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YCAR-STD 4A

AEROPLANE BASIC INSTRUMENT TRAINING DEVICES

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YCAR-STD 4A

AEROPLANE BASIC INSTRUMENT TRAINING DEVICES

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SECTION 2 - ACCEPTABLE MEANS OF COMPLIANCE (AMC)/INTERPRETATIVE AND EXPLANATORY MATERIAL (IEM)

SUBPART A – APPLICABILITY

YCAR–STD 4A.001 Applicability

YCAR-STD 4A applies to those manufacturers and/or operators of Basic Instrument Training Devices (BITD) seeking qualification of Basic Instrument Training Devices. BITD users also shall gain approval to use the BITD as part of their approved training programmes despite the fact that the BITD has been previously qualified. Although this document provides guidance material for BITD users, precise details of such approvals are contained in YCAR and other applicable documents.

Note: In the context of this YCAR-STD, the "Authority" means CAMA except whenever a foreign authority is utilized for the qualification of simulators, then the term "Authority" may also apply to this foreign Authority.

SUBPART B – GENERAL

YCAR–STD 4A.005 Terminology

(See Appendix 1 to YCAR-STD 4A.005)
(See AMC STD 4A.005)

Because of the technical complexity of Synthetic Training Device qualification, it is essential that standard terminology is used throughout. The following principal terms and abbreviations shall be used in order to comply with YCAR–STD. Further terms and abbreviations are contained in Appendix 1 to YCAR-STD 4A.005.

(a) *Synthetic Training Device (STD).* A training device which is either a Flight Simulator (FS, a Flight Training Device (FTD), a Flight Navigation Procedure Trainer (FNPT) or a Basic Instrument Training Device (BITD).

(b) *Flight Simulator (Simulator).* A full size replica of specific type or make, model and series aeroplane flight deck, including all equipment and computer programmes necessary to represent the aeroplane in ground and flight operations, a visual system providing an out-of-the-flight deck view, and a force cueing motion system. It is in compliance with the minimum standards for Flight Simulator qualification.

(c) *Flight Training Device (FTD).* A full size replica of an aeroplane's instruments, equipment, panels and controls in an open flight deck area or an enclosed aeroplane flight deck, including the assemblage of equipment and computer software programmes necessary to represent the aeroplane in ground and flight conditions to the extent of the systems installed in the device. It does not require a force cueing motion or visual system. It is in compliance with the minimum standards for a specific FTD Level of Qualification.

(d) *Flight and Navigation Procedures Trainer (FNPT).* A training device which represents the flight deck/cockpit environment including the assemblage of equipment and computer programmes necessary to represent an aeroplane type or class in flight operations to the extent that the systems appear to function as in an aeroplane. It is in compliance with the minimum standards for a specific FNPT Level of Qualification.

(e) *Basic Instrument Training Device (BITD).* A ground based training device which represents the student pilot's station of a class of aeroplanes. It may use screen based instrument panels and spring loaded flight controls, providing a training platform for at least the procedural aspects of instrument flight.

(f) *BITD User Approval.* The extent to which a qualified BITD may be used by persons, organisations or enterprises as approved by the Authority. It takes account of aeroplane to BITD differences and the operating and training ability of the organisation.

(g) *BITD Manufacturer.* That organisation or enterprise being directly responsible to the Authority for requesting the initial BITD model qualification.

(h) *BITD Model.* A defined hardware/software combination which has obtained a qualification. Each BITD will equate to a specific model and be a serial numbered unit.

(i) *BITD Operator.* That person, organisation or enterprise directly responsible to the Authority for requesting and maintaining the recurrent qualification of a particular BITD.

(j) *BITD User.* The person, organisation or enterprise requesting training credits through the use of a BITD.

(k) *BITD Qualification.* The technical ability of a BITD as defined in the compliance document.

(l) *Qualification Test Guide (QTG).* A document designed to demonstrate that the performance and handling qualities of a BITD agree within prescribed limits with agreed

validation data and that all applicable regulatory requirements have been met. The QTG includes both the agreed validation data and BITD data used to support the validation.

Appendix 1 to YCAR–STD 4A.005 Additional Terminology

In addition to the principal terms defined in YCAR-STD 4A.005 itself, additional terms used in the context of YCAR-STD 4A have the following meanings:

(a) *Automatic Testing*. BITD testing wherein all stimuli are under computer control.

(b) *Breakout*. The force required at the pilot's primary controls to achieve initial movement of the control position.

(c) *Closed Loop Testing*. A test method for which the input stimuli are generated by controllers which drive the BITD to follow a pre-defined target response.

(d) *Control Sweep*. A movement of the appropriate pilot's control from neutral to an extreme limit in one direction (Forward, Aft, Right, or Left), a continuous movement back through neutral to the opposite extreme position, and then a return to the neutral position.

(e) *Convertible BITD*. A BITD in which hardware and software can be changed so that the BITD represents more than one model, usually of the same class of aeroplane. The same cockpit shell, computers and necessary peripheral equipment can thus be used in more than one simulation.

(f) *Critical Engine Parameter*. The engine parameter which is the most appropriate measure of propulsive force.

(g) *Damping (critical)*. The CRITICAL DAMPING is that minimum Damping of a second order system such that no overshoot occurs in reaching a steady state value after being displaced from a position of equilibrium and released. This corresponds to a relative Damping ratio of 1.0.

(h) *Damping (over-damped)*. An OVER-DAMPED response is that Damping of a second order system such that it has more Damping than is required for Critical Damping, as described above. This corresponds to a relative Damping ratio of more than 1.0.

(i) *Damping (under-damped)*. An UNDER-DAMPED response is that Damping of a second order system such that a displacement from the equilibrium position and free release results in one or more overshoots or oscillations before reaching a steady state value. This corresponds to a relative Damping ratio of less than 1·0.

(j) *Deadband*. The amount of movement of the input for a system for which there is no reaction in the output or state of the system observed.

(k) *Driven*. A state where the input stimulus or variable is 'driven' or deposited by automatic means, generally a computer input. The input stimulus or variable may not necessarily be an exact match to the flight test comparison data – it is simply driven to certain predetermined values.

(l) *BITD Data*. The various types of data used to design, manufacture, test and maintain the BITD.

(m) *BITD Evaluation*. A detailed appraisal of a BITD by the Authority to ascertain whether or not the standard required for a Qualification is met.

(n) *Flight Test Data*. Actual aeroplane data obtained by the aeroplane manufacturer (or other supplier of acceptable data) during an aeroplane flight test programme.

(o) *Free Response*. The response of the aeroplane after completion of a control input or disturbance.

(p) *Frozen/Locked*. A state where a variable is held constant with time.

(q) *Functions Test*. A quantitative assessment of the operation and performance of a BITD by a suitably qualified evaluator. The test can include verification of correct operation of controls, instruments, and systems of the simulated aeroplane under normal and non-

normal conditions. Functional performance is that operation or performance that can be verified by objective data or other suitable reference material which may not necessarily be Flight Test Data.

(r) *Hands-off Manoeuvre*. A test manoeuvre conducted or completed without pilot control inputs.

(s) *Hands-on Manoeuvre*. A test manoeuvre conducted or completed with pilot control inputs as required.

(t) *Integrated Testing*. Testing of the BITD such that all aeroplane system models are active and contribute appropriately to the results. None of the aeroplane system models should be substituted with models or other algorithms intended for testing only. This may be accomplished by using controller displacements as the input. These controllers should represent the displacement of the pilot's controls and these controls should have been calibrated.

(u) *Latency*. The additional time, beyond that of the basic perceivable response time of the aeroplane due to the response time of the BITD.

(v) *Manual Testing*. BITD testing wherein the pilot conducts the test without computer inputs except for initial setup. All modules of the simulation should be active.

(w) *Master Qualification Test Guide (MQTG)*. The Authority approved QTG which incorporates the results of tests witnessed by the Authority. The MQTG serves as the reference for future evaluations.

(x) *Objective Test (Objective Testing)*. A quantitative assessment based on comparison with data.

(y) *Power Lever Angle*. The angle of the pilot's primary engine control lever(s) in the cockpit. This may also be referred to as PLA, Throttle, Power Lever and Propeller Lever.

(z) *Predicted Data*. Data derived from sources other than type specific aeroplane flight tests.

(aa) *Proof-of-Match (POM)*. A document which shows agreement within defined tolerances between model responses and flight test cases at identical test and atmospheric conditions.

(bb) *Protection Functions*. Systems functions designed to protect an aeroplane from exceeding its flight and manoeuvre limitations.

(cc) *Pulse Input*. An abrupt input to a control followed by an immediate return to the initial position.

(dd) *Reversible Control System*. A control system in which movement of the control surface will backdrive the pilot's control in the cockpit.

(ee) *Snapshot*. A presentation of one or more variables at a given instant of time.

(ff) *Statement of Compliance (SOC)*. A declaration that specific requirements have been met.

(gg) *Step Input*. An abrupt input held at a constant value.

(hh) Subjective Test (Subjective Testing). A qualitative assessment based on established standards as interpreted by a suitably qualified person.

(ii) Time History. A presentation of the change of a variable with respect to time.

(jj) Transport Delay. The total BITD system processing time between an input signal from a pilot primary flight control and the instrument response. It is the overall time delay incurred from signal input until output response. It does not include the characteristic delay of the aeroplane simulated.

(kk) *Validation Data*. Data used to prove that the BITD performance corresponds to that class of aeroplane.

(ll) *Validation Test*. A test by which BITD parameters can be compared with the relevant Validation Data.

SUBPART C – BASIC INSTRUMENT TRAINING DEVICES

YCAR–STD 4A.015 Application for BITD Qualification

(See AMC STD 4A.015)
(See IEM STD 4A.015)

(a) The BITD manufacturer of a new BITD model which requires evaluation shall apply to the Authority giving 3 months notice. In exceptional cases this period may be reduced to one month at the discretion of the Authority.

(b) A BITD Qualification Certificate will be issued for the BITD model to the manufacturer following satisfactory completion of an evaluation by the Authority. This qualification is valid for all serial numbers of this model without further technical evaluation.

YCAR–STD 4A.020 Validity of BITD Qualification

(a) A BITD qualification of each serial number is valid for 36 months from the commencement of operation, unless reduced by the Authority. It is the operator‘s responsibility to apply for the revalidation of the qualification.

(b) A BITD qualification test for revalidation may take place at any time within the 60 days prior the expiry of the validity of the qualification document. The new 36 months period of validity shall continue from the expiry date of the previous qualification document.

(c) The Authority may refuse, revoke, suspend or vary a BITD qualification, if the provisions of YCAR-STD 4A are not satisfied.

(d) As a BITD only broadly replicates a class of aeroplanes, and not a specific type of aeroplane, an interim qualification will not be issued.

YCAR–STD 4A.025 Rules governing BITD Operators

(See AMC STD 4A.025)

The operator of a BITD shall demonstrate his capability to maintain the performance, functions and other characteristics specified for the BITD qualification as follows:

(a) *Quality System.*

(1) A Quality System shall be established and a Quality Manager designated to monitor compliance with, and the adequacy of, procedures required to ensure the maintenance of the qualification of the BITD. Compliance monitoring shall include a feed-back system to the Accountable Manager to ensure corrective action as necessary.

(2) The Quality System shall include a Quality Assurance Programme that contains procedures designed to verify that the specified performance, functions and characteristics are being conducted in accordance with all applicable requirements, standards and procedures.

(3) The Quality System and the Quality Manager shall be acceptable to the Authority.

(4) The Quality System shall be described in relevant documentation.

(b) *Updating and Modifications.* The BITD operator shall maintain a link between his own organisation, the Authority and the BITD manufacturer. to incorporate important modifications,

(1) Where applicable and essential for training, BITD operators shall update their BITDs (for example in the light of data revisions). Modifications of the BITD hardware and software which affect flight characteristics and performance, shall be evaluated to determine the impact on the original qualification criteria. If necessary, BITD operators shall provide amendments for any affected validation tests.

(2) The Authority shall be advised in advance of any major changes to determine if the tests carried out by the BITD operator are satisfactory. A special evaluation of the BITD may be necessary prior to returning it to training following the modification.

(3) The BITD operator providing the information on the intended modification shall also provide a justification that this information is adequate either from the BITD operator's own resources, or through an arrangement with the BITD manufacturer.

(c) *Installations*. Ensure that the BITD is housed in suitable premises which support safe and reliable operation.

(1) BITD occupants and maintenance personnel shall be briefed on safety to ensure that they are aware of all safety equipment and arrangement in the BITD in case of emergency.

(d) *Additional Equipment*. Where additional equipment has been added by the BITD Operator to a BITD even though not required for qualification, it will be assessed to ensure that it does not adversely affect the quality of training. Therefore any subsequent modification, removal or unserviceability could affect the qualification of the device.

YCAR–STD 4A.030 Requirements for BITDs qualified on or after 1 January 2005
(See AMC STD 4A.030)
(See IEM STD 4A.030)

(a) Any BITD submitted for initial evaluation on or after 1 January 2005, shall be evaluated against YCAR-STD 4A criteria.

(b) A BITD shall be assessed in those areas which are essential to completing the student pilot training process according Appendices 1 and 2 to YCAR-STD 4A.030.

(c) The BITD shall be subjected to:

(1) Validation tests as found in the Qualification Test Guide (QTG) as expressed in AMC STD 4A.030, para 2.3.

(2) Functions & Subjective tests as expressed in AMC STD 4A.030, para 3.

(d) Data which is used to ensure the fidelity of a BITD shall be of a standard that satisfies the Authority before the BITD can be qualified.

(e) The BITD manufacturer shall submit a QTG acceptable to the Authority.

(f) Upon completion of the initial evaluation, and when all the discrepancies in the QTG have been addressed to the satisfaction of the Authority, the QTG is approved. After inclusion of the results of the tests witnessed by the Authority, the approved QTG becomes the Master QTG (MQTG), which is the basis for the BITD model qualification and subsequent recurrent BITD individual serial number evaluation.

(g) The BITD operator shall:

(1) Run the complete QTG progressively on an annual cycle. Results shall be dated and retained at least until the next requalification in order to satisfy both the BITD operator as well as the Authority that BITD standards are being maintained; and

(2) Establish a Configuration Control System to ensure the continued integrity of the hardware and software qualified.

Appendix 1 to YCAR–STD 4A.030 Technical Requirements

(a) This Appendix describes the minimum technical requirements for qualifying a BITD.

(b) Specific requirements for the use of the BITD will be determined by the Authority. Specialised training courses require an adequate standard of simulation which will be evaluated by the Authority. (See YCAR-Part 2).

(c) Maximum credits are granted according to YCAR-Part 2.

Table 1 Minimum technical requirements for qualifying BITD

Minimum Technical Requirements
1. A student pilot‘s station which represents a class of aeroplane sufficiently enclosed to exclude distraction. 2. The switches and all the controls shall be of a representative size and shape, and shall operate as and represent those as in the simulated class of aeroplane. 3. Instruments, equipment, panels, systems, primary and secondary flight controls sufficient for the training events to be accomplished shall be located in a position similar to that in the simulated class of aeroplane. 4. Lighting environment for panels and instruments sufficient for the operation being conducted. 5. In addition to the pilot’s seat, suitable viewing arrangements for the instructor shall be provided allowing an adequate view over the pilot’s panels. 6. The performance shall be representative of the simulated class of aeroplane. 7. Effects of aerodynamic changes for various combinations of drag, thrust and control settings encountered in flight, including the effect of change in aeroplane attitude and sideslip shall be representative of the simulated class of aeroplane. 8. Navigation equipment for flights under IFR with representative tolerances. This shall include communication equipment. 9. Control forces and travel shall broadly correspond to that of the simulated class of aeroplane. 10. Complete navigation data base for at least 3 airports with corresponding precision and non-precision approach procedures including regular updates. All navigational aids shall be usable, if within range, without restrictions and instructor intervention. 11. Engine sound shall be available. 12. Control and effects of atmospheric conditions, including at least: - Wind direction and speed - Barometric pressure 13. Map and approach profiles flown shall be available. 14. Provision for position freeze, flight freeze and repositioning (geographical position, heading, speed and altitude). 15. Instructor controls to set and reset malfunctions relating to: - flight instruments\ - navigation aids - flight controls - engine out operations (for multi engine aeroplanes only) 16. Stall recognition device corresponding to that of the simulated class of aeroplane. 17. A Qualification Test Guide (QTG) which shall be submitted in a form and manner acceptable to the Authority and which conforms to AMC STD 4A.030 (para1.6).

Appendix 2 to YCAR-STD 4A.030 Table 1 - BITD Standards

Table 1 below shows how the requirements, listed in Table 1 of Appendix 1 to YCAR-STD 4A.030, shall be fulfilled.

BITD STANDARDS	COMMENTS
a. Time from pilot's control input to recognisable system response (transport delay) on the attitude indicator shall be 300 ms or less. This standard shall be certified by the manufacturer in the QTG submitted for Qualification.	SOC required.
b. The basic flight instruments shall be displayed and arranged in the usual "T-layout". The following instruments shall be displayed so as to be representative for the simulated class of aeroplane: 1. An attitude indicator with at least 5° and 10° pitch markings, and bank angle markings for 10°, 20°, 30° and 60°. 2. Adjustable altimeter(s) with 20 ft markings. 3. An airspeed indicator with at least 5 kts markings within a representative speed range and colour coding. 4. An HSI or heading indicator with incremental markings each of at least 5°, displayed on a 360° circle. The heading figures shall be radially aligned. 5. A vertical speed indicator with 100 fpm markings up to 1 000 fpm and 500 fpm thereafter within a representative range. 6. A turn and bank indicator with incremental markings for a rate of 3° per second turn for left and right turns. The 3° per second rate index shall be inside of the maximum deflection of the indicator. 7. A slip indicator representative of the simulated class of aeroplane, where a coordinated flight condition is indicated with the ball in centre position. 8. A magnetic compass with incremental markings each 10°. 9. Engine instruments as applicable to the simulated class of aeroplane, with markings for normal ranges, minimum and maximum limits. 10. A suction gauge or instrument pressure gauge, as applicable, with a display as applicable for the simulated class of aeroplane. 11. A flap position indicator which displays the current flap setting. This indicator shall be representative of the simulated class of aeroplane. 12. A pitch trim indicator with a display that shows zero trim and appropriate indices of aeroplane nose down and nose up trim. 13. A stop watch or digital timer which allows the readout of seconds and minutes.	Covers also screen-based instrument panel. Instruments shall be displayed very nearly full-size as in the simulated class of aeroplane. Controls to adjust the instruments, e.g. QNH, course or heading bugs shall be located spatially correct at the respective instrument. A triangle slip indicator is acceptable if applicable for the simulated class of aeroplane.

	BITD STANDARDS	COMMENTS
c.	A communication and navigation panel shall be displayed in a manner that the frequency in use is shown. The NAV equipment shall include ADF, VOR, DME and ILS indicators with the following incremental markings: 1. one-half dot or less for course and glide slope indications on the VOR and ILS display. 2. 5° or less of bearing deviation for ADF and RMI, as applicable. All NAV radios shall be equipped with an aural identification feature. A marker beacon receiver shall also be installed with an optical and aural identification.	Controls to select the frequencies and other functions may be located on a central COM/NAV panel or on a separate ergonomically located panel.
d.	All instrument displays shall be visible during all flight operation. The instrument system shall be designed to ensure jumping and stepping is not a distraction and to display all changes within the range of the replicated instruments that are equal or greater than the values stated below: 1. Attitude ½° pitch and 1° bank 2. Turn and bank of ¼ standard rate turn 3. IAS 1 kts 4. VSI 20 fpm 5. Altitude 3 ft 6. Heading on HSI ½° 7. Course and Heading on OBS and/or RMI 1° 8. ILS ¼° 9. RPM 25 10. MP ½ inch	
e.	The update rate of all displays shall provide an image of the instruments that: 1. does not appear out of focus. 2. does not appear to "jump" or "step" to a distracting degree during operation. 3. does not appear with distracting jagged lines or edges.	Only applicable for screen-based instrument panels. SOC required to proof the resolution.

YCAR–STD 4A.035 Requirements for STDs approved or qualified before 1 January 2005

(a) FNPT(G)s and STDs under special category may be recategorised as BITDs. The STD operator shall apply for the evaluation. Following satisfactory completion of the evaluation the STD operator will be issued a Qualification Certificate.

(b) Recategorized BITD's will be qualified in accordance with YCAR-STD 4A.030.

YCAR–STD 4A.040 Changes to qualified BITDs

(a) *Requirement to notify major changes to a BITD*. The Operator of a qualified BITD shall inform the Authority of proposed major changes such as:

(1) BITD hardware and/or software modifications which could affect the handling qualities, performances or system representations.

(2) Relocation of the BITD; and

(3) Any deactivation of the BITD.

Note: The Authority may complete a special evaluation following major changes or when a BITD appears not to be performing to its initial qualification.

(b) *Upgrade of a BITD*. If an upgrade to an FNPT I is planned, the procedures according YCAR-STD 3A apply.

(c) *Relocation of a BITD*

(1) In instances where a BITD is moved to a new location, the Authority shall be advised. At the discretion of the Authority, the BITD shall be subject to an evaluation in accordance with its original qualification criteria.

(d) *Deactivation of a currently qualified BITD*

(1) In the event a BITD operator plans to remove a BITD from active status for prolonged periods, the Authority shall be notified.

(2) The BITD operator shall agree a procedure with the Authority to ensure that the BITD can be restored to active status to its original Qualification Level.

YCAR–STD 4A.045 Intentionally blank

YCAR–STD 4A.050 Transferability of BITD Qualification

(a) When there is a change of BITD operator, the new operator shall advise the Authority in advance in order to agree upon a plan of transfer of the BITD.

(b) At the discretion of the Authority, the BITD shall be subject to an evaluation in accordance with its original qualification criteria.

(c) Provided that the BITD performs to its original standard, its original qualification shall be restored.

SECTION 2 – ACCEPTABLE MEANS OF COMPLIANCE (AMC) /INTERPRETATIVE AND EXPLANATORY MATERIAL (IEM)

1 GENERAL

1.1 This Section contains Acceptable Means of Compliance and Interpretative/Explanatory Material that has been agreed for inclusion in YCAR–STD 4A.

1.2 Where a particular YCAR paragraph does not have an Acceptable Means of Compliance or any Interpretative/Explanatory Material, it is considered that no supplementary material is required.

2 PRESENTATION

2.1 The Acceptable Means of Compliance and Interpretative/Explanatory Material are presented in full page width on loose pages, each page being identified by the date of issue or the Amendment number under which it is amended or reissued.

2.2 A numbering system has been used in which the Acceptable Means of Compliance or Interpretative/Explanatory Material uses the same number as the YCAR paragraph to which it refers. The number is introduced by the letters AMC or IEM to distinguish the material from the YCAR itself.

2.3 The acronyms AMC and IEM also indicate the nature of the material and for this purpose the two types of material are defined as follows:

Acceptable Means of Compliance (AMC) illustrate a means, or several alternative means, but not necessarily the only possible means by which a requirement can be met. It should however be noted that where a new AMC is developed, any such AMC (which may be additional to an existing AMC) will be amended into the document following consultation under the NPA procedure.

Interpretative/Explanatory Material (IEM) helps to illustrate the meaning of a requirement.

2.4 New, amended or corrected text is enclosed within heavy brackets.

AMC/IEM B - GENERAL

AMC STD 4A.005 Abbreviations
See YCAR-STD 4A.005

AC	=	Advisory Circular
AFM	=	Aeroplane Flight Manual
AGL	=	Above Ground Level (metres or feet)
Airspeed	=	Calibrated airspeed unless otherwise specified (knots)
Altitude	=	Pressure altitude (metres or feet) unless specified otherwise
AOA	=	Angle of Attack (degrees)
A_d	=	Total initial displacement of pilot controller (Initial displacement to final resting amplitude)
A_n	=	Sequential amplitude of overshoot after initial X axis crossing, e.g. A1 = first overshoot.
Bank	=	Bank/Roll angle (degrees)
CCA	=	Computer Controlled Aeroplane
cd/m^2	=	candela/metre^2, 3·4263 candela/m^2 = 1 ft-Lambert
cm(s)	=	centimetre, centimetres
daN	=	decaNewtons
deg(s)	=	degree, degrees
distance	=	distance in nautical miles unless specified otherwise
EPR	=	Engine Pressure Ratio
FAA	=	Federal Aviation Administration (U.S.)
ft	=	feet, 1 foot = 0·304801 metres
ft-Lambert	=	foot-Lambert, 1 ft-Lambert = 3·4263 candela/m^2
fuel used	=	Mass of fuel used (kilos or pounds)
g	=	Acceleration due to Gravity (metres or feet/sec^2), 1g = 9·81 m/sec^2 or 32·2 feet/sec^2
G/S	=	Glideslope
Height	=	Height above ground = AGL (metres or feet)
IATA	=	International Air Transport Association
ICAO	=	International Civil Aviation Organisation
ILS	=	Instrument Landing System
IOS	=	Instructor Operating Station
IQTG	=	International Qualification Test Guide (RAeS Document)
km	=	Kilometres (1 km = 0·62137 statute miles)
kPa	=	KiloPascal (KiloNewton/m^2) (1 psi = 6·89476 kPa)
kt	=	Knots calibrated airspeed unless otherwise specified (1 knot = 0·5148 m/sec or 1·689 ft/s)
lb	=	pounds
m	=	Metres (1 m = 3·28083 feet)
Medium	=	Normal operational mass for flight segment
min	=	Minutes
MLG	=	Main landing gear
MPa	=	MegaPascals (1 psi = 6894·76 pascals)
ms	=	Millisecond(s)
N	=	Normal control state referring to computer controlled aeroplanes
NM	=	Nautical Mile 1 Nautical Mile = 6 080 feet
NN	=	Non-normal control state referring to computer controlled aeroplanes

Nominal	=	Normal operational mass, configuration, speed, etc, for the flight segment specified
N1	=	Engine Low Pressure Rotor revolutions per minute expressed in percent of maximum
N2	=	Engine High Pressure Rotor revolutions per minute expressed in percent of maximum
NWA	=	Nosewheel angle (degrees)
n	=	Sequential period of a full cycle of oscillation
PAPI	=	Precision Approach Path Indicator System
pitch	=	Pitch angle (degrees)
PLA	=	Power Lever Angle
P_0	=	Time from pilot controller release until initial X axis crossing (X axis defined by the resting amplitude)
P_1	=	First full cycle of oscillation after the initial X axis crossing
P_2	=	Second full cycle of oscillation after the initial X axis crossing
P_n	=	Sequential period of oscillation
P_f	=	Impact or feel pressure
PLF	=	Power for level flight
POM	=	Proof of match
psi	=	pounds per square inch
RAE	=	Royal Aerospace Establishment
RAeS	=	Royal Aeronautical Society
REIL	=	Runway end identifier lights
R/C	=	Rate of climb (m/s or ft/min)
R/D	=	Rate of descent (m/s or ft/min)
RVR	=	Runway visual range (m or ft)
s	=	second(s)
sec(s)	=	second, seconds
1st segment	=	That portion of the take-off profile from lift-off to completion of gear retraction
2nd segment	=	That portion of the take-off profile from after gear retraction to end of climb at V_2 and initial flap/slat retraction
3rd segment	=	That portion of the take-off profile after flap/slat retraction is complete
Sideslip	=	Sideslip angle (degrees)
sm	=	Statute miles (1 statute mile = 5 280 feet)
SOC	=	Statement of compliance
T(A)	=	Tolerance applied to amplitude
T(P)	=	Tolerance applied to period
T/O	=	Take-off
T_f	=	Total time of the flare manoeuvre duration
T_i	=	Total time from initial throttle movement until a 10% response of a critical engine parameter
T_t	=	Total time from T_i to a 90% increase or decrease in the power level specified
VASI	=	Visual approach slope indicator system
VGS	=	Visual ground segment
V_{mca}	=	Minimum control speed (Air)
V_{mcg}	=	Minimum control speed (Ground)
V_{mcl}	=	Minimum Control Speed (Landing)
V_r	=	Rotate Speed
V_s	=	Stall Speed or minimum speed in the stall
WAT	=	Weight, Altitude, Temperature

AMC/IEM C - BASIC INSTRUMENT DEVICES TRAINING

AMC STD 4A.015 BITD Qualification – Application and Inspection
See YCAR–STD 4A.015
See also IEM STD 4A.015

1 Letter of Application

A sample of letter of application is provided overleaf.

LETTER OF APPLICATION FOR EVALUATION OF A BITD

(Date)……

PRINCIPAL INSPECTOR
(Address)…….
……..
(City)…….
(Country)……..

Dear …….

.....(Name of Applicant)..... requests the evaluation of its .....(type)..... BITD for qualification. The ... (BITD manufacturer name)..... BITD is fully defined on page ..... of the accompanying Qualification Test Guide (QTG) which was run on ... (date)..... at .....(place)..... We have completed tests of the BITD and declare that it meets all applicable requirements of YCAR-STD 4A (Basic Instrument Training Devices) except as noted below. Appropriate hardware and software configuration control procedures have been established and these are appended for your inspection and approval.

The BITD has been assessed by the following evaluation team:

(name)	Qualification/Title
(name)	Qualification/Title
(name)	Pilot's Licence Nr

who attest(s) that it conforms to -------- (class of aeroplane) and that the simulated systems and subsystems function equivalently to those in that class of aeroplane. This pilot has also assessed the performance and the flying qualities of the BITD and finds that it represents the designated class of aeroplane.

(additional comments as required)

The following tests are outstanding:

It is expected that they will be completed and submitted 3 weeks prior to the evaluation date.

Sincerely,

Print Name
Position/Appointment held.

2 Composition of evaluation team for an initial evaluation

2.1 To gain a qualification, a BITD is evaluated in accordance with a structured routine conducted by a technical team. The team consists of at least:

a. A Technical STD Inspector qualified in all aspects of STD hardware, software and computer modelling and

b. A Flight Inspector, who is qualified in flight crew training procedures and class rated on the class of aeroplane.

2.2 Additionally the following persons should be present:

Sufficient BITD support staff to assist with the running of tests and operations of the instructor‘s operating station.

IEM STD 4A.015 BITD Evaluations
See YCAR-STD 4A.015
See also AMC STD 4A.015

1 General

1.1 During BITD evaluations it will be necessary for the Authority to conduct the objective and subjective tests described in YCAR–STD 4A.030 and detailed in AMC STD 4A.030. There will be occasions when all tests cannot be completed – for example during recurrent evaluations on a convertible BITD – but arrangements should be made for all tests to be completed within a reasonable time.

1.2 Following an evaluation, a number of defects may be identified, generally these defects should be rectified and the Authority notified of such action within 30 days. In case of serious defects, affecting crew training or if any defect remains unattended without good reason for period greater than 30 days, the BITD qualification could be removed.

2 Initial Evaluations

2.1 Objective Testing

2.1.1 Objective testing is centred on the QTG. Before testing can begin on an initial evaluation the acceptability of the Validation Tests contained in the QTG should be agreed with the Authority well in advance of the evaluation date to ensure that the BITD time especially devoted to the running of some of the tests by the Authority is not wasted. The acceptability of all tests depends upon their content, accuracy, completeness and recency of the results.

2.1.2 Much of the time allocated to objective tests depends upon the speed of the manual systems set up to run each test and whether or not special equipment is required. The Authority will not necessarily warn the BITD operator of the sample validations tests which will be run on the day of the evaluation, unless special equipment is required. It should be remembered that normally the objective tests on a BITD are manually flown. Therefore sufficient time should be set aside for the examination and running of the QTG. A useful explanation of how the Validation Tests should be run is contained in the RAeS ‘Airplane Flight Simulator Evaluation Handbook’ (February 95 or as amended).

2.2 Subjective Testing

2.2.1 The Subjective Tests for the evaluation can be found in AMC STD 4A.030, paragraph 3, and a suggested Subjective Test profile is described in sub-paragraph 4.6 below.

2.2.2 Essentially half a working day is required for the Subjective Test routine, which effectively denies use of the BITD for any other purpose.

2.3 Conclusion

2.3.1 To ensure adequate coverage of subjective and objective tests and to allow for cost effective rectification and retest before departure of the inspection team, one working day (i.e. 8 consecutive hours) should be dedicated to an initial evaluation of a BITD.

3 Recurrent Evaluations

3.1 Objective Testing

During recurrent evaluations, the Authority will wish to see evidence of the successful running of the QTG between evaluations. The Authority will select a number of tests to be run during the evaluation, including those, which may be cause for concern, giving adequate notification if special equipment is required.

3.1.2 Essentially the time taken to run the objective tests depends upon the need for special equipment and the test system.

3.2 Subjective Testing

3.2.1 Essentially the same subjective test routine should be flown as per the profile described in sub-paragraph 4.6 below with a selection of the subjective tests taken from AMC STD 4A.030, paragraph 3.

3.3 Conclusion

3.3.1 To ensure adequate coverage of subjective and objective tests during a recurrent evaluation, a total of 4 hours should be allocated. However, it should be remembered that any BITD deficiency, which arises during the evaluation could necessitate the extension of the evaluation period.

3.3.2 The recurrent evaluation may be conducted by one suitably qualified Flight Inspector only, in conjunction with the visit of any Registered Facility or inspection of any Flight Training Organisation, using the BITD.

4 Functions and Subjective Tests – Suggested Test Routine

4.1 During initial and recurrent evaluations of a BITD, the Authority will conduct a series of functions and subjective tests, which together with the objective tests complete the comparison of the BITD with the class of aeroplane.

4.2 Whereas functions tests verify the acceptability of the simulated class of aeroplane systems and their integration, subjective tests verify the fitness of the BITD in relation to training tasks.

4.3 The BITD should provide adequate flexibility to permit the accomplishment of the desired/required tasks while maintaining an adequate perception by the flight crew that they are operating in a real aeroplane environment. Additionally, the Instructor Operating Station (IOS) should not present an unnecessary distraction from observing the activities of the flight crew whilst providing adequate facilities for the tasks.

4.4 Section 1 of YCAR-STD 4A prescribes the requirements and the AMCs in Section 2 the means of compliance for BITD qualification. However, it is important that both the Authority and the BITD operator understand what to expect from the routine of BITD functions and subjective tests. It should be remembered that part of the subjective tests routine should involve an uninterrupted fly-out comparable with the duration of typical training sessions in addition to assessment of flight freeze and repositioning. A description of such a profile is to be found in 4.6 below. A useful explanation of functions and subjective tests and an example of subjective test routine checklist are to be found in the RAeS Airplane Flight Simulator Evaluation Handbook (February 95 or as amended).

4.5 BITD operators who are unfamiliar with the evaluation process are advised to contact a suitably experienced Authority.

4.6 Typical Subjective Test Profile (2 hours - items and altitudes as applicable to BITDs)

- Instrument departure, rate of climb, climb performance
- Level-off at 4 000 ft
- Fail engine (if applicable)
- Engine out climb to 6 000 ft (if applicable)
- Engine out cruise performance (if applicable), restart engine
- All engine cruise performance with different power settings
- Descent to 2 000 ft
- All engine performance with different configurations, followed by ILS approach
- All engine go-around
- Non precision approach
- Go-around with engine failure (if applicable)
- Engine out ILS approach (if applicable)
- Go-around engine out (if applicable)
- Non precision approach engine out (if applicable), followed by go-around
- Restart engine (if applicable)
- Climb to 4 000 ft
- Manoeuvring:
  - Normal turns left and right
  - Steep turns left and right
  - Acceleration and deceleration within operational range
  - Approaching to stall in different configurations
  - Recovery from spiral dive
- Autoflight performance (if applicable)
- System malfunctions
- Approach

AMC STD 4A.025 Operator's Quality System
See YCAR-STD 4A.025

1 Introduction

1.1 In order to show compliance with YCAR-STD 4A.025, a BITD operator should establish his Quality System in accordance with the instructions and information contained in the following paragraphs.

2 Quality Policy

3 A BITD operator should establish a formal written Quality Policy Statement that is a commitment by the Accountable Manager as to what the Quality System is intended to achieve.

The Accountable Manager is someone who by virtue of his position has overall authority and responsibility (including financial) for managing the organisation.

The Quality Manager is responsible for the function of the Quality System and requesting corrective actions.

3 Quality System

3.1 The Quality System should enable the BITD operator to monitor compliance with YCAR-STD 4A, and any other standards specified by that BITD operator to ensure correct maintenance and performance of the device.

3.2 A Quality Manager oversees the day to day control of quality.

3.3 For a small STD operator the position of the Accountable Manager and the Quality Manager may be combined. However, in this event, independent personnel should conduct Quality Audits.

4 Quality Assurance Programme

4.1 A quality Assurance Programme together with a statement acknowledging completion of a periodic review by the Accountable Manager should include the following:

4.1.1 A maintenance facility which provides suitable BITD hardware and software test and maintenance capability.

4.1.2 A recording system in the form of a technical log in which defects, deferred defects and development work are listed, interpreted, actioned and reviewed within a specified time scale.

4.1.3 Planned routine maintenance of the BITD and periodic running of the QTG with adequate manning to cover BITD operating periods and routine maintenance work.

4.1.4 A planned audit schedule and a periodic review should be used to verify that corrective action was carried out and that it was effective. The auditor should have adequate knowledge of BITDs and should be acceptable to the Authority.

5 Quality System Training

5.1 The Quality Manager should receive appropriate Quality System training and brief other personnel on the procedures.

AMC STD 4A.030 BITDs qualified on or after 1 January 2005
See YCAR-STD 4A.030
See also IEM STD 4A.030

Note: The structure and numbering of this AMC departs from normal layout due to the complexity of the technical content and the need to retain harmonisation with FAA AC 120 series.

1 Introduction

1.1 Purpose.

This AMC establishes the criteria, which define the performance and documentation requirements for the evaluation of BITDs, used for training of student pilots.

1.2 Background

1.2.1 The availability of advanced technology has permitted greater use of BITDs for training of student pilots. The complexity, costs and operating environment of modern aircraft also have encouraged broader use of advanced simulation. BITDs can provide more in-depth training than can be accomplished in aeroplanes and provide a safe and suitable learning environment, especially during the instrument rating.

1.2.2 The methods, procedures, and testing standards contained in this AMC are the result of the experience and expertise of Authorities, operators, aeroplane- and STD manufacturers.

1.3 BITD Qualification.

Appendix 1 of YCAR-STD 4A.030 and paragraph 2 of this AMC describe the minimum requirements for qualifying BITDs.

1.4 Terminology and Abbreviations

Terminology and abbreviations of terms used in this AMC are contained in Appendix 1 of YCAR-STD 4A.005 and AMC STD 4A.005.

1.5 Testing for BITD Qualification

1.5.1 The BITD should be assessed in those areas, which are essential to completing student pilot training process. This includes the BITD's longitudinal and lateral directional responses; performance in climb, cruise, descent, approach, cockpit, and instructor station functions checks.

1.5.2 The intent is to evaluate the BITD as objectively as possible. Pilot acceptance, however, is also an important consideration. Therefore, the BITD will be subjected to validation, functions and subjective tests listed in paragraph 2.3 and 3 of this AMC. Validation tests are used to compare objectively BITD and class of aeroplane data to ensure that they agree within specified tolerances. Functions and subjective tests provide a basis for evaluating BITD capability to perform over a typical training period and to verify correct operation of the BITD.

1.5.3 Aeroplane flight test data packages are usually not available; therefore most of the tolerances can only be of the nature of Correct Trend and Magnitude (CT&M) during an initial evaluation. The tolerances listed in this AMC are intended to ensure repeatability for recurrent evaluations.

1.5.4 For initial qualification testing of BITDs validation data will be used. They may be derived from a specific aeroplane within the class of aeroplane the BITD is representing or they may be based on information from several aeroplanes within the class. With the concurrence of the Authority, it may be in the form of a manufacturer's previously approved set of validation data for the applicable BITD. Once the set of data for a specific BITD has been accepted and approved by the Authority, it will become the validation data that will be used as reference for subsequent recurrent evaluations.

1.5.5 The substantiation of the set of data used to build the validation data should be in the form of an engineering report and should show that the proposed validation data are representative of the class of aeroplane modelled. This report may include flight test data, manufacturer's design data, information from the Aeroplane Flight Manual (AFM) and Maintenance Manuals, results and approved or commonly accepted simulations or predictive models, recognised theoretical results, information from the public domain, or other sources as deemed necessary by the BITD manufacturer to substantiate the proposed model.

1.5.6 During BITD evaluation, if a problem is encountered with a particular validation test, the test may be repeated to ascertain if the problem was caused by test equipment or operator error. Following this, if the test problem persists, a BITD operator should be prepared to offer alternative test results, which relate to the test in question.

1.5.7 Validation tests, which do not meet the test criteria, should be addressed to the satisfaction of the Authority.

1.6 Qualification Test Guide (QTG)

1.6.1 The QTG is the primary reference document used for evaluating a BITD. It contains test results, statements of compliance and other information for the evaluator to assess if the BITD meets the test criteria described in this AMC.

1.6.2 The manufacturer should submit a QTG, which includes:

a. A title page with manufacturer/operator and approving Authority signature blocks.

b. A BITD information page (for each configuration in the case of convertible BITDs) providing:

i. BITD model and serial number.
ii. Class of aeroplane being simulated.
iii. Aerodynamic and engine model data revision.
iv. Avionics equipment system identification.
v. BITD manufacturer.
vi. Date of BITD manufacture.
vii. BITD computer identification.

c. Table of contents.

d. Log of revisions and/or list of effective pages.

e. Listing of all references and source data.

f. Glossary of terms and symbols used.

g. Statements of Compliance (SOC) are required to comply with the BITD standards according Appendix 1 to YCAR-STD 4.A.030, table 1. SOC's should refer to sources of AMC STD information and show compliance rationale to explain how the referenced material is used, applicable mathematical equations and parameter values, and conclusions reached.

h. Recording procedures and required equipment for the validation tests.

i. The following items for each validation test designated in par. 2.3 of this AMC:

i. Test Title. This should be short and definitive, based on the test title referred to in par. 2.3 in this AMC.

ii. Test Objective. This should be a brief summary of what the test is intended to demonstrate.

iii. Demonstration Procedure. This is a brief description of how the objective is to be met.

iv. References. These are the aeroplane data source documents including both the document number and the page/condition number.

v. Initial Conditions. A full and comprehensive list of the test initial conditions is required.

vi. Manual test procedures. Procedures should be sufficient to enable the test to be flown by a qualified pilot, using reference to flight deck instrumentation and without reference to other parts of the QTG or other documents.

vii. Evaluation criteria. Specify the main parameter(s) under scrutiny during the test.

viii. Expected result(s), including tolerances and, if necessary, a further definition of the point at which the information was extracted from the validation data.

ix. Test Result. Dated BITD validation test results obtained by the manufacturer from the BITD. Tests run on a computer, which is independent of the BITD, are not acceptable.

x. Source Data. Copy of the validation data, clearly marked with the document, page number, issuing Authority, the test number and title.

xi. Comparison of Results. An acceptable means of easily comparing BITD test results with the validation data. The preferred method is over-plotting.

j. A Statement of Compliance (SOC) covering the functions and subjective tests designated in paragraph 3 below.

1.7 Configuration control.

1.7.1 A configuration control system should be established and maintained to ensure the continued integrity of the hardware and software as originally qualified.

1.8 Procedures for initial BITD Qualification

1.8.1 The request for evaluation should reference the QTG and also include a statement that the STD manufacturer has thoroughly tested the BITD and that it meets the criteria described in this document except as noted in the application form. The manufacturer should further certify that all the QTG checks, for the requested qualification, have been achieved and that the BITD is representative of the class of aeroplane.

1.8.2 A copy of the manufacturer's QTG, marked with test results, should accompany the request. Any QTG deficiencies raised by the Authority should be addressed prior to the start of the on-site evaluation.

1.9 BITD recurrent qualification basis

1.9.1 Following satisfactory completion of the initial evaluation and qualification tests, a periodic check system should be established to ensure that BITDs continue to maintain their initially qualified performance, functions and other characteristics.

1.9.2 The BITD operator should run the complete QTG – which includes validation, functions & subjective tests – between each 3-yearly evaluation by the Authority. The QTG should be run progressively on an annual cycle. Results shall be dated and retained in order to satisfy both the STD operator as well as the Authority that the BITD standards are being maintained.

Note: It is not intended that the complete QTG be run just prior to the 3-yearly recurrent evaluation.

2 BITD Validation Tests

2.1 Discussion.

2.1.1 BITD performance and system operation shall be objectively evaluated by comparing the results of tests conducted in the BITD with the relevant validation data. To facilitate the validation of the BITD, a line printer, or other appropriate recording device acceptable to the Authority should be used to record each validation test result. These recordings should then be compared with the relevant validation data.

2.1.2 Some tests in this paragraph are not necessarily based upon validation data with specific tolerances. However, these tests are included here for completeness, and the required criteria should be fulfilled instead of meeting a specific tolerance.

2.1.3 The QTG provided by the STD manufacturer shall describe clearly and distinctly how the BITD will be set up and operated for each test. It is not the intent, nor is it acceptable, to test each BITD subsystem independently. Overall integrated testing of the BITD should be accomplished to assure that the total BITD system meets the prescribed standards. A test procedure with explicit and detailed steps for completion of each test shall therefore be provided.

2.1.4 The tests and tolerances contained in this paragraph should be included in the STD manufacturer's QTG. Submittals for approval of data other than flight test should include an explanation of validity with respect to available flight test information.

2.1.5 The table of validation tests of this AMC generally indicates the test results required. Unless noted otherwise, BITD tests should represent aeroplane performance and handling qualities at operating weights and centres of gravity (CG) typical of normal operation.

2.2 Test requirements

2.2.1 The flight tests required for qualification are listed in the table of validation tests. Computer generated BITD test results should be provided for each test. The results should be produced on a line printer or other appropriate recording device acceptable to the Authority. Time histories are highly recommended as indicated in the table of validation tests.

2.2.2 Validation data, which exhibit rapid variations of the measured parameters, may require engineering judgement when making assessments of BITD validity. Such judgement shall not be limited to a single parameter. All relevant parameters related to a given manoeuvre or flight condition shall be provided to allow overall interpretation. When it is difficult or impossible to match BITD to validation data throughout a time history, an explanation shall be provided.

2.2.2.1 Parameters, tolerances, and flight conditions. The table of validation tests in paragraph 2.3 below describes the parameters, tolerances, and flight conditions for BITD validation. When two tolerance values are given for a parameter, the less restrictive may be used unless indicated otherwise. If a flight condition or operating condition is shown which does not apply to the qualification, it should be disregarded. BITD results shall be labelled using the tolerances and units specified.

2.2.2.2 Flight condition verification. When comparing the parameters listed to those of the reference aeroplane, sufficient data shall also be provided to verify the correct flight condition. For example, to show the control force is within ±2·2 daN (5 pounds) or ±20% in a flap change force test, data to show correct airspeed, power, aeroplane configuration, altitude, and other appropriate datum identification parameters should also be given. If validating short period dynamics, normal acceleration shall be used, but airspeed, altitude, control input, aeroplane configuration and other appropriate data shall also be given. All airspeed values should be clearly annotated as to indicated, calibrated, etc., and like values used for comparison.

2.2.2.3 Where the tolerances have been replaced by 'Correct Trend and Magnitude' (CT&M), the BITD shall be tested and assessed as representative of the class of aeroplane to the satisfaction of the Authority. To facilitate future evaluations, sufficient parameters should be recorded to establish a reference and to ensure repeatability.

2.3 Table of validation tests

Most of the tests within the QTG have numerical tolerances and "Correct Trend and Magnitude" (CT&M). Where CT&M is used as tolerance for initial qualification, it is strongly recommended that an automatic recording system be used to footprint the baseline results during initial evaluation (column I in the table below). The numerical tolerances shall avoid the effects of possible divergent subjective opinions during recurrent evaluations (see column R in the table below).

Numerical tolerances for initial evaluations shall be used for all tests where numerical data out of an Aeroplane Flight Manual from a reference aeroplane are available.

The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. It is imperative that the specific characteristics are present. An incorrect effect would be unacceptable (e.g. if the validation data show positive spiral stability, it would not be acceptable to exhibit neutral or even negative spiral stability).

	Test	Tolerance	Flight Condition	Comments	I	R
1.	**PERFORMANCE**					
a.	**Climb**					
(1)	Normal climb all engines operating	±3 kt IAS ±5% or ±100 fpm ROC	Climb	Gear up, take-off flaps	✓	✓
(2)	One engine inoperative second segment climb	±3 Kt IAS ±5% or ±100 fpm ROC	Climb	Gear up, take-off flaps Multi engine aeroplane only	✓ C T & M	✓ ✓
b.	**In flight**					
(1)	Stall warning	±3 Kt IAS ±2° bank	Climb and approach	Gear up, take-off flaps and normal approach configuration	✓	✓
c.	**Engines**					
(1)	Acceleration	±10% time or ±1 sec	Approach or landing	Time from power lever idle position up to 90% of go-around power following slam opening of the power lever	C T & M	✓
(2)	Deceleration	±10% time or ±1 sec	Ground / take-off	Time from power lever max take-off power to idle over a power decay of 90% after abrupt reduction of power lever to idle.	C T & M	✓
2.	**HANDLING QUALITIES**					
a.	**Static control checks**					
(1)	Column position vs. force	±2·2 daN (5 lb) or ±10% force	Cruise or approach	Control forces and travel shall broadly correspond to that of the replicated class of aeroplane	C T & M	✓
(2)	Wheel position vs. force	±1·3 daN (3 lb) or ±10% force	Cruise or approach	Control forces and travel shall broadly correspond to that of the replicated class of aeroplane	C T & M	✓
(3)	Pedal position vs. force	±2·2 daN (5 lb) or ±10% force	Cruise or approach	Control forces and travel shall broadly correspond to that of the replicated class of aeroplane	C T & M	✓
(4)	Pitch trim calibration	±1° of trim angle	Ground	Only applicable if appropriate trim settings are available, e.g. data from the AFM.	C T & M	✓
(5)	Alignment of power lever angle vs. selected engine parameter	±5% or ±2 cm (0·8") of power lever angle	Ground	In case of adjustable propeller powered aeroplane, this test is also applicable for the propeller lever.	✓	✓

	Test	Tolerance	Flight Condition	Comments	I	R
b.	**Dynamic Control Checks**			not applicable		
c.	**Longitudinal**					
(1)	Power change force or power change dynamics	±2·2 daN (5 lb) or ±10% force ±3 Kt IAS ±100 ft altitude ±1·5° or ±20% pitch	Cruise or approach Cruise or approach	Time history of uncontrolled free response recommended for a time increment of 5 sec before and 15 sec after any control input.	C T & M C T & M	✓ ✓
(2)	Flap change force or flap change dynamics	±2·2 daN (5 lb) or ±20% force ±3 Kt IAS ±100 ft altitude ±1·5° or ±20% pitch	Climb and approach Climb and approach	Time history of uncontrolled free response recommended for a time increment of 5 sec before and 15 sec after any control input.	C T & M C T & M	✓ ✓
(3)	Gear change force or gear change dynamics	±2·2 daN (5 lb) or ±20% force ±3 Kt IAS ±100 ft altitude ±2° or ±20% pitch	Take-off and approach Climb and approach	Time history of uncontrolled free response recommended for a time increment of 5 sec before and 15 sec after any control input.	C T & M C T & M	✓ ✓
(4)	Gear and flap operating times	±3 sec or ±10% of time	Take-off and approach		C T & M	✓
(5)	Longitudinal trim	±2° pitch trim ±2° pitch ±5% power	Cruise and approach	May be a series of snapshot tests.	C T & M	✓
(6)	Longitudinal manoeuvring stability (stick force / g)	±2·2 daN (5 lb) or ±10% force	Cruise and approach	Test at approx. 20° bank for approach and 30 to 45° bank for cruise configuration.	C T & M	✓
(7)	Longitudinal static stability	±2·2 daN (5 lb) or ±10% force	Approach		C T & M	✓
(8)	Phugoid dynamics	10% period with representative damping	Cruise	Test should include at least 3 full cycles. Time history recommended.	C T & M	✓

	Test	Tolerance	Flight Condition	Comments	I	R
d.	**Lateral directional**					
(1)	Minimum control speed air (V_{mca})		Take-off	It is important that there exists a realistic relationship between V_{mca} and V_s for all configurations and in particular the most critical full-power engine-out take-off configuration. Multi engine aeroplane only.	C T & M	C T & M
(2)	Roll response (rate)	±10% or ±2°/sec roll rate	Cruise and approach	Test with normal wheel deflection (about 30% of maximum wheel). Time history of uncontrolled free response recommended for a time increment of 5 sec before and 15 sec after any control input.	C T & M	✓
(3)	Spiral stability	Correct trend and ±2° or ±10% bank in 20 sec	Cruise	Time history of uncontrolled free response recommended for a time increment of 5 sec before and 20 sec after any control input. Test for both directions required.	C T & M	✓
(4)	Rudder response	±2°/sec or ±10% yaw rate or heading change	Approach	Test with a step input of approx. 25% of full rudder travel. Time history of uncontrolled free response recommended for a time increment of 5 sec before and 15 sec after any control input.	C T & M	✓
(5)	Steady heading sideslip	For a given rudder position: ±2° bank ±1° sideslip. ±10% or ±5° wheel position	Approach	May be a series of snapshot tests using at least two rudder positions in both directions.	C T & M	✓
3.	**TRANSPORT DELAY**					
a	**Transport delay**					
(1)	Instrument response time	300 ms or less		One test for each axis	✓	✓

Test		Tolerance	Flight Condition	Comments		
					I	R
4.	**SOUND SYSTEM**					
a	**Aeroplane system sound**					
(1)	Engine and propeller sound			On a multi engine BITD propeller synchronisation should be possible by means of audio awareness	C T & M	C T & M

3 Functions and Manoeuvres

Functions Tests will be run in a logical flight sequence at the same time as performance and handling assessments. This also permits real time BITD running for around 2 hours, without repositioning or flight or position freeze, thereby permitting proof of reliability.

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	Comments
1. PREPARATION FOR FLIGHT **a. Pre-flight** Accomplish a functions check of all switches, indicators, systems and equipment at student pilots' and instructor's stations and determine that the design and functions represent those of the simulated class of aeroplane.	
2. SURFACE OPERATION (pre-take-off) **a. Engine Start** (i) Normal start **b. Taxi**	Not applicable
3. TAKE-OFF **a. Normal** **b. Abnormal / Emergency**	Sufficient to commence the airborne exercises. Not applicable
4. CLIMB **a. Normal** (i) Landing gear and flap operation (ii) Constant speed climb (iii) Climbing turns **b. One engine inoperative** (i) Yaw moment (ii) Climb performance	multi engine aeroplane only
5. CRUISE **a. Performance characteristics** (i) Straight and level flight (ii) Change of airspeed	Speed vs. power / configuration and attitude

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		Comments
6.	**MANOEUVRES**	
a.	**Approach to stall**	
(i)	Stall warning in climb, cruise, approach and landing configuration	Horn or light
b.		
(i)	**Turns**	
(ii)	Normal turns with 20° to 30° of bank	
(iii)	Standard rate turns	
	Spiral dive recovery	
c.		multi engine aeroplane only
(i)	**Manoeuvring with one engine inoperative**	
(ii)	Standard rate turns	
(iii)	Performance	
	Power changes	
7.	**DESCENT**	
a.	**Normal**	
(i)	With constant speed and rate	
(ii)	Descending turns	
8.	**INSTRUMENT APPROACHES**	One approach shall be flown with one engine inoperative if applicable.
a.	**Precision approaches**	
b.	**Non precision approaches**	NAV equipment failure shall be demonstrated
(i)	NDB / VOR	
9.	**MISSED APPROACHES**	
a.	**All engines**	
b.	**One engine inoperative**	multi engine aeroplane only
10.	**ANY FLIGHT PHASE**	
a.	**Aeroplane systems operation**	
(i)	Communications	
(ii)	Electrical	
(iii)	Engine, fuel and oil	
(iv)	Other systems	As applicable
b.	**Radio Navigation Procedures**	
(i)	VOR intercept and tracking	Also cone of silence
(ii)	NDB intercept and tracking	Dip if programmed
(iii)	Holding procedures	
(iv)	Checking the DME	
(vi)	Checking beam-width of VOR and LOC	
c.	**Effect of wind**	

IEM STD 4A.030 Guidance on Design and Qualification
See YCAR–STD 4A.030
See also AMC STD 4A.030

1 Background

1.1 Traditionally training devices used by the ab-initio pilot schools have been relatively simple instrument flight-only aids. These devices were loosely based on the particular school's aeroplane. The performance would be approximately correct in a small number of standard configurations, however the handling characteristics could range from rudimentary to loosely representative. The instrumentation and avionics fit varied between basic and very close to the target aeroplane. The approval to use such devices as part of a training course was based on a regular subjective evaluation of the equipment and its operator by an Authority inspector.

1.2 YCAR-STD 3A introduces two new devices, where the FNPT I device is essentially a replacement for the traditional instrument flight ground training device taking advantage of recent technologies and having a more objective design basis.

1.3 YCAR-STD 4A sets the requirements and guidelines for the lower level of STDs by introducing BITDs. It should be clearly understood that a BITD never can replace an FNPT I. The main purpose of a BITD is to replace an old instrument training device which cannot be longer approved either due to poor fidelity or system reliability.

2 Design Standards

2.1 Unlike flight simulators, a BITD is intended to be representative of a class of aeroplane. The configuration chosen should broadly represent the aeroplane likely to be used as part of the overall training package. It would be in the interest of all parties to engage in early discussions with the Authority to broadly agree a suitable configuration, known as the 'designated aeroplane configuration'.

2.2 The student pilot station should be broadly representative of the designated aeroplane configuration and should be sufficiently enclosed to exclude any distractions.

2.3 The main instrument panel in a BITD may be displayed on a CRT. Touch screen or mouse and keyboard operation by the student pilot would not be acceptable for any instrument or system.

3 Validation Data

3.1 The data used to model the aerodynamics and engine(s) should be soundly based on the designated aeroplane configuration. It is not acceptable if the models merely represent a few key configurations.

3.2 Recognising the cost and complexity of flight simulation models, it should be possible to generate a generic class typical model. Such models should be continuous and vary sensibly throughout the required training flight envelope. A basic principal for any modelling is the integrity of the mathematical equations and models used to represent the flying qualities and performance of the class of aeroplane simulated. Data to tune the generic model to represent a more specific aeroplane can be obtained from many sources without recourse to expensive flight test:

a. Aeroplane design date

b. Flight and Maintenance Manuals

c. Observations on ground and during flight

Data obtained on ground or in flight can be measured and recorded using a range of simple means such as:

a. Video

b. Pencil and paper

c. Stopwatch

d. New technologies like GPS etc.

Any such data gathering should take place at representative masses and centres of gravity. Development of such a data package including justification and the rationale for the design and intended performance, the measurement methods and recorded parameters should be carefully documented and available for inspection by the Authority as part of the qualification process.

4 Limitations

A force cueing system may be spring-loaded. But it should be remembered that it is vitally important that negative characteristics would not be acceptable.

5 Testing and Evaluation

To ensure that any device meets its design criteria initially and periodically throughout its 'life' a system of objective and subjective testing will be used. The subjective testing may be similar to that in use in the recent past. The objective testing methodology is drawn from that used currently on higher level training devices.

The validation tests specified in AMC STD 4A.030, par. 2.3 can be flown by a suitably skilled person and the results recorded manually. However a print out of the parameters of interest is highly recommended, thereby increasing the repeatability of the achieved results.

The tolerances specified are designated to ensure that the device meets its original target criteria year after year. It is therefore important that such target data is carefully derived and values are agreed with the inspecting Authority in advance of any formal qualification process. For initial qualification, it is highly desirable that the device meets its design criteria within the listed tolerances, however the tolerances contained in this document are specifically intended to be used to ensure repeatability during the 'life' of the device and in particular at each recurrent Authority evaluation.

Most of the tests within the QTG had their tolerances reduced to Correct Trend and Magnitude (CT&M). The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the device should be approximate and representative of the simulated class of aeroplane and should under no circumstances exhibit negative characteristics. In all these cases it is strongly recommended to print out the baseline results during initial evaluation thereby avoiding the effects of possible divergent subjective opinions during recurrent evaluations.

The subjective tests listed under AMC STD 4A.030, par. 3, functions and manoeuvres, should be flown out by a suitably qualified and experienced pilot. Subjective testing will not only review the interaction of all the applicable systems but the integration of the BITD within a training syllabus, including:

a. Training environment

b. Freezes and repositions

c. Navaid environment

In parallel with this objective and subjective testing process it is envisaged that suitable maintenance arrangements as part of a Quality System are in place. Such arrangements will cover routine maintenance, the provision of satisfactory spares supply and personnel.

6 Additional Information

Unlike with other STDs the manufacturer of a BITD has the responsibility for the initial evaluation of a new BITD model. Because all serial numbers of such a model are automatically qualified, the user approval at the operator's site becomes more important before the course approval is granted.