visual survey of the condition of an item
Extrusion	Forcing plastic metal through a die of required shape by means of hydraulic pressure
Face Side	The flat side of the aerofoil cross-section of a blade. It is also referred to as the pressure side
Fatigue	The diminishing resistance to fracture caused by fluctuating stresses
Feather	The blade coarse pitch position where the blade chord line is aligned with the direction of flight. The selection is used to prevent a windmill condition following an engine shut down.
Feather Stop	An internal fixed stop that limits the travel of the pitch changing mechanism at its maximum coarse position. On feathering propellers, this step coincides with the blade's feathered position.
Feathering Pump	A mechanical engine oil pump driven by a heavy duty 25V DC electrical motor that can be selected on to draw oil from a feathering oil reserve well in the engine oil tank and then to supply the oil under pressure to the propeller governor when the normal engine oil pressure supply fails.
Feathering Reserve	A volume of engine oil contained in a well in the engine oil tank that cannot enter the normal engine oil circulation system. It has a single cutlet to the feathering pump.
Feathering Spring	A double spring incorporated into single acting variable pitch propellers that applies a force to move the blade towards coarse pitch against propeller control oil pressure. If propeller control oil pressure fails, the spring will force the blades onto the feather stop.
Fences	Vanes fitted chord-wise across a swept back wing to check the span-wise boundary layer outflow
FFPS Withdrawal Solenoid Valve	A solenoid valve that opens to pass third oil line pressure to the FFPS withdrawal piston in the pitch change mechanism. The solenoid receives an electrical signal from either a FFPS stop lever or a switch on the flight deck. The solenoid is also in circuit with the aircraft weight on ground switch and an FFPS withdrawn warning light. The FFPS cannot be withdrawn in flight.
Fin	A vertical symmetrical aerofoil section structural member designed to provide directional stability. Alternative name is vertical stabiliser.
Fine Pitch	A low blade angle.
Fineness Ratio	The length of a streamlined shape divided by its maximum thickness
Fillet	A radius formed at an intersection
Filtered	The process in which the solids are separated from the fluids

Fit	Correctly attach one item to another
Fits	There are four types of fits: 1. Force fit, requiring hydraulic pressure or heat to mate the parts 2. Driving fit, requiring pressure of hammering to mate the parts 3. Push fit, requiring to be pushed into position to mate the parts; parts are net free to rotate 4. Running fit, where the parts are free to rotate
Fixed Pitch Propeller	A propeller that has only one blade angle setting. Fixed pitch propellers are classified by their diameter and pitch, the pitch being related to the blade angle at 0.75 of the propeller radius or a nominated master station.
Flame Propagation	The spread of the flame from the point of ignition
Flange	A projecting rim
Flanged Shaft	A propeller shaft that has a flat propeller mounting plate at right angles to the shaft centreline.
Flap	A lift augmentation surface designed to increase the coefficient of lift throughout the normal range of the angle of attack
Flash Point	The temperature at which a vapour will ignite if brought into contact with a flame
Flexible Coupling	Used to connect two shafts in which perfect rigid alignment is impossible
Flight Fine Pitch	The minimum safe blade angle that can be set in flight. Blade angles below this in flight will produce a windmill condition, over-speeding and negative torque.
Flight Fine Pitch Stop (FFPS)	A removable stop in the pitch changing mechanism. It limits the travel of the mechanism towards fine to the flight fine pitch position. The step is engaged during flight and can only be withdrawn by selection when the aircraft is on the ground. When the stop is withdrawn, the pitch change mechanism can be moved into the Beta range. The step is mechanically engaged under spring force and is hydraulically withdrawn by third oil line pressure. The FFPS warning light is ON whenever the stop is withdrawn.
Flight Range	The blade angle range used when in flight that includes flight fine pitch at the lower end and feather at the higher end. When a propeller is selected in the flight range, access to the ground range is denied by the flight fine pitch stop.
Fluctuate	To continually change or vary in an irregular way
Fluidity	The ability of a fluid to flow easily and smoothly
Flux	1. A substance used to clean the surface of a job, prevent oxidisation and aid the flow of the material in such processes as fusion, soldering, brazing and welding 2. Magnetic line of force
Force	Energy brought to bear, which tends to cause a motion or change
Forced Vibration	If an external disturbing force is continuously applied to a body it will continue to vibrate until the forces are removed. This is forced vibration. If a tuning fork is struck it will vibrate at its resonant frequency. If its stem is then pressed onto a tabletop, for example, the tabletop will be forced to vibrate at the same frequency.
Forging	Shaping the metal by hammer blows
Form Drag	Boundary layer normal pressure drag resulting from the adverse pressure gradient over the back of an aerofoil creating a higher-pressure region behind the low pressure region at the front. It forms a part of the profile drag.
Fowler Flap	A flap that moves rearwards initially increasing area and then downwards to increase the camber of a wing
Free Stream Air	The air that is undisturbed by the passage of a body through it

Free Turbine	A turbine wheel which rather than driving a compressor rotor, drives a propeller or helicopter transmission through a reduction gearbox
Free Turbine	A configuration of turbo-prop engine that incorporates a Gas Generator shaft and a separate Power Turbine shaft. There is no mechanical interconnection between the shafts leaving them free to rotate independent of each ether. The principle is described as 'gas coupled1 because it is only the gas flow that connects the gas generator and power turbine shafts. This configuration permits the propeller and the engine to operate at its own optimum rotational speeds. Ease of starting is also an important feature.
Frequency Generator	An engine RPM signal generator used in engine synchronisation systems. A pulse generator.
Fretting	Decolourisation on surfaces, which are pressed or bolted together under high pressure
Frise Ailerons	A configuration where the up-going aileron projects a 'beak' into the airflow under the wing to create additional profile drag to counter adverse yaw
Frequency	The number of complete cycles in one second is the frequency and is measured in Hertz (Hz).
Fuel/Air Ratio	The proportion of fuel to air in a combustible mixture
Fulcrum	A point on which a lever is supported
Gag	To prevent movement (especially rotation)
Galling	The transfer of metal from one surface to another, caused by chafing
Gas Generator	The section of a turbo-prop engine that produces the gas flow to drive the power turbines. Includes the compressor, combustion section and the compressor turbines.
Gasket	A thin sheet of material sandwiched between surfaces to make a gas tight joint
Gaspath	The airflow or open portion of the engine from to back where air is compressed, combusted, and exhausted
Gear Pump	A form of constant displacement pump in which two spur gears mesh and rotate within a close fitting housing
Gear Ratio	The ratio between the output and input speeds of a train of gears
Geared Fan	A design which allows the fan to rotate at a different speed than the compressor rotor. The fan being geared down allows for higher tip speeds in the compressor
Generate	To produce, for example electrical energy
Geometric Pitch	The theoretical distance that a propeller moves forward in one revolution at zero degrees angle of attack without slip. The distance is the product of the circumference of a circle traced out by the master station in one revolution and the tangent of the blade angle at the master station. The formula for geometric pitch is $2\pi R \tan 8$, where R is the radius of the disc at the master station and 8 is the blade angle at the master station. The geometric pitch will be the same for all blade stations.
Gouging	The displacement of materials from one surface by cutting, tearing, or displacement effect
Governor	A speed controlling unit
Governor Oil Pressure	Normal engine oil system pressure that has been boosted by a spur gear oil pump in the propeller governor. The increase in oil pressure is required to operate the propeller pitch change mechanism.
Grooving	Smooth rounded furrows, such as score marks, where the sharp edges have been polished off
Ground Adjustable	A propeller that is designed so that its blade angle can only be adjusted manually when the aircraft is on the ground and the

Propeller	engine is stopped.
Ground Fine Pitch	A low blade angle that is set for engine starting and idling. It produces low torque and thus low resistance to the propeller's rotation. High idling percentage RPM can be maintained with relatively low turbine loading.
Ground Idling Consumption	The amount of fuel used by the engine at, its lowest RPM on the ground
Guttering	A deep concentrated erosion, caused by overheating or burning
Half-Ball Valve	In the shape of a half-ball, positioned over the end of a duct and capable of controlling fluid flow
Helix Angle	Name given to the angle of advance that subtends the effective pitch.
Horizontal Stabiliser	The tail plane. A structural member fitted to give longitudinal stability.
Horsepower HP	The standard unit of power used for mechanical measurement. It is equal to 33,000 foot pounds of work done in one minute
Horse Shoe Vortex	The shape derived when the wing tip trailing vortices are bridged in the aircraft wake by the wing bound vortex so forming the three sides of a closed figure
Hot Start	Condition developing when starting a turbine engine in which the gas temperature exceeds the allowable limit
Housing	That part of a mechanism which carries a bearing
Hub	A high tensile steel, hollow casing, often produced in two parts, that holds the blades within its flanged apertures and absorbs the centrifugal forces they produce.
Hub Switch	A mechanical switch that is moved by a cam on the foot of one blade to make or break contact with a slip ring. Contact is made when the blade is in the ground range. This illuminates the Below Stop Warning Light on the flight deck. The switch is also in circuit with the auto-coarsen system through the 'Valve lift solenoid', otherwise known as the 'increase pitch solenoid valve'.
Hung Start	A condition when starting a turbine engine in which ignition is achieved, but the engine refuses to accelerate to a self-sustaining speed
Hydraulic Pitch Lock	A spring leaded ball valve in the coarse pitch oil line that automatically closes to prevent oil returning through the coarse pitch line following a failure of the propeller control oil pressure. The valve traps oil in the pitch change mechanism to form a hydraulic lock that prevents the propeller from running to fine pitch after a failure of control oil pressure. The valve is held open by fine pitch oil line pressure and is mechanically closed by spring pressure.
Hydromatic Propeller	A propeller that incorporates an oil-operated geared pitch change mechanism. The pitch change mechanism changes the axial movement of its piston into rotary movement of a bevel gear that is engaged with a gear segment on each blade root.
Hydromechanical	Combination of hydraulic and mechanical operation
Hysteresis	A lag, delay of differential in a function or operating point in a system
Idler Gear	A gear in a train of gears which reverses the direction of motion but does not change the overall ratio of the gear train
Impeller	The rotating member of a centrifugal pump or blower that imparts kinetic energy
Inclusion	Foreign material enclosed in the metal
Inconel	A propriety trademark of the International Nickel Company for a chromium-iron alloy similar to stainless steel, but which cannot be hardened by heat treatment

Increase Pitch Solenoid Valve	More commonly called the 'valve lift solenoid'. It receives an electrical signal from either the hub switch or the low torque switch. When open, it allows oil pressure to act on the pilot valve lift piston in the governor head. This lifts the pilot valve to direct governor oil pressure to auto-coarsen or auto-feather the propeller dependent on which system is activated.
Indexing	The act of applying the Aerodynamic Correction Factor (AOF) when assembling a propeller.
Indicated Airspeed (IAS)	The airspeed displayed on the air speed indicator that due to changes in air density will not always correspond with the true air speed or the equivalent lower than true airspeed at altitude.
Induced Drag	A type of drag that is generated as a by-product of lift and is inversely proportional to the Square af airspeed. If airspeed doubles, induced drag reduces by a factor of four.
Induced Drag	The portion of the total drag that is thrust dependent. It is created by the blade tip vortices and increases as thrust increases.
Inertia	The opposition which a body offers to a change of motion
Inertia	The tendency of a body to remain at rest or if moving to continue moving in a straight line. The greater the mass of the body the greater its inertia will be.
Inhibit	To cover temporarily with a protective film in order to resist corrosion
Inspect	To examine, and where necessary test, equipment; the review by a supervisor of the work or tradesmen
Insulate	To separate by means of a non-conductor
Insulation Resistance Check	Checks carried cut to determine whether there is any breakdown of the insulation between heater elements and the blades or spinner. During service, the insulation resistance of heater elements may vary due to moisture absorption caused by atmospheric conditions.
Interference Drag	A part of Profile Drag that is produced by the effect of the airframe component joints where changes in section create interference to the local boundary layer airflows. Wing and tail to fuselage etc.
International Standard Atmosphere (ISA)	A table of Standard values for atmospheric conditions at different altitudes that is used internationally to establish and compare the Performance of equipment that is reliant on air density.
International Standard Atmosphere (ISA)	A set of standard values for ambient pressure, air temperature and density at various altitudes. The standard was produced to enable meaningful performance checking of equipment that relies on air density for its operation. The standard values for sea level ISA are: air pressure - 14.7psi (1013mb), temperature 15°C.
Isolating	To separate one system from another
Isothermal	At constant temperature
Jet pump	A pump which operates by directing a motive fluid through a venturi for the purpose of carry surrounding fluid along with it or for removing vapours
Jet silencer	A device used to reduce and change the lower frequency sound waves emitting from the engine's exhaust nozzle, and thus reducing the noise factor
Jointing	A thin paper gasket
Journal	The part of a rotating shaft that is supported in a bearing
Keel Surface	The area presented by the aircraft in side elevation. The area to the rear of the C of G gives directional stability.
Kelvin Temperature scale	Absolute temperature scale with minus 273° Celsius as absolute zero

Kinetic Energy	Energy contained in a body due to motion
Labyrinth	Seal formed by a series of passages
Laminar Flow	The boundary layer flow where the streamlines remain separated and the varying speed sub-layers slide over each other without intermingling
Laminated	Consisting of thin plates, one upon the other
Lap	To polish using fine abrasive, and produce a flat surface
Lateral Axis	A line running span-wise through the aircraft centre of gravity at right angles to the longitudinal and normal axes
Lateral Stability	The ability of the aircraft to return to its original lateral axis around the longitudinal axis called roll. Stability is provided by dihedral and sweep back.
Leading Edge	The front edge of an aerofoil or streamlined shape
Lift	An upward force whose line of action is at right angles to the relative airflow direction and acts on the Centre of Pressure. Lift = CL x 1/2pv² x S
Lift	Caused by pressure differences on blade surfaces
Lift	The component of the reaction force en an aerofoil that acts at right angles to the relative airflow. When related to a propeller the forward acting component of the lift force is referred to as the 'thrust'.
Lift Coefficient (C_L)	A measure of the lift effectiveness of an aerofoil that takes into account shape and angle of attack. Used as a multiplier to the lift calculation 1/2pv²S
Lift/ Drag Ratio	The ratio of total lift and total drag L/D
Longitudinal Axis	A line running from the aircraft nose to tail that passes through the centre of gravity at right angles to the normal and lateral axes
Low Torque Switch	A switch incorporated into a turbo-prop torque indicating system that closes when it senses a specified low torque signal. It completes a circuit to the Valve lift solenoid', otherwise known as the 'increase pitch solenoid valve', and also energises the feathering motor to initiate auto-feathering. This can only occur when the power lever has been advanced to the cruise position. The auto-feather system is not active at lower power settings.
Lubricant	A natural or artificial substance used to reduce friction between moving parts or to prevent corrosion on metallic surfaces
Lug	A projection from a structural member used as an attachment point
Mach No.	The true air speed of an aircraft divided by the local speed of sound in air
Mach No.	The ratio of velocity of a body to the local velocity of sound
Magnetic Flux	Lines of magnetic energy given off from a magnet
Major Repairs	Repairs that are considered to be beyond the scope of an operator and should be referred back to the manufacturer or an approved repair organisation.
Mandrel	An accurately ground shaft for supporting or locating a hollow part during measurements or machining, the mandrel accurately fits the hole
Manifold Air Pressure (MAP)	The gauge pressure, in psi, or absolute pressure, in inches Hg, existing in the intake manifold of a reciprocating engine. Otherwise known as 'boost pressure' on supercharged engines. MAP is used to set the engine power output of reciprocating engines.
Manoeuvre Margin	The distance from the aircraft centre of gravity to the Manoeuvre Point
Manoeuvre point	The aft centre of gravity position where any movement of the elevator would cause instability
Mass	A measure of the amount of material contained in a body

Master Station	The position along the length of a blade where the blade angle is measured. The position is normally measured in inches from the axis of rotation and is approximately three quarters of the blade length from the shank.
Master Switch	Switch in an electrical circuit capable of isolating the whole circuit
Mating	Surfaces that are or will be in contact with others
Matter	Any substance that has weight and occupies space
Mean Chord	The average chord length of a wing
Mechanical Advantage	(Of a machine) the ration of load to effort
Mechanical Pitch Lock	A lock that will automatically engage to lock the pitch change mechanism piston at its last position if the propeller control oil pressure supply fails. The lock prevents the propeller from running to fine pitch in the event of a control oil failure. The lock does not prevent movement towards feather. The lock is held out of engagement by fine pitch oil line pressure during normal operation and is mechanically engaged under spring pressure in the event of an oil pressure failure.
Megger	A test instrument for measuring the serviceability of the insulation of low tension electrical wiring
Meter	An instrument used for measuring
Metering	To measure
Microswitch	Registered trade name for a type of electrical switch, which is used to open or close a circuit with an extremely small movement of the actuator
Minor Repairs	Repairs that are classed as being within the scope of an operator.
Moment	The moment of a force about a point is the product of the force and the perpendicular distance between its line of action and the point
Momentum	The tendency of a body to continue in motion, after being placed in motion
Motoring Cycle	Turning engine through a starting cycle without a light up
Natural Vibration	When a body oscillates under the action of its own gravitational or elastic forces with no external forces being present it is described as having a free or natural vibration. The pendulum and spring may be set into oscillation by external forces; but the subsequent oscillations are caused by their internal forces only.
Negative Torque System (NTS)	Similar to the auto-coarsen system, this system uses the engine torque indicating system to sense low torque and will initiate automatic coarsening of the propeller. The NTS system will keep activating each time the torque falls until the engine is either shut down or the fault clears.
Neoprene	A form of rubberised material used for joins and diaphragms
Net Thrust	The effective thrust developed by a jet engine during flight, taking into consideration the initial momentum of the air mass prior to entering the engine
Neutral Point	The aft position of the aircraft centre of gravity where the aircraft is on the point of becoming unstable. It is point where longitudinal stability becomes neutral.
Nick	A sharp indentation caused by striking one part against another metal object
Nimonic	A special heat resisting alloy
Nominal	A figure or value about which is a permitted variation
Observed RPM	The rev/min as read directly from the Cockpit Tachometer
On-speed Condition	A propeller governor condition where the speeder spring balances the centrifugal force acting through the governor flyweights. The engine RPM will be equal to that selected by the RPM lever.

Optimum Angle of Attack	The angle of attack where an aerofoil would produce the highest lift/drag ratio, usually 3° to 4°
Orifice	An opening at the end of a tube or pipe
Oscillate	To swing back and forth with a constant force or rhythm
Oscillation	To swing to and fro, like a pendulum
Overswing	Tendency of the engine to temporarily exceed maximum rev/min on full throttle opening
Over Speed Condition	A propeller governor condition where the centrifugal force acting through the governor flyweights is greater than the governor speeder spring force The propeller blades move towards coarse to reduce RPM.
Overtemperature	1. Condition in which a device has reached a temperature above that approved by the manufacturer 2. Any exhaust temperature that exceeds the maximum allowable for a given operating condition or time limit
Overshoe	A thin strip rubber mat that is bonded with adhesive onto the leading edge of a blade. It may be grooved to assist in the distribution of de-icing fluid so it may carry embedded heating elements as part of an electrical ice protection system. Otherwise known as a 'boot' or 'shoe'.
Parameter	A variable quantity, which is measurable and affects other variables, e.g. the parameter of temperature varies mass flow
Parity Bit	In order that the data being transmitted is authentic and free from errors, an addition check bit is used in each storage location. A computer using ASCII code, which is an 8-bit system, will have an additional ninth bit for parity checking. Aircraft data bus systems such as AR.INC 429 will have a parity bit within the 32-bit word.
Particle	A small piece of any substance or matter
Peening	Deformation of the surface, caused by impact
Phase Lag	The angular difference in the rotational positions of similar blades on two or more propellers. Phase lag is adjusted through the synchrophasing system
Phugoid	Otherwise known as 'porpoising'. An oscillatory diving and climbing long period motion
Pigmented	Coloured with pigment, colouring matter or dye
Pilot Valve	A landed valve in the governor body that is raised or lowered under the combined action of the governor flyweights and the speeder spring to direct governor oil pressure to the pitch changing mechanism.
Pinion	The smaller of a pair of high ration gears
Pitch	A nose up or down movement when the longitudinal axis moves around the lateral axis
Pitch	The distance a propeller moves forward in one complete revolution. Pitch may be described as being effective or geometric to describe the actual and theoretical distances respectively.
Pitch Change Axis	The axis about which a blade turns when the blade angle is altered.
Pitch Distribution	The twist in a propeller blade along its length
Pitch Range	The plane in which the propeller rotates. It is at right angles to the axis of rotation.
Pitting	Surfaces are said to be pitted when corrosion, excessive heating, or hammering, has caused shallow irregular depression in the surface
Pivot	Pin or hinge about which rotation may take place
Placard	A notice placed in or on the aircraft depicting pertinent information relating to the aircraft, its operation, particular component limitations, etc.

Place	Flat surfaces
Plane of Rotation	The plane at right angles to the rotation shaft
Plane of Rotation	The plane in which the propeller rotates. It is at right angles to the axis of rotation.
Plastic	1. The property whereby a material is easily deformed 2. A synthetic resin, capable of being moulded
Play	Relative motion between two parts
Plenum	An enlargement of a duct or an enclosing space in an aircraft engine induction system or air conditioning system
Porosity	The condition of a material having small pores or small cavities throughout the material
Port	An opening for the inlet and/or outlet gases
Potential Energy	That energy possessed by an object because of its position, configuration, or the chemical arrangement of its constituents
Pour Point	1. The lowest temperature at which a fluid will pour without disturbance 2. Refers to the lowest temperature at which oil will gravity flow
Pressure	Load divided by cross-sectional area. Nm^2 or $lb\ in^2$
Pressure Altitude	Is the altitude at which the air pressure, ISA day, is equal to the local air pressure during a ground run, irrespective of the actual height above sea level
Pressure Ratio	The ratio or pressures at 2 points in an engine, e.g. P1/P2 ratio or P3/P4 ratio
Pressurise	To raise the pressure in a compartment
Primary	First
Priming	To fill completely a system with it's own fluid
Profile Drag	The drag associated with the shape of a body and its surface finish. Includes Form Drag, Skin Friction and Interference Drag. Combines the effects of boundary layer friction drag and surface friction. Profile drag is proportional to the Square of airspeed.
Progressively	To alter by easy stages. Variable
Propeller	A component that is designed to convert engine power output into thrust
Propeller Brake	A disc brake that is operated by the aircraft hydraulic system pressure. The brake may be applied following the shut down of a free turbine engine to reduce the run down time and to prevent the propeller wind milling in the prevailing wind. The brake may only be applied below a given RPM. Fusible plugs in the brake will release the hydraulic pressure if the brake overheats in use.
Propeller Control Unit (PCU)	Description given to the propeller governor unit fitted to a turbo-propeller engine. The unit normally takes its drive from the engine reduction gearing so that its governor speed is directly related to propeller speed.
Propeller Over-speed Limits	Up to 115% RPM no special checks are required, a tracking check may be recommended. 115% to 130% RPM in excess of any specified time limit requires that the propeller be removed for inspection. Over 130% requires that the propeller be returned to the manufacturers for investigation.
Pulsate	To expand and contract rhythmically, yet not to change direction
Pulse Generator	A frequency generator used in engine synchronisation systems to signal engine RPM.
Purge	To cleanse a system by flushing
Pusher	The term used to describe a propeller that is mounted behind the engine and produces a thrust that pushes the aircraft forwards.
Pyormetric	Measurement of heat
Quantity	An amount or portion. The exact amount of a particular thing

Quill Drive	A short drive shaft designated to shear at its waisted portion, used to prevent continued driving force being transmitted to seized or partly seized components
Race	The surface on which a bearing is supported
Radial	Issuing as rays from a common centre
Radial Inflow Turbine	A turbine wheel, which receives its gases at the blade tips and guides the air inward and outward to the exhaust duct
Rake	A pressure sensor, usually small holes in a stationary engine component, which act as a total pressure probe
Ram Air Pressure	Pressure slightly higher than ambient, caused by the forward motion of the aircraft
Ram Ratio	The ratio of ram pressure to ambient pressure in a jet engine
Ram Recovery	The increase in thrust as a result of ram air pressure and density on the front of the engine caused by air velocity
Ram Recovery Point	The point at which the suction condition in the inlet returns to the value of ambient pressure
Rarefied Air	"Thin Air", such as that found at higher altitudes
Ratchet	A mechanism which consists of a toothed wheel and a bar, or pawl, which allows the wheel to rotate in one direction but prevents its backward motion
Ratio	The relationship between one number and another
Reciprocating	Movements backward and forward in a straight motion line
Recondition	This process consists of dismantling the assembly, renewing worn and unserviceable parts, reassembling and testing
Reconnect	Correctly couple pipelines, controls, cables etc
Reduction Gears	The gear arrangement in an aircraft engine which allows the engine to turn at a faster speed than the propeller
Reference RPM	The specified RPM that should be obtained when a reciprocating engine is set at a given manifold air pressure (MAP), usually this is static (Opsi gauge), at sea level ISA conditions.
Reference Torque	The specified torque that should be obtained by a turbo-propeller engine at sea level ISA conditions at a given power setting, usually take-off power.
Refit	To replace correctly an item that has previously been removed
Reid Vapour Pressure	A measure of the pressure required above a liquid to hold vapours in the liquid at a given temperature
Relative Airflow	The airflow in relation to the aircraft passing through it
Relative Airflow	The airflow that meets a propeller. It is the resultant of the axial and radial airflows encountered by a propeller as a result of its simultaneous forward and rotational movement. The relative airflow direction and velocity is dependent on the direction and velocity of the axial and radial airflow components.
Replenish	To refill a container to a given level, pressure or quantity
Resonant Frequency	Many objects, because of their shape and material, have a natural vibration frequency, which occurs if the object is struck. This natural frequency is the resonant frequency of the object.
Restrictor	An orifice for reducing or restricting the flow of a fluid
Resultant Force	The resultant of the components of thrust and torque that acts at right angles to the line of direction of the relative airflow.
Reverse Pitch	The angular position taken up when a blade passes back through zero pitch to a negative angle. Used in the power on brake condition to provide a braking force after landing. Can only be selected when the aircraft is on the ground. The maximum negative reverse angle is limited by a fixed stop. When in reverse pitch, the angle of attack is negative, the thrust is negative but the torque remains positive.

Reynold's No.	The value where laminar flow becomes turbulent. Depends upon air density, air velocity, chord length and coefficient of air viscosity. pvl/μ.
Rich Mixture	One which has an excess of fuel
Rigid	Fixed, will not move, stiff, unyielding
Roll	The movement of the lateral axis around the longitudinal axis
Root	End of blade nearest hub
Root Loss	The loss in propeller efficiency created by the thickened aerofoil sections at the blade shank and the close proximity of the engine.
Rotor	The revolving part of a component
Rudder	The control surface used for directional control
Scalar Quality	That which is considered to have a magnitude only
Scoring	The term applied to scratch like mark found on bearings or on cylinder walls and pistons caused by lack of lubrication or by the ingress of dirt between the bearing surfaces
Screech Liner	A perforated liner within an afterburner, designed to combat destructive vibrations which cause metal fatigue and noise emissions
Secondary	Second
Sediment	Matter that settles to the bottom of the liquid
Semispherical	In the shape of half a sphere. Dome-shaped
Separation	Describes the action where the flow no longer follows the contour of an aerofoil but 'separates' from it to produce a turbulent re-circulating airflow
Servo	The portion of the system which assists in the operation of the main system
Shaft Horsepower (SHP)	The unit used to describe the power output of turbo-prop and reciprocating engines.
Shank	The inner, thickened region of a propeller blade that is exposed to maximum stress. Otherwise known as the 'root'. No repairs are permitted in this region.
Shim	A thin piece of metal cut to shape, used between two surfaces to adjust accurately their distance apart
Shock Load Check	A concentricity check of the propeller shaft carried out after a heavy landing or impact. Shaft eccentricity is HALF the DTI reading.
Shock Wave	A compression wave formed when a body moves through the air at a speed greater than the speed of sound
Short Period Pitching Oscillation	A heavily damped oscillation that incurs little change in aircraft height or speed and lasts for no more than one or two cycles
Shroud	A portion of a component which covers or shields
Sideslip	The sideways movement produced by a component of lift produced when an aircraft rolls
Single-acting Propeller	A propeller that incorporates a pitch change mechanism that selectively uses governor oil pressure on only one side of the pitch change piston. The hydraulic force acting on the piston is opposed by a combination of spring and blade counterweight force. The oil pressure is used to drive the pitch change piston towards fine pitch.
Sink Rate	Loss of altitude with time during a gliding descent for endurance
Sintered Metal	A porous material made up by fusing powdered metal under heat and pressure
Skin Friction	The frictional force produced as a result of the shearing action between the layers of varying speed air flows in the boundary layer over the surface of an aircraft. It is a component of profile drag.

Slat	A leading edge device used to control the boundary layer and prevent leading edge Separation. Increases the stalling angle of attack of an aerofoil.
Slender Delta	A type of delta wing designed to operate with separated flow over the wing designed to produce vortex lift
Slinger Ring	A 'U' section ring mounted on the rear of a propeller hub that enables de-icing fluid to transfer from the engine to the rotating propeller.
Slip	The difference between the geometric pitch and the effective pitch. It is often presented as a percentage ratio between the two. Slip occurs because the air is not a solid medium. The blade angle of attack varies with the value of the slip. If there were no slip, the angle of attack would be zero.
Slip Ring	A circular copper track that makes contact with carbon brushes. Slip rings are used to transfer electrical power from the engine to a rotating propeller.
Slot	A device used to control the boundary layer and prevent flow Separation. May be used as a leading edge device or with trailing edge flaps
Snap Ring	An extractor ring fitted along with a propeller retaining nut to aid in the removal of a propeller from its shaft.
Solidity	The ratio of the total blade area to the propeller disc area. It can be determined by calculating the ratio between the circumference of the propeller disc at a given radius and the sum of the blade chord lengths at that radius. As the solidity is increased in design, the amount of engine power that can be absorbed by the propeller also increases.
Sonic	The condition where all the airflow over a body is travelling at the local speed of sound in air
Software	Software gives the computer instructions on how to function. This is carried by loadable programs from CD-ROMs, floppy disks etc.
Span	The length of a wing taken at right angles to the longitudinal axis to the wing tip. Wingspan is the total straight-line distance across the aircraft from wing tip to opposite wing tip.
Speed of Sound in Air	The speed at which sound waves, travel through air. The speed is proportional to the absolute temperature of the air only.
Speeder Spring	A spring incorporated into the propeller governor head that acts on the governor flyweights. Changes in engine speed in the constant speed range will cause the flyweights to either be overcome by, or overcome the load of the speeder spring. RPM control inputs alter the loading on the spring.
Specific Fuel Consumption	The weight of fuel required to produce a unit of output an hour; expressed as pounds of fuel/brake horse power/hour, or, pounds of fuel/pounds of thrust/hour
Specific Gravity (Relative Density)	The weight of a fluid by comparison to the same volume or water
Spider	A high tensile steel component that is incorporated into a variable pitch propeller hub. It has tapered arms designed to fit into the reverse taper counter bores of the propeller blades, locating them within the hub. The spider also incorporates a hub drive centre that has internal splines that mate with the propeller drive shaft and thus transmits the drive to the blades.
Spigot	An extension which will enter and help to locate one engine part to another, to ensure concentricity

Spin	A spiral dive created when directional and lateral stabilities become unbalanced usually initiated by a wing tip stalling
Spinner	A light alloy, streamlined shell fairing that encloses the thick-sectioned blade roots and the hub and pitch change mechanism. The spinner smoothes the airflow that passes back to the engine.
Spiral Instability	Occurs when directional stability is much higher than lateral stability. A yaw produces a roll that produces a sideslip that produces a further yaw into a spiral dive.
Splined Shaft	A propeller drive shaft that has external splines that mate with internal splines in the hub drive centre of a propeller. There may be a 'master' spline that ensures the correct positional relationship between the propeller and its shaft.
Splines or Serrations	A series to longitudinal ridges on the outer surface of a shaft, separated by grooves, these fit into a similarly grooved and ridged counterpart
Spoilers	Control surfaces consisting of a hinged flaps on the top wing surface that can be used to differentially spoil lift and support the ailerons in lateral control or collectively to act as speed brakes in the air or lift dumpers on the ground
Stagger Angle	The angle formed between the chord line of a compressor blade and the horizontal centreline of the engine
Stagnation	A region of stationary air usually occurring just below the leading edge of an aerofoil where the airflow divides to pass on either side
Stall	The point where the boundary layer separates from the surface resulting in a sharp loss of lift. Occurs around fifteen degrees angle of attack on an aerofoil.
Stall	An aerodynamic condition in which the smooth flow of air has broken away from the upper surface of an airfoil, and the flow is turbulent, decreasing the amount of life produced
Stalling Angle	The angle of attack of an aerofoil at which stall occurs
Stamping	Shaping and/or cutting by means of dies in a press
Standard Atmosphere	The conditions for a standard atmosphere (ICAO) are: Pressure = 1013.25mb (14.7 lbf/in²) Temperature = 15°C Density = 1.22250 Kg/m³
Starting Vortex	A horizontal vortex that is formed and left behind the aircraft whenever there is an increase in wing circulation such as on take-off and when pulling out of a dive. Wing bound vortex.
Static	Still, not moving. A condition of rest
Static Balance	Achieved when the centre of gravity of a propeller is aligned with its axis of rotation and no periodic out of balance forces exist.
Static Pressure	Atmospheric pressure measured at a point where there is no external disturbance, and the flow of air over the surface is perfectly smooth
Static Pressure	The ambient atmospheric pressure
Static RPM	The engine RPM obtained when the aircraft is stationary on the ground.
Static Stability	The ability of an aircraft to recover to its original Position following a disturbance around its axes
Stator	To be stationary, fixed compressor blades
Stoichiometric	Chemical combination which completely uses all the products of the reaction. In the case of a stoichiometric mixture, all the oxygen and all the hydrocarbon fuel are used. There is no oxygen or free carbon left
Streamlined shape	A shape where the air flows around it in streamlines without separating and becoming turbulent
Streamlines	The lines traced out in smoke delineating smoothly flowing layers of

	air in laminar flow
Stress	An applied load. A tensile stress is a force that tends to stretch a body, a shear stress a force that tends to cut through its section, and a compressive stress a force that tends to collapse it
Stroke	The distance that the piston moves from one extreme end of its travel to the other
Subsonic	The condition where all the airflow over a body is travelling below the local speed of sound in air
Suction	The production of a partial vacuum causing a fluid to move or adhere
Superfine	A very low blade angle in the Beta range that is used as the Ground Fine Pitch setting.
Surge	To move up and down or to and fro, in waves
Swirl	The rotary motion given to a fluid
Swirl Vanes	Air circulation vanes which surround fuel nozzles causing a vortex in which fuel vapour is made to recirculate and more completely ignite
Synchronise	To cause two or more events to happen at the same time
Sychronising	The matching of the engine RPMs on a multi-engine aircraft to reduce noise and vibration.
Synchrophasing	A refinement of the engine synchronisation system to further reduce noise and vibration by maintaining blade angular position separation on adjoining propellers to avoid aerodynamic interference occurring as a result of the blade tips passing in close proximity to each other.
Tachometer	Engine rev/min gauge may be in % of max rev/min
Tailpipe Inserts	Small sheet metal wedge-shaped tabs that are inserted into the tailpipe of some older engines to reduce the nozzle opening and increase thrust
Tailplane	The structural component that is fitted to give longitudinal stability. Sometimes referred to as the horizontal stabiliser.
Tapered Shaft	A propeller drive shaft that has a tapered seating that mates with a similar reverse taper in the propeller hub. Tapered shafts incorporate a keyway and key to transmit the drive and ensure the correct propeller to shaft position. Tapered shafts offer a greater seating contact area and centralise the propeller.
Tapper Ratio	The ratio of the chord lengths of the wing root and the wing tip. Taper ratio zero refers to a pointed tip.
Temperature Ratio	A ratio of two engine temperatures, used in certain performance calculations
Tertiary	Third
Test	To make certain, by using the necessary test equipment that a component functions correctly
Thermal Efficiency	The ratio of the amount of heat energy converted into useful work, to the amount of heat energy in the fuel used
Thermal Fatigue	A condition in turbine metals caused by the heating and cooling (compression and tension forces) each time a power setting is changed
Third Oil Line	A line that transfers engine oil under pressure from the oil transfer housing, through the propeller drive shaft and the FFPS withdrawal solenoid valve to the propeller flight fine pitch lock piston. The oil is used to withdraw the FFPS.
Thrust	The forward acting propelling force that opposes drag
Thrust	The forward acting component of the resultant force that is at right angles to the plane of a propeller's rotation.
Thrust Bearing	A shaft bearing designated to take an axial load
Tip	End of blade furthest from hub

Tip Clearance	The minimum specified clearances that should exist between a propeller blade tip and the ground, water and aircraft structure.
Tip Loss	The loss of propeller efficiency experienced at a blade tip due to the induced drag from tip vortices and from compressibility effects.
Tip Vortex	A vortex that trails from a blade tip and is created by high-pressure air constantly spilling from the pressure side over the tip and attempting to enter the low pressure region of the camber side. The vortex increases in intensity in proportion to thrust and creates induced drag.
Torque	A resistance to turning or twisting
Torque	The name given to the force that resists the rotation of a propeller through the air. The force acts against the direction of rotation in the plane of rotation and thus opposes the engine power output.
Torquemeter	An indicator used to indicate the amount of torque the engine is producing
Total Reaction	The resultant of the lift and drag forces acting on an aircraft
Tracking Check	A check that is carried out to compare the "track' of all the blades on a propeller with each other. The total measured difference should be within a specified minimum value.
Tractor	The term used to describe a propeller that is mounted on the front of an engine and produces thrust that pulls the aircraft forwards.
Trailing Edge	The rear edge of an aerofoil
Trailing Vortex	The vortex formed at a wing tip resulting from the airflow under the wing trying to curl over into the low-pressure region above the wing. This vortex is the primary cause of induced drag. Its intensity is inversely proportional to airspeed and proportional to aircraft weight.
Transient Conditions	Conditions which may occur briefly while accelerating or decelerating, or while passing through a specific range of engine operation
Transient Vibration	When an object is struck and vibrates at its resonant frequency the vibration will slowly die away. This is known as transient vibration.
Transition point	The point on the surface of an aerofoil where laminar airflow becomes turbulent. The point moves forward as airspeed increases.
Transition Range	A region of flight deck power lever dead movement between the ground and flight ranges.
Transonic	The condition where the airflow velocity over a body is part sub-sonic and part sonic or supersonic.
Trim	Adjustment to fuel flow, e.g. top temperature trimming
Trim Drag	The profile drag created by the tail plane.
Turbine	That part of an engine which is rotated by the medium of gas flow
Turbulent Flow	The situation where streamlines cannot maintain their separation and intermingle creating vortices and re-circulatory flow
Two-pitch Propeller	A propeller that incorporates only two blade angle settings. A low or fine setting for take-off and climbing and a high or coarse pitch setting for cruise.
Un-feathering Accumulator	A pneumatically charged accumulator that stores engine oil under pressure to assist in the un-feathering of a single acting counterweight propeller.
Underspeed	The condition in which the actual engine speed is lower than the desired engine speed as set by pilot
Under Speed Condition	A propeller governor condition where the speeder spring force is greater than the centrifugal force acting through the governor flyweights. The propeller blades move towards fine pitch to increase the RPM.

Universal Propeller Protractor	The measuring instrument that is used to measure a propeller's blade angle in relation to the normal and longitudinal datum lines of a propeller.
Upwash	The upward deflection of the airflow at the leading edge of an aerofoil
Vacuum	A region in which the gas pressure is considerably lower than atmospheric pressure. A perfect vacuum is practically unobtainable
Valve Lift Solenoid	See 'Increase pitch solenoid valve'.
Vane	Term generally used for stationary airfoils in an engine
Vaporisation	The conversion of fluids or solids into a gas
Variable Pitch Propeller	A propeller that has a pitch setting that varies automatically to maintain a pre-selected constant rotational speed.
Vector Quality	That which has both magnitude and direction
Velocity	The velocity of a vibrating body reaches zero at each displacement peak. It reaches a maximum value as it passes through its natural rest position.
Velocity	Distance divided by time or rate of change of distance
Velocity Ratio (of a machine)	Efforts distance moved 4- Loads distance moved
Vent	A small escape pipe which carries off excess pressures or vapours
Venturi	A reduction in the bore of a duct, with convergent upstream and divergent downstream walls, that increases the speed of the fluid flow
Vibration	Vibration is described as the physical and alternating displacement of a body about its rest position. It is caused by disturbing forces. The Parameters of vibration are its displacement, velocity, acceleration and frequency.
Vibration	Oscillation, rapid motion to and fro, of a liquid or solid whose equilibrium has been disturbed
Viscosity	A fluid 's resistance to flow
Viscosity	The reluctance of a fluid to flow, or to change shape easily
Volatile	Easily vaporised
Voltage Proof Test	A test earned out after repairs to the electrical overshoe. The leads from all the elements are connected together and a high voltage is applied between the leads and the blade for a period of at least one minute to ensure there is no breakdown in insulation resistance. The voltage is gradually increased and then gradually decreased.
VOR	VHF Omni-Range
VORTAC	Collocated VOR and Tacan Stations
Vortex	A spinning column of air with a low-pressure core
Wash-in	An increase in the angle of incidence of a wing from its root to its tip
Wash-out	A decrease in the angle of incidence of a wing from its root to its tip
Weak Mixture	One which has an excess of air
Weight	The force that acts vertically downwards through the centre of gravity that is the product of the mass and the acceleration due to gravity.
Windmill	A condition where a negative angle of attack exists as a result of low blade angle and high forward speed. The condition produces negative thrust and torque resulting in very high drag. The propeller continues to rotate in the same direction of rotation but it is driving the engine. Windmill can only occur when there is an axial airflow component. The condition usually occurs immediately following an engine failure and can be removed by feathering the propeller.

Windmill Brake	A condition that is deliberately selected after landing to improve braking. The condition is induced by the selection of ground fine pitch during the landing run. The condition produces negative thrust and torque with a negative angle of attack.
Windmilling	The act of being turned by the air (motion) stream
Wing Sweep Angle	The angle formed between the longitudinal axis and a line drawn along the wing at one quarter chord length.
Winglet	Aerofoil shaped device fitted at each wing tip to modify and raise the wing tip trailing vortices to reduce their influence on induced drag
Wipe Contact	Where contact is made between a fixed and a moving object, e.g. carbon brushes in a magneto
Yaw dampers	The movement of the longitudinal axis around the normal axis. Stabilised by the fin and controlled by the rudder.
Yaw dampers	An automatic System used to damp un-commanded yawing motions that would otherwise lead to Dutch Roll. Used as an alternative to reducing lateral stability on some swept wing aircraft.

13 Attachment 2: Part-66 Abbreviations

The following list is a sample of terms taken out of handbooks and technical training documents. It is suggested to compare the descriptions with the relevant specialists books or refer to “Common Support Data Dictionary published by Air Transport Association of America, Inc.,1301 Pennsylvania Avenue, NW - Suite 1100, Washington, DC 20004-1707,USA”, admin@ataebiz.org

EASA Part-66 Abbreviations	
Abbreviation	**Description**
A/D	Analogue-to-Digital
ACARS	ARINC Communications Aircraft Reporting System
ACCEL	Accelerometer, Acceleration
ACP	Audio Control Panel
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADSEL	Address Selective
AFC	Automatic Frequency Control
AFCS	Automatic Flight Control System
AFIS	Automatic/Airborne Flight Information System
AGC	Automatic Gain Control
AGL	Above Ground Level
AHC	Attitude Heading Computer
AHRS	Attitude & Heading Reference System
AID	Aircraft Installation Delay
AIL	Aileron
AIS	Aeronautical Information Services
ALC	Automatic Level Control
ALT	Altitude
ALTS	Altitude Select
ALU	Arithmetic & Logic Unit
AMM	Aircraft Maintenance Manual
AMPL	Amplifier
ANN or ANNUN	Annunciator
ANSI	American National Standards Institute
ANT	Antenna
AOC	Aircraft Operating Certificate
AOG	Aircraft On Ground
AOM	Aircraft Operating Manual
AP, A/P	Autopilot
APC	Autopilot Computer
APE	Autopilot Engage
APP, APPR, APR	Approach
APS	Altitude Preselect
APSB, APSBK	APS Bracket
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio Incorporated
ARM	Armed
AS	Airspeed
ASCB	Avionics Standard Communications Bus
ASEL	Altitude Select

ASI	Airspeed Indicator
ATC	Air Traffic Control
ATE	Automatic Test Equipment
ATIS	Automatic Terminal Information System
ATN	Aeronautical Telecommunications Network
ATT	Attitude
AUX	Auxiliary
AZ	Azimuth
B/A	Bank Angle
BARO	Barometric
BC, B/C	Back Course
BCD	Binary Coded Decimal
BDI	Bearing Distance Indicator
BFO	Beat Frequency Oscillator
Bit	A bit is the smallest unit of information in computer and communication theory, representing a logic '1' or logic '0'. It is derived from contracting the terms binary bit.
BITE	Built In Test Equipment
BL, B/L	Back Localiser
BRG	Bearing
CAA	Civil Aviation Authority
CAD	Computer Aided Design
CAP	Capture
CAS	Calibrated Airspeed
CASE	Computer Aided Software Engineering
CAT	Clear Air Turbulence
CB	Circuit Breaker
CBT	Computer Based Training
CDU	Control Display Unit
CE	Course Error
OFIT	Controlled Flight Into Terrain
CH	Channel
CHP	Course Heading Panel
CKT	Circuit
CLB	Climb
CLK	Clock
CLR	Clear
CMC	Central Maintenance Computer
CMD	Command
CMOS	Complementary Metal Oxide Semiconductor
CMPTR	Computer
CNTL	Controller
COMP, COMPTR	Compensation, Compass or Comparator
CONT	Controller
CORR	Correction
COS	Cosine
CP	Cross Pointer/Control Panel
CPU	Central Processor Unit
CRC	Cyclic Redundancy Check
CRS	Course
CRT	Cathode Ray Tube

CS	Cross Side
CSDB	Commercial Serial Data Bus
CT	Control Transformer
CTRL	Controller
CTVAL	Count Valid
CVR	Cockpit Voice Recorder
CW	Carrier Wave
D/A	Digital to Analogue
DA	Drift Angle
DADC	Digital Air Data Computer
DADS	Digital Air Data System
DAU	Data Acquisition Unit
dB	Decibel
DBI	Distance Bearing Indicator
DCP	Display Control Panel
DDM	Difference in Depth of Modulation
DEFL	Deflection
DEG	Degree
DEL	Delete
DEMOD	Demodulator
DET	Detector, Detent
DEV, DEVN	Deviation
DH	Decision Height
DIFCS	Digital Integrated Flight Control System
DIFF	Differential, Difference
DISPL	Displacement
DIST	Distance
DMA	Direct Memory Access
DME	Distance Measuring Equipment
DN	Down
DOS	Disk Operating System
DPU	Display Processor Unit
DSB	Double Side Eand
DSP	Display Selector Panel
DSR	Desired
DUP	Duplicate
GA, G/A	Go Around
GCS	Ground Clutter Suppression
GEN	Generator
GHz	Giga-Hertz
GIGO	Garbage In Garbage Out
GMT	Greenwich Mean Time
GND	Ground
GP	Glide Path
GPS	Global Positioning System
GPSSU	Global Positioning System Sensor Unit
GS, G/S	Glideslope
HB	Heart Beat
HBM	Heart Beat Monitor

HDG	Heading
HDG SEL	Heading Select
HDLC	High Level Data Link
HF	High Frequency
HIRF	High Intensity Radiated Field
HSI	Horizontal Situation Indicator
HUD	Heads Up Display
HYD	Hydraulic
Hz	Hertz
I/O	Input/Output
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organisation
ID	Identification
IF	Intermediate frequency
IFE	In Flight Entertainment
ILS	Instrument Landing System
INC-DEC	Increase-Decrease
IND	Indicator
INS	Inertial Navigation System
INTGL	Integral
INTLK	Interlock
INTPT	Interrupt
INV	Invert
IRC	Instrument Remote Controller
IRS	Inertial Reference System
ISO	Isolation
IVV	Instantaneous Vertical Velocity
K	Kelvin
Kg	Kilogram
kHz	Kilo Hertz
KN	Knots
KTS, Kts	Knots
L	Left
L/C	Inductive/Capacitive
LAT	Lateral, Latitude
LBS	Lateral Beam Sensor
LCD	Liquid Crystal Display
LF	Low Frequency
LH	Left Hand
LNAV	Lateral Navigation
LOC	Localiser
LONG	Longitude
LORAN	Long Range Navigation
LOS	Line Of Sight
LRN	Long Range Navigation
LRU	Line Replacement Unit
LS	Low Speed
LSB	Lower Side Band
LSK	Line Select Key
LSS	Lightning Sensing System

LTG	Lightning
MB	Marker Beacon
MCP	Mode Control Panel
MDA	Minimum Descent / Disconnect Altitude
MF	Medium Frequency
MFD	Multifunction Display
MHz	Mega Hertz
MIC	Microphone
MKR	Marker
MLS	Microwave Landing System
MM	Middle Marker
MMO	Maximum Mach Operating
MODEM	Modulator/Demodulator
MOM	Momentary
MON	Monitor
MOSFET	Metal Oxide Semiconductor Field Effect Transmitter
MPU	Multi-function Processor Unit
MSB	Most Significant Bit/ Byte
MSG	Message
MSI	Mach Speed Indicator
MSP	Mode Selector Panel
MT, MTRIM	Mach Trim
MTBF	Mean Time Between Failure
MTBR	Mean Time Between Removal
MTBUR	Mean Time Between Unscheduled Removal
MUX	Multiplexer
NAV	Navigation
NC	No Connection or Normally Closed
NCD	No Computed Data
ND	Navigation Display
NDB	Non Directional Beacon
NEG	Negative
NFF	No Fault Found
NM(s)	Nautical Mile(s)
NMOS	N-type Metal Oxide Semiconductor
NO	Normally Open
NOC	Navigation on Course
NORM	Normal
NTF	No Trouble Found
NVM	Non Volatile Memory
O/C	On Course
OAT	Outside Air Temperature
OBS	Omni Bearing Selector
OM	Outer Marker
OSC	Oscillator
OSS	Over Station Sensor
OVRD	Override
P0	Ambient air pressure
PI	Air intake pressure

P2	Compressor outlet pressure (single spool engines)
P3	Combustion chamber outlet pressure (single spool engines)
P4	Jet pipe pressure (single spool engines)
P-DME	Precision Distance Measuring Equipment
P/R	Pitch/Roll
PA	Passenger Address
PA	Power Amplifier
PAM	Pulse Amplitude Modulation
PAST	Pilot Activated SelfTest
PATT	Pitch Attitude
PB	Push Button
PCB	Printed Circuit Board
PCU	Power Control Unit
PCWS	Pitch Control Wheel Steering
PES	Passenger Entertainment System
PFD	Primary Flight Display
PISO	Parallel In Serial Out
PITCH SYNC	Pitch Synchronisation
PLC	Path Length Control
PMOS	P-type Metal Oxide Semiconductor
PMS	Performance Management System
POS	Position
POST	Power On System Test
PPI	Plan Position Indicator
Pressure	Load divided by cross-sectional area. Nm^2 or $lb\ in^2$
PREV	Previous
PRF	Pulse Repetition Frequency
PRI, PRIM	Primary
PROC	Processor
PROG	Programmer, Programming
PROM	Programmable Read Only Memory
PSU	Power Supply Unit
PTR	Press To Reset
PW	Pitch-wheel or Pulse-width
PWM	Pulse-width Modulated
PWR	Power
QAR	Quick Access Recorder
QC	Quality Control
QEC	Quadrantal Error Corrector
QTY	Quantity
QUAD	Quadrant
R	Right
RA	Resolution Advisory
RA, R/A, RAD ALT	Radio Altimeter
RAM	Random Access Memory
RCB	Radio Communications Bus
RCVR	Receiver
RDR	Radar
REF	Reference
REFL	Reflection

REL	Release
REQ	Request
RET	Return
RETR	Retract
REV	Reversionary
RF	Radio Frequency
RFI	Request For Information
RG	Rate Gyro
RGB	Red/Green/Blue
RH	Right Hand
RLG	Ring Laser Gyroscope
RMI	Radio Magnetic Indicator
RMU	Radio Management Unit
RN, RNAV	Area Navigation
RNAPP	RNAV Approach
RNG	Range
RSB	Radio System Bus
RT, R/T	Receiver/Transmitter, Rate of Turn
RUD	Rudder
RVT	Rotary Variable Transformer
RX/TX, Rx/Tx	Receiver/Transmitter
RZ	Return to Zero
SAT	Static Air Temperature
SATCOM	Satellite Communication
SBY, STBY	Standby
SCR	Silicon Controlled Rectifier
SCS	Single Channel Select
SDI	Source Destination Index
SEC	Seconds, Secondary
SEC	Sector
SEL	Select
SELCAL	Selective Calling
SG	Signal/Symbol Generator
SID	Standard Instrument Departure
SIG	Signal
SIN	Sine
SIPO	Serial In Parallel Out
SLS	Side Lobe Suppression
SPD	Speed
SPKR	Speaker
SQ	Squelch
SRC	Source
SRN	Short Range Navigation
SSB	Single Side Band
SSEC	Static Source Error Correction
STA EL	Station Elevation
STAB	Stabilised, Stabilisation
STAR	Standard Terminal Arrival Route
STC	Sensitivity Time Control
STP	Steep
STR, STRG	Steering
SVO	Servo

SYNC	Synchronisation
SYS	System
TA	Traffic Advisory
TACAN	Tactical Air Navigation System
TAS	True Air Speed
TAT	Total Air Temperature
TBA	To Be Assigned
TBD	To Be Decided
TCAS	Traffic alert Collision Avoidance System
TCS	Touch Control Steering
TEMP	Temperature
Test	To make certain, by using the necessary test equipment that a component functions correctly
TGT	Turbine Gas Temperature
TGT	Target
TKE	Track Error
TLA	Torque Limit Aileron
TLE	Torque Limit Elevator
TOGA	Take-Off Go-Around
TP	Test Point
TRK	Track
TRU	Transformer Rectifier Unit
TSO	Technical Standard Order
TTG	Time To Go
TTL	Tuned To Localiser
TURB	Turbulence
TX	Transmit
UART	Universal Asynchronous RX/TX
UB	Utility Bus
UHF	Ultra High Frequency
ULB	Underwater Locator Beacon
UNCPLD	Un-coupled
USB	Upper Side Band
V/L	VOR/ Localiser
VA	Volt Ampere
VAL	Valid
VALT	Vertical Altitude
VANG	Vertical Angle
VAPP	VOR Approach
VASL	Vertical Altitude Select
VBS	Vertical Beam Sector
VFLC	Vertical Flight Level Change
VHF	Very High Frequency
VLD	Valid
VLF	Very Low Frequency
VLV	Valve
VMO	Velocity Maximum Operating
VNAV	Vertical Navigation
VOR	VHF Omni-Range
VORTAC	Collocated VOR and Tacan Stations

VPTH	Vertical Path
VRT, VERT	Vertical
VS	Vertical Speed
VSI	Vertical Speed Indicator
VSWR	Voltage Standing Wave Ratio
WAAS	Wide Area Augmentation System
WL, W/L	Wings Level
WO	Washed Out
WOW	Weight On Wheels
WT	Weight
WX	Weather Radar
WXP	Weather Radar Panel
XCVR	Transceiver
XFR	Transfer
XMIT	Transmit
XMTR	Transmitter
XPDR	Transponder
XPNDR	Transponder
XTK	Cross Track
YD, Y/D	Yaw Damper
YDS	Yaw Damper System