

**REQUIREMENTS FOR THE USE OF GLOBAL NAVIGATION
SATELLITE SYSTEMS (GNSS) PROCEDURES UNDER
INSTRUMENT FLIGHT RULES (IFR)**

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PART I: INTRODUCTION

The requirements in this appendix relate to use of GNSS as a primary means of navigation system for GNSS terminal and *en route* navigation and non-precision instrument approaches, including Lateral Navigation, non-precision instrument approaches both with and without Vertical Navigation (LNAV/VNAV) and shall apply to the use of GNSS as a RNAV primary means navigation system for terminal and *en route* navigation and non-precision instrument approaches if the applicable RNAV conditions and requirements specified in other State regulations are less restrictive than those prescribed in these Regulations.

The requirements do not apply to the use of GNSS under VFR and IFR as a sole means navigation system.

PART II: AIRWORTHINESS REQUIREMENTS

1. The airworthiness requirements prescribed in this Chapter shall apply to GNSS equipment and the installation of such equipment that is intended for VFR and IFR use on any aircraft registered in Kenya.
2. Classes of GNSS equipment are defined by reference to the levels of Global Positioning System (GPS) services they support and equipment shall be approved according to the following classes:
 - i). Class A – equipment incorporating both the GPS sensor and navigation capability, including Receiver Autonomous Integrity Monitoring (RAIM):
 - (a) Class A1 – en route, terminal and non-precision approach, other than localiser, Localiser Directional Aid (LDA) and Simplified Directional Facility (SDF), navigation capability;
 - (b) Class A2 – en route and terminal navigation capability only;
 - ii). Class B – equipment consisting of a GPS sensor, which provides data to an integrated navigation system:
 - (a) Class B1 – en route, terminal and non-precision approach, other than localiser, LDA and SDF, navigation capability;
 - (b) Class B2 – en route and terminal navigation capability only, providing RAIM;
 - (c) Class B3 – en route, terminal and non-precision approach, other than localiser, LDA and SDF, navigation capability, which equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to that provided by RAIM;
 - (d) Class B4 – en route and terminal navigation capability only, which equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to that provided by RAIM;

- iii). Class C – equipment consisting of a GPS sensor that provides data to an integrated navigation system that in turn provides guidance to an auto-pilot or flight director in order to reduce Flight Technical Error (FTE):
 - (a) Class C1 – en route, terminal and non-precision approach, other than localiser, LDA and SDF, navigation capability, providing RAIM;
 - (b) Class C2 – en route and terminal navigation capability only, providing RAIM;
 - (c) Class C3 – en route, terminal and non-precision approach, other than localiser, LDA and SDF, navigation capability, which equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to that provided by RAIM;
 - (d) Class C4 – en route and terminal capability only, which equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to that provided by RAIM.
- iv). Class C equipment shall be limited to installations in large aeroplanes approved for use in domestic and international commercial air transport operations.

3. GNSS equipment shall be approved according to the following criteria:

- (a) For multi-sensor navigation systems using GPS inputs, the requirements contained in Federal Aviation Administration (FAA) Advisory Circular (AC) 20-130A (Airworthiness Approval of Navigation for Flight Management Systems integrating Multiple Navigation Sensors) or equivalent requirements; and
- (b) for Class A equipment –
 - (i) the requirements contained in FAA AC 20-138 (Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Navigation System) or equivalent requirements; and
 - (ii) the minimum performance standards contained in FAA TSO-C129a (Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS) or equivalent performance standards.

4. For all classes of equipment, integrity shall be provided by:

- (a) RAIM; or
- (b) an equivalent method, such as by comparison within a multi-sensor navigation system with other approved sensors.

5. When verifying GNSS equipment accuracy for any installation by means of a flight test evaluation, position information shall be referenced in World Geodetic System (WGS-84) co-ordinates.
6. The following additional criteria shall apply to any Class A equipment installation:
 - (a) Where other navigation sources, apart from Class A equipment, provide display or guidance to an auto-pilot or flight director, means shall be provided for –
 - (i) a navigation source selector as the only means of selection;
 - (ii) clear annunciation of the selected navigation source;
 - (iii) display guidance information appropriate to the selected navigation source; and
 - (iv) guidance information to an auto-pilot or flight director appropriate to the selected navigation source;
 - (b) annunciation for an auto-pilot or flight director and navigation source shall be consistent and compatible with the original design philosophy of the cockpit;
 - (c) loss of navigation capability shall be indicated to the flight crew;
 - (d) if altitude input is used, loss of altitude information shall be indicated by the equipment;
 - (e) installation configuration features provided by the equipment, which affect airworthiness or operational approval, such as –
 - (i) external Course Deviation Indicator (CDI) selection;
 - (ii) external CDI calibration;
 - (iii) entering of GNSS antenna height above ground;
 - (iv) serial Input/Output port configuration; or
 - (v) reference datum,
 shall not be selectable by the pilot;
 - (f) instructions on the manner in which to configure the equipment for the particular installation shall be listed in the appropriate manual;
 - (g) controls, displays, operating characteristics and pilot interface to equipment shall be assessed in relation to flight crew workload, particularly in the non-precision approach environment, in which case the FAA checklist concerning the pilot system interface characteristics (DOT/FAA/AAR-95/3) or an equivalent checklist, shall be applied for approval purposes.
- 7** An application for any initial airworthiness approval of GNSS equipment shall be made in accordance with the requirements prescribed for type certification or supplemental type certification.

PART III: MAINTENANCE REQUIREMENTS

8 The maintenance requirements prescribed in this Chapter shall apply to any follow-on installation of GNSS equipment intended for VFR and IFR operations on any aircraft registered in Kenya.

9 i) No person shall, without the prior written approval of the Director General, carry out a follow-on GNSS equipment installation limited to VFR use only.

ii) Before the approval of the Director General is considered for the follow-on installation referred to in sub-regulation (1), the person who applies for the installation, shall comply with the following requirements:

(a) The applicant shall provide the Director General with proof that the installation generally conforms to the appropriate methods, techniques and practices contained in FAA AC 20-138 (Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Navigation System), or equivalent methods, techniques and practices;

(b) the applicant shall provide the Director General with proof of the following assessments:

- (i) A review of the equipment installation in the aircraft;
- (ii) Verification that the equipment is appropriate to the aircraft environment in which it is installed;
- (iii) verification that the installation of the equipment, including the antenna, is sufficient to meet all structural mounting, dynamic and emergency landing loads appropriate to the aircraft; and
- (iv) Verification that the equipment installation does not interfere with the normal operation of other equipment installed in the aircraft;

(c) the applicant shall provide the Director General with a certification from the manufacturer of the equipment to confirm that the following *en route* and terminal accuracy requirements have been complied with:

(i) The total position fixing error of the airborne equipment shall be equal to or less than the following:

Error Type	Oceanic/Remote (nmi)	<i>En route</i> Domestic (nmi)	Terminal (nmi)	Non-Precision Approach* (nmi)
Position fixing error**	0.124	0.124	0.124	0.056
CDI centering***	0.2	0.2	0.2	0.01

* Non-precision approach criteria only apply to Class A1 equipment

** Equipment error assumes an average Horizontal Dilution of Precision (HDOP) of 1.5, equipment waypoint input resolution of 0.01 minute, and co-ordinate output resolution of 0.01 minute for approach and 0.1 minute otherwise

*** The maximum difference between the displayed cross-track deviation and the computed cross-track deviation

(ii) the reference datum shall use latitude/longitude values corresponding to the WGS-84 ellipsoid;

(d) the applicant shall provide the Director General with a certification from the manufacturer of the equipment to confirm that the following ground accuracy test requirements have been complied with:

(i) A static ground test shall be conducted to verify that the installed equipment configuration, including the antenna, provides position data which meet the *en route* and terminal accuracy criteria referred to in paragraph (c);

(ii) such test shall cover a continuous period of 24 hours with a maximum sample interval of five minutes;

(iii) if such test is performed by using a representative mock-up configuration, the entire installed equipment configuration, including the antenna, shall consist of the hardware to be used in the installation and be representative of the installed system configuration;

(e) Unless a placard adequately address the required limitations, the applicant shall provide the Director General with a Aircraft Flight Manual (AFM) supplement, which contains at least the following information:

(i) Equipment operating limitations;

(ii) emergency/abnormal operating procedures, if applicable;

(iii) normal procedures for operating GNSS and any interfaced equipment; and

(iv) a general description of the system; and

(f) the applicant shall provide the Director General with the results of a functional flight evaluation, including at least the following:

(i) An evaluation of the installed equipment to verify that it is functioning properly and safely and that it operates in accordance with the manufacturer's specifications;

(ii) an evaluation of the steering response while the auto-pilot or flight director is coupled to the equipment during a variety of

different track and mode changes, including an evaluation of all available display sensitivities;

- (iii) an evaluation to verify that the installation does not adversely affect other onboard equipment, which evaluation may be partially accomplished as a ground test;
- (iv) a validation of the system accuracy by at least five low altitude over-flights of one or more surveyed locations;
- (v) an evaluation of the accessibility of all controls pertaining to the installation; and
- (vi) an evaluation of the visibility of the controls, displays and annunciators relating to the installation during day and night lighting conditions.

10 No person shall, without the prior written approval of the Director General, carry out a follow-on GNSS equipment installation for IFR use.

Before the approval of the Director General is considered for the follow-on installation referred to in sub-regulation (1), the person who applies for the installation, shall comply with the following requirements:

- (a) The applicant shall provide the Director General with proof that the installation generally conforms to the acceptable methods, techniques and practices contained in FAA AC 20-138 (Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System), or equivalent methods, techniques and practices;
- b) the applicant shall provide the Director General with alteration data for the equipment installation;
- (c) the applicant shall provide the Director General with a certification from the manufacturer of the equipment to confirm that the following *en route* and terminal accuracy requirements have been complied with:
 - (i) The total position fixing error of the airborne equipment shall be equal to or less than the following:

Error Type	Oceanic/Remote (nmi)	<i>En route</i> Domestic (nmi)	Terminal (nmi)	Non-Precision Approach* (nmi)
Position fixing error**	0.124	0.124	0.124	0.056
CDI centering***	0.2	0.2	0.2	0.01

- * Non-precision approach criteria only apply to Class A1 equipment
- ** Equipment error assumes an average HDOP of 1.5, equipment waypoint input resolution of 0.01 minute, and co-ordinate output resolution of 0.01 minute for approach and 0.1 minute otherwise
- *** The maximum difference between the displayed cross-track deviation and the computed cross-track deviation

- (ii) the reference datum shall use latitude/longitude values corresponding to the WGS-84 ellipsoid;
- (d) the applicant shall provide the Director General with a certification from the manufacturer of the equipment to confirm that the following ground accuracy test requirements have been complied with:
 - (i) A static ground test shall be conducted to verify that the installed equipment configuration, including the antenna, provides position data which meet the *en route* and terminal accuracy criteria referred to in paragraph (c);
 - (ii) such test shall cover a continuous period of 24 hours with a maximum sample interval of five minutes;
 - (iii) if such test is performed by using a representative mock-up configuration, the entire installed equipment configuration, including the antenna, shall consist of the hardware to be used in the installation and be representative of the installed system configuration;
- (e) the applicant shall provide the Director General with a certification from the manufacturer of the equipment to confirm that the system performance standards contained in FAA TSO-C129a (Airborne Navigation Equipment Using the Global Positioning System (GPS)), or equivalent performance standards;
- (f) the applicant shall, if so required for equipment not produced under a FAA TSO-C129a, or equivalent, authorisation, provide the Director General with a copy of –
 - (i) the equipment data;
 - (ii) the manufacturer’s operating and installation instructions;
 - (iii) a fault analysis for installation;
 - (iv) installation details and/or photographs;
 - (v) structural substantiation;
 - (vi) system wiring diagrams; and
 - (vii) ground test evaluation results;

- (g) the applicant shall provide the Director General with a AFM supplement, which contains at least the following information:
- (i) Equipment operating limitations;
 - (ii) emergency/abnormal operating procedures;
 - (iii) normal procedures for operating GNSS and any interfaced equipment; and
 - (iv) a general description of the system; and
- (h) the applicant shall provide the Director General with the results of a functional flight evaluation, including at least the following:
- (i) An evaluation of the overall operation of the equipment, including the ability–
 - to readily create and modify a flight plan;
 - to perform "DIRECT TO" functions;
 - to hold at a designated waypoint;
 - to intercept and track to or from a waypoint on a selected course;
 - to turn anticipation, waypoint sequencing and the general presentation of navigational data, depicting, among other, the "TO" waypoint, distance to waypoint, estimated time of arrival, estimated time *en route* and ground speed;
 - (ii) a review of various failure modes and associated annunciations, such as loss of electrical power, loss of signal reception, equipment failure and auto-pilot or flight director response to GNSS flags;
 - (iii) an evaluation of steering response while the auto-pilot or flight director is coupled to the equipment during a variety of track and mode changes, including, as applicable, transition from *en route* to approach transition to approach modes and vice versa and an evaluation of all available display sensitivities;
 - (iv) an evaluation of displayed GNSS navigation parameters on interfaced cockpit instruments such as a Horizontal Situation Indicator (HSI), CDI, distance display, Electronic Flight Instrument Systems (EFIS), moving maps and fuel management systems;
 - (v) an assessment of all switching and transfer functions, including electrical bus switching, pertaining to the GNSS equipment installation;
 - (vi) an evaluation to determine satisfactory Electromagnetic Compatibility (EMC) between the GNSS equipment installation

and other onboard equipment, which evaluation may be partially accomplished as a ground test;

- (vii) an evaluation of the accessibility of all controls pertaining to the GNSS equipment installation;
- (viii) an evaluation of the visibility of the controls, displays and annunciators relating to the GNSS equipment installation during day and night lighting conditions;
- (ix) an analysis of crew workload when operating the GNSS equipment in association with other piloting requirements;
- (xi) a validation of GNSS equipment accuracy in each operating mode by at least five low altitude overflights of one or more surveyed locations;
- (xi) a verification of the continuity of navigation data during normal aircraft maneuvering, including holding patterns and turns at up to at least 30 degrees of bank for one minute;
- (xii) a verification that FTE can be maintained at less than 1.0 nmi *en route*, 1.0 nmi for approach transition and 0.25 nmi for approach operating modes both with and without auto pilot or flight director use, as applicable;
- (xiii) for equipment approved for approach, an evaluation of the proper operation of GNSS in the approach environment, including at least –
 - turn anticipation;
 - waypoint sequencing;
 - display sensitivity changes;
 - annunciations;
 - procedure turns at the Final Approach Fix (FAF);
 - holding patterns at the missed approach holding fix;
 - transitions from "TO-FROM" operation to "TO-TO" operation;
 - heading legs after the Initial Approach Fix (IAF) to intercept the final approach course both before and after the FAF; and
 - "DIRECT TO" operation before and after the IAF.

11 An application for the approval of any follow-on installation of GNSS equipment shall be made in accordance with the requirements prescribed for modifications.

12 Each person performing maintenance on GNSS equipment shall –

1. use methods, techniques and practices that –

- (a) are prescribed in the current manufacturer's maintenance manual or Instructions for Continued Airworthiness; or
- (b) are approved by the Director General; and perform the maintenance so as to ensure that the equipment meets all applicable airworthiness requirements.

PART IV: PILOT LICENSING REQUIREMENTS

13 The licensing requirements prescribed in this Chapter shall apply to any instrument rated pilot who wishes to use GNSS equipment in IFR operations on any aircraft registered in Kenya.

14 The holder of an instrument rating who wishes to use GNSS equipment in IFR operations may apply to the Director General to have the appropriate additional privileges of the instrument rating endorsed on his or her pilot licence.

Upon receipt of an application and payment of the prescribed fee, the Director General may endorse the appropriate additional privileges on the pilot licence.

The appropriate additional privilege which may be endorsed on the pilot licence is GNSS.

15 Subject to sub-regulation (2), a current instrument rating authorises the holder to act as pilot-in-command or co-pilot of an appropriate aircraft under IFR.

To exercise the privileges of the rating, the holder shall, if carrying out an instrument approach procedure under IFR, have certified in his or her pilot logbook by a flight examiner that the holder has satisfactorily demonstrated competency on that approach aid or system.

The approach aids or systems that may be endorsed are Automatic Direction-Finder (ADF), Very High Frequency Omni-directional Radio Range (VOR), GNSS, ILS and in the case of GNSS, the class of each GNSS unit demonstrated shall be recorded.

16 For the purposes of regulation 15(2), the pilot shall conduct the approaches under Visual Meteorological Conditions (VMC) until he or she has attained adequate proficiency with all aspects of the GNSS equipment, including the following:

- Utilising the RAIM prediction function;
- proceeding direct to a waypoint in and not in the flight plan;

- inserting an instrument departure procedure (DP) into the flight plan, including setting terminal CDI sensitivity, if required, and the conditions under which terminal RAIM is available for departure;
- inserting the destination aerodrome in a flight plan;
- determining the correct IAF to proceed to when entering a Terminal Movement Area (TMA) and determining the correct altitudes within a TMA;
- executing overlay approaches, in particular "no-FAF" procedure turns and arcs;
- changing to another approach after selecting an approach;
- executing "direct" missed approaches where the route is direct to the first waypoint after the Missed Approach Waypoint (MAWP);
- executing "routed" missed approaches where the route is not direct to a waypoint from the MAWP, including approaches where a course has to be manually inserted and flown;
- entering, flying and exiting holding patterns "manually" with a receiver that normally does the procedure automatically;
- flying a "route" from a holding pattern to another waypoint;
- executing an approach with radar vectors to the final segment;
- indicating the actions required for RAIM failure both before and after the Final Approach Waypoint (FAWP);
- programming a radial and distance from a Very High Frequency Omni-Directional Range (VOR); and
- recovering from sequencing past a waypoint where holding was intended.

1 REGENCY REQUIREMENTS

The holder of a current instrument rating shall not exercise the privileges of the rating unless:

1.1 the holder of the rating, if carrying out an instrument approach procedure under IFR has, within the immediately preceding three months, performed in flight or in an approved flight training device, an authorised instrument approach procedure using a similar type of navigation system; or

1.2 the pilot is conducting an IFR operation under the authority of –

1.2.1 an air operator certificate; or

1.2.2 an air service licence,

where the operator satisfies the Director General that its pilots have an equivalent level of instrument rating competency and the pilot only conducts the IFR operation in an aircraft operated under the authority of the certificate or licence, as the case may be.

For the purposes of sub-regulation (1)(a) –

- i) ILS shall be deemed to be similar types of navigation systems;

- ii) VOR, Non-Directional Radio Beacon (NDB) and localiser shall be deemed to be similar types of navigation systems; and
- iii) in the case of GNSS, only an approach using GNSS shall comply with the requirements in this regulation.

2 TRAINING AIRCRAFT REQUIREMENTS

An aeroplane or helicopter that is used for instrument flight training toward the additional endorsement for GNSS shall be equipped with a GNSS navigation receiver.

CHAPTER V: OPERATIONAL REQUIREMENTS

3 APPLICABILITY

1. The operational requirements –

1.1 prescribed in this Chapter; and

1.2 contained in FAA AC 90-94A (Guidelines for Operators using Global Positioning System Equipment for IFR En Route and Terminal Operations and for Non-Precision Instrument Approaches in the U.S. National Airspace System), or equivalent requirements promulgated and published by the International Civil Aviation Organisation (ICAO), shall apply to the use of GNSS equipment on any aircraft registered in Kenya that is operated under IFR..

2 The operational criteria prescribed in this Chapter and the criteria for constructing RNAV departure procedures contained in FAA Order 8260.44A (Civil Utilization of Area Navigation (RNAV) Departure Procedures) or equivalent criteria shall apply to the use of RNAV systems on any aircraft registered in Kenya that is operated under IFR.

3. The operational criteria –

3.1 prescribed in this Chapter;

3.2 contained in FAA Order 8260.47 (Barometric Vertical Navigation (BARO VNAV) Instrument Procedures Development) or equivalent criteria; and

3.3 contained in FAA Order 8260.48 (Area Navigation (RNAV) Approach Construction Criteria) or equivalent criteria,

shall apply to the use of BARO VNAV systems on any aircraft registered in Kenya, that is operated under IFR.

4 GENERAL REQUIREMENTS

1. The use of GNSS equipment in IFR operations shall be in accordance with the requirements contained in the approved Aircraft Flight Manual (AFM) or

- the approved AFM supplement.
2. The Master Minimum Equipment List (MMEL) or Minimum Equipment List (MEL) of the aircraft shall identify the minimum equipment necessary to satisfy operations using GNSS equipment.
 3. Prior to an IFR flight using GNSS equipment, the pilot shall ensure that the equipment and its installation are approved and certified for the intended IFR operation.
 4. The pilot shall be thoroughly familiar with the GNSS equipment installed in the aircraft and its limitations, including, but not limited to, the following:
 - 4.1 Position orientation while using GNSS equipment;
 - 4.2 the differences between the heading information portrayed on navigational charts and the GNSS navigation display when flying an overlay approach or along an airway;
 - 4.3 the appropriate aeronautical information contained in the GNSS Notice to Airmen (NOTAM); and
 - 4.4 RAIM availability.

5 PILOT QUALIFICATION

1. A pilot shall not carry out an instrument approach procedure under IFR using GNSS equipment unless a flight examiner certifies in the pilot's logbook that competency in the use of that type and model of GNSS unit has been satisfactorily demonstrated.
2. A flight examiner shall endorse a pilot logbook for the class of GNSS unit if the pilot has satisfactorily completed a flight test demonstrating adequate proficiency with all the aspects of the GNSS equipment referred to in regulation 16.

6 USE OF GNSS EQUIPMENT TO FLY PROCEDURES DESIGNED AROUND GROUND BASED NAVIGATION AIDS

1. GNSS-based navigation equipment may be used to fly any part of a conventional instrument procedure that was designed around ground based navigation aids if each of the following requirements have been complied with and verified, as required during pre-flight planning:
 - 1.1 The Director General has approved the use of multi-sensor equipment using GNSS as one sensor or Class A1 equipment for such purpose;
 - 1.2 the Director General or the appropriate authority, as the case may be, has published or authorised a procedure for use with GNSS equipment;
 - 1.3 the published procedure is referenced to WGS-84 co-ordinates;

- 1.4 the navigation database contains current Aeronautical Information Regulation and Control (AIRAC) cycle information on the non-precision approach to be flown;
 - 1.5 the procedure to be flown is retrievable from the database and defines the location of all navigation aids and all waypoints required for the approach;
 - 1.6 the information stored in the database is presented to the flight crew in the order shown on the published non-precision approach placard;
 - 1.7 the navigation database waypoints indicating the procedure cannot be changed by the flight crew;
 - 1.8 the appropriate airborne equipment required for the route to be flown from the destination aerodrome to any required destination alternate aerodrome and for an approach at such aerodrome, is installed in the aircraft and is operational and the associated ground-based navigation aids are operational;
 - 1.9 the procedure is selectable from the navigation database and the coding of the database supports the officially published approach; and
 - 1.10 no part of the procedure involves the use of GNSS equipment to fly a precision approach path.
 - 1.11 Use of GNSS equipment to fly non-precision instrument approach procedures other than GNSS stand-alone procedures shall be restricted to overlay of approaches based on VOR, VOR/DME, NDB, NDB/DME and RNAV.
2. In addition to the requirements referred to in sub-regulation (1), compliance with the published procedure must be checked against raw data from ground-based navigation aids, if –
- 2.1 the RAIM function, or equivalent, is not available; or
 - 2.2 in respect of Class A1 equipment installed in the aircraft, the additional criteria Referred to in regulation 6(4) are not satisfied.
3. All ground-based navigation aids and the associated airborne equipment required for the published approach procedure must be operational.

7 GNSS STAND-ALONE APPROACHES

- 1. A GNSS stand-alone approach, which is based on GNSS equipment without reference to conventional ground-based navigation aids, shall only be conducted subject to the following requirements additional to those referred to in regulation 22:

- 1.1 The RAIM function, or equivalent, is available;
- 1.2 in respect of Class A1 equipment installed in the aircraft, the additional criteria referred to in regulation 6(4) have been satisfied;
- 1.3 the published approach procedure is identified as a GNSS approach;
- 1.4 during the pre-flight planning stage for the IFR flight –
 - 1.4.1 where a destination alternate aerodrome is required, a non-GNSS-based approach procedure is available at the destination alternate aerodrome
 - 1.4.2 where a destination alternate aerodrome is not required, at least one non-GNSS-based approach procedure is available at the destination aerodrome;
 - 1.4.3 predictive RAIM or an equivalent prediction tool is used and the RAIM capability (or equivalent) is available at the destination aerodrome at the expected time of arrival; and
- 1.5 where a take-off or en route alternate aerodrome is required, at least one non-GNSS-based approach procedure is available at the alternate aerodrome.

8 PRE-FLIGHT REQUIREMENTS

In addition to the specific start-up and self-testing procedures for the GNSS receiver as contained in the approved AFM or approved AFM supplement, the pilot shall –

- 1. review the appropriate NOTAM for the underlying approach procedure;
- 2. if an overlay approach requiring an operative ground-based navigation aid is to be executed, ensure that the ground-based facilities upon which the approach is
 - based are operational; and
- 3. include the equipment suffix referred to in regulation 25 in the flight plan.

9 FLIGHT PLANS

- 1. A pilot shall only operate an aircraft under IFR using GNSS equipment as a primary means navigation system if the letter "G" is inserted in the block item 10 on
 - the ICAO flight plan form.
- 2. No person shall enter the letter "G" in the block item 10 on the ICAO flight plan form unless the requirements prescribed in this Chapter have been complied
 - with.

10 DEPARTURES, ARRIVALS, AND INSTRUMENT DEPARTURE AND ARRIVAL PROCEDURES

1. In order to fly published IFR departures, IFR arrivals, instrument departures, and instrument arrival procedures, the pilot shall ensure that:

1.1 the GNSS receiver is set to terminal Course Deviation Indicator (CDI) sensitivity; and

1.2 the navigation routes are contained in the database.

2. For Flight Management System (FMS) equipped aircraft without the capability of manually setting the CDI, the pilot shall fly the departure with a flight director.

3. Helicopter-only GNSS departure procedures shall be flown at 70 knots or less.

11 EN ROUTE DOMESTIC OPERATIONS

The following criteria shall apply to en route domestic operations:

1. The navigation equipment shall be installed and operational to receive the intended ground-based facilities that define the route to be flown to the destination and

any required alternate(s);

2. all ground-based facilities that define such routes, shall be operational;

3. the aircraft shall be equipped with an approved and operational alternate means of navigation appropriate to the route being flown;

4. the alternate means of navigation must be actively monitored if the RAIM capability of the GNSS equipment fails.

12 TERMINAL OPERATIONS

The following criteria shall apply to terminal operations:

1. GNSS equipment may be used to fly all non-precision instrument approach procedures, except localiser, LDA and SDF approach procedures;

2. any required alternate aerodrome shall have an approved instrument approach procedure other than GNSS, which is anticipated to be operational at the estimated

time of arrival;

3. for the Approach Overlay Program, the pilot is not authorised to use GNSS equipment to fly any segment of the instrument approach under IFR weather conditions

unless the following requirements have been complied with:

3.1 The GNSS equipment used to fly any non-precision instrument approach shall be approved and installed in accordance with Chapter II or Chapter III of these Regulations;

- 3.2 the appropriate requirements contained in the approved Aircraft Flight Manual (AFM) or AFM supplement shall be met;
- 3.3 the airborne navigation database shall contain all waypoints for the published non-precision instrument approaches to be flown;
- 3.4 the approach shall not be flown unless such approach is retrievable from the airborne navigation database;
- 3.5 the GNSS equipment shall store all waypoints depicted in the approach to be flown and shall present them in the same manner as the published non-precision instrument approach procedure chart;
- 3.6 all approaches shall be flown in accordance with the approved AFM or AFM supplement and the procedure depicted on the appropriate instrument approach chart;
- 3.7 any required alternate aerodrome shall have an approved instrument approach procedure other than GNSS that is anticipated to be operational at the estimated time of arrival;
- 3.8 the aircraft shall have the appropriate avionics installed and operational to receive such navigational aids;
- 3.9 the pilot shall check the NOTAM(s) to determine the operational status of the alternate aerodrome navigational aids;
- 3.10 any GNSS instrument approach operation outside Kenya shall be authorised by the appropriate authority of the State concerned prior to the operation;

4. upon clearance for the approach by the appropriate Air Traffic Service (ATS) unit, the pilot shall select the appropriate aerodrome, the runway approach procedure and the initial approach fix on the GNSS receiver to determine RAIM integrity for such approach;

5. in the event that GNSS navigation outages are predicted or occur, the pilot shall rely on other approved equipment, delay departure or cancel the flight;

6. if a RAIM failure or status annunciation occurs prior to the FAWP, the approach shall be terminated;

7. if the GNSS receiver does not sequence into the approach mode or a RAIM failure or status annunciation occurs prior to the Final Approach Waypoint (FAWP), the pilot shall not descend to Minimum Descent Altitude (MDA), but shall proceed to the Missed Approach Waypoint (MAWP) via the FAWP, perform a missed approach and contact the appropriate Air Traffic Service (ATS) unit as soon as practicable;

8. if a RAIM flag or status annunciation appears after the FAWP, a missed approach shall be executed immediately.

13 AIRBORNE NAVIGATION DATABASE REQUIREMENTS

1. In order to conduct IFR operations using GNSS equipment, the equipment shall include an updateable navigation database, which conforms to the requirements contained in RTCA Inc. Document RTCA/DO-200 (Preparation, Verification and Distribution of User-Selectable Navigation Databases) or equivalent requirements, to support –
 - 1.1 en route and terminal operations; or
 - 1.2 en route, terminal and non-precision approach instrument approach operations.
2. The database shall be current to fly GNSS approaches and to use GNSS equipment in lieu of NDB and DME and have at least the following characteristics:
 - 2.1 Geographic area of content – i.e., data covering geographic areas where GNSS equipment has been certified for IFR use;
 - 2.2 Database description – i.e., records of location information by latitude and longitude to a resolution of 0.01 minutes or better for the area in which IFR operations are approved;
 - 2.3 Update of data – i.e., waypoint information is provided and updated at regular intervals (such as the AIRAC cycle of every 28 days);
 - 2.4 Geodetic Reference Datum – position information referenced to the WGS-84 is provided.

14 COMMERCIAL AIR TRANSPORT OPERATIONS

The operator of an aircraft approved for use in domestic and international commercial air transport operations, shall, in addition to the operational requirements prescribed in this Chapter, comply with the appropriate provisions of its approved operations specifications.

15 TRAINING PROGRAMME

1. Every operator of an aircraft approved for use in domestic and international commercial air transport operations shall establish and maintain a ground and flight training programme that:
 - 1.1 is designed to ensure that each person who receives training, acquires the competence to perform the person's assigned duties; and
 - 1.2 is approved by the Director General.
2. The operator's ground and flight training programme shall include a detailed syllabus on GNSS and RNAV systems training, comprising the following:
 - 2.1 General training

2.1.2 To qualify for use of RNAV systems on IFR operations, the operator shall have an approved flight crew training and qualifications programme for use of the system.

2.1.3 Flight crew shall have completed the appropriate training and have completed an in-flight check or an equivalent check in an approved synthetic training device.

2.1.4 The qualification check shall be conducted by an approved check pilot.

2.2 Training shall be in the following areas:

2.2.1 Pre-flight;

2.2.2 normal operation of the system;

2.2.3 procedures for manually updating system;

2.2.4 methods of monitoring and cross checking system;

2.2.5 operation in area of compass unreliability;

2.2.6 malfunction procedures;

2.2.7 terminal procedures;

2.2.8 waypoint symbology, plotting procedures, record keeping duties/practices; and

2.2.9 post-flight.

2.3 To qualify for approval to conduct GNSS approaches in IFR, the operator shall have a flight crew training programme approved by the Director General.

2.4 Flight crew shall have completed the appropriate ground and flight training and have completed an in-flight check, or an equivalent check in an approved synthetic training device prior to conducting GNSS approaches.

2.5 This qualification check shall be conducted by an approved check pilot.

2.6 Where pilots are required to use more than one type of GNSS equipment for approach, the operator shall ensure that the training programme addresses the differences between the units, unless the units have been determined by the Director General to be sufficiently similar.

2.7 The operator shall ensure that the ground training includes "hands on" training using a desk top simulator, a computer based simulation of the unit to be used,

a static in-aircraft unit or any other ground training device approved by the Director General for the purpose.

2.8 Ground training: Non-Integrated Receivers

The air operator shall ensure that the training programme candidates are trained to proficiency in each of the elements associated with the following areas:

2.8.1 Knowledge in respect of the following:

2.8.1.1 GNSS, including –

(i) GNSS components and aircraft equipment;

(ii) composition of the satellite constellation;

(iii) the minimum number of satellites required for 2-D and 3-D navigation;

(iv) the basic concept of satellite ranging;

(v) factors affecting the accuracy of GNSS signals;

- (vi) the WGS-84 reference datum and the effect of using any other datum;
 - 2.8.1.2 human factors applicable to the use of GNSS equipment and how errors may be reduced or eliminated;
 - 2.8.1.3 air operator standard operating procedures for using GNSS units;
 - 2.8.1.4 procedures for reporting GNSS equipment problems and database errors.
- 2.8.2 Ability to perform the following operational tasks:
- 2.8.2.1 Select appropriate operational modes;
 - 2.8.2.2 recall categories of information contained in the airborne navigation database;
 - 2.8.2.3 predict RAIM availability;
 - 2.8.2.4 enter and verify user defined waypoints;
 - 2.8.2.5 recall and verify airborne navigation database waypoints;
 - 2.8.2.6 interpret typical GNSS navigational displays including latitude/longitude, distance and bearing to waypoint, Course Deviation Indicator (CDI), Desired Track (DTK), Track Made Good (TMG), Actual Track (TK), cross track error and any other information appropriate for the equipment used;
 - 2.8.2.7 intercept and maintain GNSS defined tracks;
 - 2.8.2.8 determine navigation information appropriate for the conduct of the flight including ground speed (GS), estimated time of arrival (ETA) for next waypoint and destination;
 - 2.8.2.9 recognition of waypoint passage;
 - 2.8.2.10 use of "DIRECT TO" function;
 - 2.8.2.11 link the en route portion of the GNSS flight plan to the approach;
 - 2.8.2.12 conduct Standard Instrument Departures (SIDs), Standard Terminal Arrival Routes (STARs), terminal area procedures and holds;
 - 2.8.2.13 retrieve, verify and conduct GNSS stand-alone approaches; and
 - 2.8.2.14 conduct GNSS missed approaches.
- 2.8.3 Ability to conduct the following operational and serviceability checks:
- 2.8.3.1 Airborne navigation database currency and area of operation;
 - 2.8.3.2 receiver serviceability;
 - 2.8.3.3 RAIM status;
 - 2.8.3.4 CDI sensitivity;
 - 2.8.3.5 position indication; number of satellites acquired and,
 - 2.8.3.6 satellite position information (if available).

2.8.4 Ability to recognise and take appropriate action for all GNSS warnings and messages including, where applicable:

- 2.8.4.1 "LOSS OF RAIM";
- 2.8.4.2 "2-D NAVIGATION";
- 2.8.4.3 "IN DEAD RECKONING MODE";
- 2.8.4.4 "DATABASE OUT OF DATE";
- 2.8.4.5 "GNSS FAIL";
- 2.8.4.6 "BAROMETRIC INPUT FAIL";
- 2.8.4.7 "POWER/BATTERY LOW" or "FAIL";
- 2.8.4.8 "PARALLEL OFFSET ON"; and
- 2.8.4.9 "SATELLITE FAIL".

2.9 Ground training: Receivers Integrated into Flight Management Systems

The operator shall ensure that the training programme candidates are trained to proficiency in each of the elements associated with the following areas:

2.9.1 Knowledge in respect of the following:

- 2.9.1.1 GNSS and theory of operation, including –
 - (i) GNSS components and aircraft equipment;
 - (ii) composition of the satellite constellation;
 - (iii) the minimum number of satellites required for 2-D and 3-D navigation;
 - (iv) the basic concept of satellite ranging;
 - (v) factors affecting the accuracy of GNSS signals; and
 - (vi) the WGS-84 reference datum and the effect of using any other datum; and
- 2.9.1.2 human factors applicable to the use of GNSS equipment and how errors may be reduced or eliminated by maintaining situational awareness.

2.9.2 Ability to perform the following operational tasks:

- 2.9.2.1 predict RAIM availability;
- 2.9.2.2 link en route portion of GNSS flight plan to approach;
- 2.9.2.3 conduct GNSS stand-alone approaches; and
- 2.9.2.4 conduct GNSS missed approaches.

2.9.3 Ability to conduct the following operational and serviceability checks:

- 2.9.3.1 RAIM status;
- 2.9.3.2 CDI sensitivity; and
- 2.9.3.3 number of satellites acquired and satellite position information (if available).

2.9.4 Ability to recognise and take appropriate action for all GNSS warnings and messages including, where applicable:

- 2.9.4.1 "LOSS OF RAIM";
- 2.9.4.2 "2-D NAVIGATION";
- 2.9.4.3 "GNSS FAIL";

- 2.9.4.4 "BAROMETRIC INPUT FAIL"; and
 - 2.9.4.5 "SATELLITE FAIL".
- 2.10 Flight training
- 2.10.1 Pilots shall complete flight training in the use of GNSS for approach and other associated duties for each flight crew position they are authorised to occupy.
- 2.10.2 Flight training may be completed in an aircraft, in an approved synthetic training device that is equipped with the same model of GNSS receiver or on another model of GNSS receiver that has been approved by the Director General as sufficiently similar for flight training purposes that is already installed in the aircraft.
- 2.10.3 Flight training shall be conducted by a designated training pilot who has previously completed the air operator ground training programme approved by the Director General and has demonstrated proficiency in the use of training purposes.
- 2.10.4 Before a pilot is assigned as pilot-in-command of an IFR operation using GNSS for an instrument approach, the following requirements shall be complied with:
- 2.10.4.1 Within the preceding 90 days, whilst under the direct supervision of a designated training pilot, the pilot shall conduct a minimum of ten GNSS approaches of which –
- (i) five approaches are conducted in actual or simulated instrument meteorological conditions (IMC) to the prescribed landing minima;
 - (ii) three approaches including a published missed approach, at least two of which are conducted in actual or simulated IMC; and
 - (iii) two approaches are conducted using different initial approach waypoints (IAWPs);
- 2.10.4.2 completion of all of the requirements listed in paragraph (2.10)(2.10.4)(2.10.4.1) shall be recorded in the pilot's training file together with the following information:
- (i) the registration and type of aircraft (or type of simulator) that was used for the GNSS approaches;
 - (ii) the manufacturer and model number of the GNSS equipment used;
 - (iii) the date, name and number of all approaches conducted (in total) under Instrument Meteorological Conditions (IMC) with missed approaches and from the Intermediate Approach Waypoint (IAWP); and

- (iv) certification by the designated training pilot attesting to the training given to the pilot;
- 2.10.4.3 the pilot shall successfully demonstrate his or her proficiency in GNSS operations as part of a proficiency check or as a separate check ride conducted by an approved operator check pilot or a Civil Aviation Authority (CAA) inspector and shall be certified as proficient; and
- 2.10.4.4 Currency requirements shall be complied with by conducting GNSS instrument approaches during the proficiency check.

16 OPERATIONAL CRITERIA FOR THE USE OF RNAV/BARO VNAV SYSTEMS

1. An aircraft equipped with a RNAV/BARO VNAV system approved for the appropriate level of RNAV/VNAV operations may be used to carry out RNAV/BARO VNAV approaches if:
 - 1.1 The navigation system has a certified performance functioning level equal to or less than 0.3 nm(95 percent probability) that includes:
 - 1.1.1 a GNSS navigation systems that is properly certified for approach operations
 - 1.1.2 a multi-sensor system that uses inertial reference unit(s) in combination with a certified DME/DME or GNSS;
 - 1.2 the RNAV/BARO VNAV equipment is serviceable;
 - 1.3 the aircraft and aircraft systems are appropriately certified for the intended RNAV/BARO VNAV approach operations and the aircraft is equipped with an integrated Lateral Navigation (LNAV) system with an accurate source of barometric altitude; and
 - 1.4 the VNAV altitudes and all relevant procedural and navigational information are retrieved from a navigation database whose integrity is supported by appropriate quality assurance measures.
2. The following factors upon which the vertical navigational performance of the BARO VNAV procedure depends, shall be taken into account:
 - 2.1 Atmospheric effects – atmospheric errors associated with non-standard temperatures;
 - 2.2 along-track position uncertainty – along-track error that may result in an error in the vertical path;
 - 2.3 FTE;
 - 2.4 other system errors – errors such as static source error, non-homogenous weather phenomena and latency defects; and
 - 2.5 blunder errors – errors such as the application of an incorrect or out-of-date altimeter setting either by the ATS unit or the pilot.

3. The pilot shall be responsible for performing and verifying any cold temperature correction that is required for all published minimum altitudes/heights, including the preceding initial and intermediate segments, Decision Altitude/Height (DA/H) and subsequent missed approach heights/altitudes.
4. BARO VNAV procedures shall not be permitted in cases when the aerodrome temperature is below the promulgated minimum aerodrome temperature for the procedure. If the aerodrome temperature is below the promulgated minimum aerodrome temperature for the procedure, a LNAV procedure may still be used if:
 - 4.1 A conventional RNAV non-precision procedure and RNAV/LNAV Obstacle Clearance Altitude/Height (OCA/H) is promulgated for the approach; and
 - 4.2 The pilot applies the appropriate cold temperature altimeter correction to all minimum promulgated altitudes/heights.
5. The pilot shall have current knowledge of operation of the equipment so as to achieve the optimum level of navigation accuracy.
6. BARO VNAV procedures shall only be flown with a current local altimeter setting and the QNH/QFE, as appropriate, set on the altimeter of the aircraft.
7. The pilot shall ensure obstacle clearance by limiting vertical path excursions to a range of less than +30 m (+100ft) and over -15 m (-50 ft) from the VPA.

CHAPTER VI: AIR TRAFFIC SERVICE REQUIREMENTS

17 APPLICABILITY

The requirements prescribed in this Chapter shall apply to ATS units that provide area control services and approach control services related to the Instrument Flight Rule (IFR) use of GNSS equipment on any aircraft registered in Kenya.

18 TRAINING REQUIREMENTS FOR ATS PERSONNEL

Air traffic controllers who provide area control services and approach control services in an ATS unit for purposes of GNSS non-precision instrument approaches, shall have completed training in the following:

1. Description of GNSS;
2. GNSS availability and integrity;
3. current GNSS approvals;
4. the RAIM integrity concept;
5. GNSS equipment airworthiness requirements;
6. GNSS equipment operational requirements;
7. IFR primary means approval;
8. non-RAIM operation requirements;
9. RAIM holes;
10. stand-alone GNSS procedures;
11. overlay GNSS procedures;
12. restrictions on GNSS procedures;

13. GNSS distance information; and
14. lateral separation procedures.

19 TIME

1. An ATS unit shall establish a procedure to ensure that ATS unit clocks and other time recording devices –

1.1 use Co-ordinated Universal Time (UTC) and express that time in hours and minutes of the 24-hour day beginning at 0000 Standard Universal Time (UTS); and

1.2 are correct to within 5 seconds of UTC as determined by reference to a standard time station or GPS time standard.

2. The ATS unit shall establish a procedure to ensure that the correct time, to the nearest half minute, is provided –

2.1 in respect of any aerodrome control service or aerodrome flight information service, to IFR aircraft prior to taxiing or take-off unless arrangements have been made for the pilot to obtain it from other sources; and

2.2 to any aircraft on request.

20 GNSS DISTANCE INFORMATION TO ATS UNITS

1. When a GNSS distance is requested by the appropriate ATS unit, the GNSS derived distance information may be provided to the ATS unit. If RAIM is unavailable and has been unavailable for the preceding ten minutes, then the pilot shall provide Distance Measuring Equipment (DME) derived distance information to the ATS unit. .

2. Notwithstanding sub-regulation (1), if the ATS unit has issued a clearance or requirement to reach a certain level by a GNSS distance, the pilot shall inform the ATS unit if RAIM is not available.

3. When the DME distance is not specifically requested, or when the position of a DME distance is not possible, distance information based on GNSS derived information may be provided, in which case the transmission of distance information shall include the source and point of reference.

4. If a GNSS distance is provided to the ATS unit and RAIM is not currently available, but has been available in the preceding ten minutes, the distance report shall be suffixed "NEGATIVE RAIM".

5. Distance information shall only be provided in relation to published waypoints, unless specifically requested by the ATS unit.

6. Where GNSS distance is requested or provided from a NDB, VOR, DME or published waypoint, the latitude and longitude of the navigation aid or waypoint shall be

derived from a validated database, which cannot be modified by the operator or flight crew.

21 SEPARATION ADJUSTMENT

If RAIM is lost, the accuracy of the GNSS equipment shall be deemed not to meet the required standard for both navigation and the application of Air Traffic Control (ATC) separation, in which case the following procedures for separation adjustment shall apply:

1. Aircraft tracking shall be closely monitored against another onboard system;
2. in controlled airspace, the ATS unit shall be advised if –
 - 2.1 RAIM is lost for periods greater than ten minutes, even if GNSS is still providing position information;
 - 2.2 RAIM is not available when the ATS unit requests GNSS distance or if an ATC clearance or requirement is imposed based on GNSS distance;
 - 2.3 the GNSS receiver is in Dead Reckoning (DR) mode or experiences loss of navigation function, for more than one minute; or
 - 2.4 indicated displacement from track centreline is found to exceed 2 nm, upon which the ATS unit may adjust separation
 - 2.5 cases where subsection 36 (2) applies.;
3. following the re-establishment of RAIM, the ATS unit shall be notified of RAIM restoration prior to using GNSS information in order to allow the ATS unit to re-assess the appropriate separation standards;
4. when advising the ATS unit of the status of GNSS, the phrases “RAIM FAILURE” or “RAIM RESTORED” shall be used.

22 SEPARATION CRITERIA AND MINIMA: LATERAL SEPARATION

1. GNSS distance may be used, in lieu of DME distance, in the provision of lateral separation when:
 - 1.1 both aircraft are flying tracks based on the same navigation aid,
 - 1.2 the GNSS distance reported is from the same navigation aid on which the lateral separation is based, and
 - 1.3 RAIM is operational.
2. Lateral separation may only be applied in accordance with criteria and minima approved by the Director General.

23 NOTIFICATION OF GNSS INCIDENTS

The pilot-in-command, any other flight crew member, operator or owner of an aircraft involved in a GNSS incident within Kenya, or any air traffic service personnel witnessing a GNSS incident, shall, as soon as possible, notify an air traffic service unit of such GNSS incident, and such air traffic service unit shall immediately upon receipt of the notification, notify the Director General in the form prescribed in the Annex.

CHAPTER VII: AERONAUTICAL TELECOMMUNICATIONS REQUIREMENTS

24 APPLICABILITY

The requirements prescribed in this Chapter shall apply to any operator of ground equipment in support of GNSS IFR operations.

25 AERONAUTICAL TELECOMMUNICATIONS SYSTEMS

1. Any person who operates any ground equipment in support of GNSS IFR operations, shall ensure that:

1.1 the equipment is installed, maintained and operated in accordance with the standards specified by the Director General; and

1.2 documentation is maintained that indicates the manner in which compliance with the standards referred to in paragraph (a) is being achieved.

2. Any person who operates any equipment that is part of an aeronautical telecommunications system referred to in sub-regulation (1) shall, at the request of th

Director General provide the Director General with a copy of the documentation referred to in sub-regulation (1)(b).

**Annex
GNSS Incident Report Template**

For ANS Use Only

Occurrence No:						
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ORIGINATOR INFORMATION

Name:

.....
.....

Organisation:

.....
.....

Telephone:

.....
.....

Fax:

.....
.....

E-mail:

.....
.....

GNSS EQUIPMENT INSTALLATION

Aircraft

registration:.....

GNSS Equipment Make/Model:

.....

OCCURRENCE INFORMATION

Geographic location:

Altitude:

.....

Latitude:

Longitude:

.....

Date:

Time (UTC) from:

to:.....

Satellite vehicle numbers, if known (please circle):

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 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40

Total number of
warning

Flight rules

Phase of flight RAIM

satellites available VFR *En route*
..... Yes.....
No..... IFR Terminal
Approach

Brief description of occurrence:

.....

Corrective action (if any):

.....
Assessment of effect on safety of flight or severity of problem:

.....