Certification Scheme for Unmanned Aircraft Systems (CSUAS):

Guidelines for ATEs and Manufactures

Contents

1. Clause specific guidelines for ATEs and Manufacturers

S. No.	Parameter / Characteristics	Compliance Criteria (with Requirements)	Expected Documents/ compliance	Guidelines for ATEs/CBs to mention the conformance for respective requirements	Guidelines for Manufacturers
1	**General**				
1.1	(i) Classification of UAS	Micro / Small / Medium/ Large ● Nano: Less than or equal to 250 grams* ● Micro: Greater than 250 grams and less than or equal to 2 kg ● Small: Greater than 2 kg and less than or equal to 25 kg ● Medium Greater than 25 kg and less than or	Statement	1. Verified from Design documents 2. Provide the statement about referring the MTOW and under which classification it is following 3. Give the reference the of the document in which the statement has been mentioned by the manufacturer. For example, statement can be written as: The “Model Name” falls under small classification, and CB has verified that the according to the MTOW (24 K.G.) its falling under small category. Hence it meets the clause requirements (Specific reference of appropriate document, i.e., name of	Manufacturer should provide the statement in the design document.

		equal to 150 kg ● Large: Greater than 150 kg		document, version number, page number, clause/para number etc.)	
	(ii) Category of the UAS	(a) Aeroplane (b) Rotorcraft (c) Hybrid (A Combination of Aeroplan and Rotorcraft categories)	Statement	Same as above	Same as above
	(iii) Sub Category	(a) RPAS	Statement	Same as above	Same as above
		(b) Autonomous UAS	-	-	-
1.2	Weight	i) Empty weight ● Weight without fuel / battery and without payload. ● Weight with	Weight test Report (From Nabl accredited test lab or in case provided inhouse	Provide the following weight configurations; 1. Empty Weight of the UAV without battery and payload 2. Weight of the battery 3. Weight with integrated engine/battery but no fuel or payload	● Manufacturer to give breakdown of the weights. Drone weight, battery weight, each payload weight and weight of its components. Weight should be mentioned in design document along with tolerance.

		integrated engine / battery but no fuel or payload.	test report, calibration of equipment to be ensured)	4. Weight of payload along with it's accessories like (incase of agri drone pipe, pump, atomizer etc.) After providing above values, give the reference of the weight test report submitted by the manufacturer, The above values have been verified by the CB on stage 2 audit on "date of stage 2 audit" hence the it meets the compliance.	• MTOW should be without any tolerance. • Max all up weight should be with heaviest payload. Its upper tolerance should not exceed MTOW. • Weight measured during Stage-2 as per Annexure-D (preflight check) should not cross MTOW.
		ii) Maximum all up weight ● Weight with maximum fuel/ largest battery and with all compatible payloads (Fixed + Variable)	Weight test report	1. Maximum take of weight of UAV (This will include the "+" value of the tolerance which is defined by the manufacturer) 2. Upto 5 % of the tolerance is allowed in following requirements a. Max. take of weight b. Wight of UAV without battery c. Weight of the battery The above values have been verified by the CB on stage 2 audit	

				on “date of stage 2 audit” hence the it meets the compliance.	
		iii) Relevant CG limits for each configuration.	C.G calculation and analysis report	The following details should be provided The C.G limits as per design: 1. Without payload X Axis: Y Axis: Z Axis: 2. Maximum takeoff weight X Axis: Y Axis: Z Axis: 3. If applicable (different payload) 4. With Configuration 1. X Axis: Y Axis: Z Axis: 5. With Configuration 2. X Axis: Y Axis: Z Axis: The above-mentioned C.G limits has been mentioned in “Reference of the C.G analysis report” submitted by manufacturer and it is in verified by the CB and meets the compliance	• Manufacturer to calculate CG limits in all axes (X, Y & Z) and give details in design documents. • Manufacturer should give CG in each configuration in multiple payloads • CG in various configurations should not cross the defined limits by the manufacturer.
1.3	Type of	Launch and Recovery	Physical Inspection	The “Model name of UAS” is under Rotorcraft or Fixed wing category,	Manufacture should define about the launch and recovery type, VTOL or

	Launch and/or Recovery Mechanism (If installed)	type (as applicable)		i.e. either it will “VTOL”, and it has been inspected during stage 2, no other launch or recovery is used.	other mechanism if applicable, that should be defined in the design documents.
1.4	Dimensions	Wing Span /Max Diagonal Length	Design Document	The following values has been verified 1. Wing Span 2. Max. Diagonal length 3. Propeller Tip to Tip length And give reference of the design document version number. The same values have been witnessed during the stage 2 audit “give the reference of the Stage 2 report of the CB” hence the it meets the compliance of the clause	• Design documents should have CAD drawings with all dimensions of the UAV. • Propeller tip to tip Length & breadth and height from ground to highest point of drone in design document with CAD drawing. • Other dimensions are tip to ground, payload to ground, tip to body, tip to mounting arm, dimension measurements with arm folded etc. • Diagonal length in cases of rotorcraft and Wingspan in case of fixed wing. • Other Dimensions of the Drone as applicable • Manufacturer should provide the UAV dimensions in Top View, Front View and Side View, in-

					case of rotor craft propeller tip to tip diagonal dimensions as well. • Manufacturer should specify dimensional measurement tolerance. Actual measured value and the value as per CAD design should be within this tolerance. • Measurement should be carried out in an accredited lab or the measurement system / tools should have treatability of calibration from a NABL accredited Lab.

1.5	Life of UAS	i) Airframe	Design Documents + If design is outsourced then undertaking + Contact b/w manufacturer and OEM. However manufacture shall be responsible for design compliance.	As per submitted "reference to the documents design/ FEA analysis report" the life of the airframe is "value" hours of operation.
				If applicable: "However, for safety, manufacturer has set a life to "value" hours of operation.
				Verified and accepted by the CB, hence meet the compliance to the clause.
					• Manufacturer should define all Primary Structure Element life in manuals.
					
					Or,
					• Manufacturer to do FEA analysis to determine life of airframe. FEA report should have all information like nodes, meshing, boundary condition, material property, and all other inputs considered in the FEA analysis.
					• It should be listed / explained in the analysis report. Analysis report should have purpose, methodology, explanation of result and importantly final findings / conclusion.
					• FEA analysis data is a theoretical estimation. For safety reason, manufacturer can set a life lesser than the theoretical life.
					
					• Life to be mentioned in Flight and Maintenance manual along with maintenance and overhauling of all components
					
					• Regarding Life of UAS – The maximum life may be calculated using the following logic:
					  • Maximum life of airframe by FEA
					  • Reduce the same for factor of safety of 1.5x

					• Calculate operational life of UAS with respect to other components • If it envisaged that operational life can be extended then the life of critical components overhauling, maintenance and replacement, for such component should be defined (such life extensions shall not be more than defined life of airframe) For further details refer FEA guidelines issued by QCI.
		ii) Engine			

		iii) Battery	Battery R-Number and Life Cycle Test Report	The Battery is registered with BIS with Valid R-Number (Provide R Number). The CB has verified the R-Number on BIS website and having a validity (give validity to-from) The Battery Test for Life cycle has been conducted by Manufacturer and "Value as defined in life cycle test report" has been conducted by the lab i.e. CB has verified the test report hence it meets the clause compliance. "Reference of the design documents and test report"	• In the design document under the heading power plant details of the battery should be mentioned. Details like, voltage, capacity, power, nominal values (of power, voltage, current), cutoff voltage, weight, dimensions, life, photograph showing R number, manufacturers details, number of cells, configurations of the cell connections, etc. • If more than one battery is used then, configuration of the battery connection (series /parallel), the parameters in these configurations should be mentioned in the design document. In case of series, one battery can be used for life cycle test. But for parallel configuration, same configuration should be used for life cycle test. • justification of the calculation arrived for power/voltage/current requirement of batteries should be included in the design document. • Calculation and basis of discharge current for power; energy density (high discharge test) life cycle test should be

					explained in the design documents. • Average Discharge current to be derived from flight test. The same value to be provided to Lab for conducting cycle test. • The test report to have mention of all parameters like charging current, discharge current requested, cutoff voltage requested, the charging, discharge current and cutoff voltage the lab actually tested, configuration of the battery (if parallel), Ah, Wh, duration of discharge till it reaches cutoff voltage in each cycle should be mentioned. • Test report should also mention number of discharge cycle achieved minimum to 80% DoD or above.

		iv) Propeller / Rotor	OEM Data/Design analysis and analysis report	Give reference of the documents and CB has verified the document, The life of propeller of “value” hours. The design analysis is accepted by the CB and meets the requirements of compliance.	• If it is bought out (purchased) item, OEM data sheet should suffice. All data of OEM should be mentioned in the design document. • If propeller design is by the manufacturer, then FEA analysis (same like airframe) and bench test validation report to be submitted in the design document. • Life of propeller to be mentioned in Flight and Maintenance manual. • FEA analysis data is a theoretical estimation. For safety reason, manufacturer can set a life lesser than the theoretical life.

		v) Number of Maximum Permissible Landings	Design analysis and analysis report (All life values should be defined in the manuals as well kindly ensure)	As per submitted "reference to the documents design/ FEA analysis report" the Maximum Permissible Landings is "value". If applicable: "However, for safety, manufacturer has set a maximum permissible landing to "value". Verified and accepted by the CB, hence meet the compliance to the clause.	• Estimation based on actual flight data. Manufacturer should mention details of flight data and how the values has been calculated. Or, • FEA analysis (same like airframe). For analysis all details to be provided clearly in design document. • Life to be mentioned in Flight and Maintenance manual.
1.6	Payloads	Compatible Payload Details	Payload specified documents	Payload configuration and details of the payload is given in "reference to the documents"	• Manufacturer should give details of all payloads. Make, model, purpose, weight, etc. • As far as possible operation of the payload should be explained with the help of a functional / schematic diagram. • In case of agriculture drone and leak proofing requirements – Manufacturers should add a requirement in the user manual so that operator/service provider may

					take care of leakage during operations.
2					
2.1	Speeds	i) Minimum operating speed – the minimum specified operating speed of UAS at standard sea level conditions shall be at least 10% above the actual stall speed	Flight Test/ Incase of rotorcraft it is not applicable Stage 2 Witness test report	The minimum operating speed is not appliable as it is rotorcraft. In case the concept of stall speed is not applicable, the minimum operating speed of the rotor should be considered which is needed for supporting the drone while airborne. In case of fixed wing: The Minimum operating speed is “value in m/s” given the reference of the document, Flying at this minimum speed was witnessed by the CB and give the reference of the CB Stage 2 witness report.	• For rotorcraft stalling speed is not applicable. • In case the concept of stall speed is not applicable, the minimum operating speed of the rotor should be considered which is needed for supporting the drone while airborne. • For fixed wing, stalling speed should be clearly explained in the design document. Manufacturer to explain the stall speed in reference to angle of attack (for fixed wing), lift drag and weight. • Evidence / demonstrate UAS flying at 10% above stall speed.

				Hence submitted documents (flight test and analysis) is verified and accepted i.e., meets the requirements of clause. Environmental condition: Minimum operating Speed:	
		ii) Determine maximum operating speed at standard sea level conditions	Inhouse test report/analysis Stage 2 Witness Test Report	The Maximum operating speed is "value in m/s" given the reference of the document, Flying at this maximum speed was witnessed by the CB and give the reference of the CB Stage 2 witness report. Hence submitted documents (flight test and analysis) is verified and accepted i.e., meets the requirements of clause. Environmental condition: Maximum speed:	• Manufacturer can decide on max operating speed based on the role and usage of the drone. • Software limited max operating speed should be written in the design document. Manufacturer should submit objective evidence of flying the drone at max speed and that the UAS did not breach the max speed.
		iii) Determine that maximum kinetic energy on impact does not exceed 95 KJ at any combination of mass and speed	Max K.E ≯95 KJ Design Documents along with calculation	Manufacturer's calculation of K.E. is submitted "reference of the document", as per the calculation K.E. is "value" which is less than 95KJ. Give the reference of the document.	• Manufacturer should do the calculations provide same in design document

2.2	Range	Determine maximum range in still air	Stage 1: Analysis report Stage 2: flight test + logs D1 Values, test values and values during the witness should be same.	Max. Range as per the "document reference" is "value". The documents submitted by the manufacturer is verified and accepted. During the witness assessment the range is "value" is verified as per the 'witness flight test reference'. In case of Night flight "reference of the Night Flight test". And following values Lux Meter readings: Environmental condition: Range: Strobe light visibility: Drone Visibility:	• Theoretical calculation and actual flight data during trial to be mentioned in design document with environmental condition for the testing and flight logs should be in readable format (high resolution) with explanation.
2.3	Endurance	a) Determine fuel and oil consumption and endurance (if applicable)	Stage 1: Analysis report Stage 2: flight test + logs D1 Values, test values and values during the witness should be same.	Max. endurance as per the "document reference" is "value". The documents submitted by the manufacturer is verified and accepted. During the witness assessment the endurance is "value" is verified as per the 'witness flight test reference'. In case of multiple payload,	• Manufacturer to calculate endurance of drone and explain in design document. Objective evidence of endurance test along with readable extract of flight log should be attached in the design document • Manufacturer should provide the endurance with the ▪ Empty payload ▪ With full payload

				The endurance with following configurations, 1. As per configuration one: The AUW is “value” and endurance is “value” 2. As per configuration two: The AUW is “value” and endurance is “value” 3. As per configuration three: The AUW is “value” and endurance is “value”	
		b) Determine endurance of the UAS with fully charged battery.	Stage 1: Analysis report Stage 2: flight test + logs D1 Values, test values and values during the witness should be same.	Max. endurance as per the “document reference” is “value”. The documents submitted by the manufacturer is verified and accepted. During the witness assessment the endurance is “value” is verified as per the ‘witness flight test reference’. In case of multiple payload, The endurance with following configurations, 1. As per configuration one: The AUW is “value” and endurance is “value” 2. As per configuration two:	• Manufacturer to calculate endurance of drone and explain in design document. Objective evidence of endurance test along with readable extract of flight log should be attached in the design document • In case of multiple payloads, endurance should be calculated with each payload and should be mentioned in design documents with extract of flight log.

				The AUW is “value” and endurance is “value” 3. As per configuration three: The AUW is “value” and endurance is “value”	
2.4	Operational altitude	Determine maximum attainable altitude above mean sea level condition as per standard atmospheric conditions	Statement along with flight test logs + Stage 2 witness test	Max. attainable altitude AMSL as per the “document reference” is “value”. The documents submitted by the manufacturer is verified and accepted. During the witness assessment the max attainable altitude AGL is “value” is verified as per the ‘witness flight test reference’. The UAS did not breach the set altitude. In case of multiple payloads, The max. attainable altitude with following configurations, 1. As per configuration one: The AUW is “value” and max. attainable altitude is “value” 2. As per configuration two: The AUW is “value” and max. attainable altitude is “value” 3. As per configuration three: The AUW is “value” and max. attainable altitude is “value” The operational altitude should be restricted up to 400feet and during	• Calculate the max attainable altitude AMSL taking in to consideration all parameters like propeller characteristics, power, and density of air etc. This is also called density altitude. Show the calculation in the design documents. • Mention at what max height AGL has been limited by software. • As per the present scheme, it should not be more than 400ft / 120m. Should not exceed this value. • The UAS should not breach the AGL set altitude. • Attach objective evidence to support the set altitude.

				stage 2 flight test it should not breach the manufacturer defined altitude.	
2.5	Operational envelope	Determine boundaries of operational envelope within which safe flight, in normal and emergency conditions, can be demonstrated under combinations of weight, center of gravity (if applicable), altitude, temperature and airspeed	S1- Design Documents S2- Flight test Manual Boundaries of Operational Envelope - Normal - Emergency With combination of □ Altitude □ Temp □ Airspeed	The operational envelope is explained in “documents name” which has considered both normal and emergency conditions. During the stage 2 the demonstration of the operating envelope have been witnessed in both conditions which are as following, 1. Normal operation: Airspeed condition: Altitude: Operational Temp: Load factor: Operational environment: Etc. etc. 2. Emergency operation: Same as above parameters	• Envelope to be explained in design document. • Load factor, speed, range, altitude, wind velocity, temperature, and humidity

2.6	Ceiling height	Determine ceiling height over a range of weight, center of gravity (if applicable), altitude, temperature and airspeed	Currently restricted to 400 ft S1 Design documents Verification S2- Flight test .	Same as above The ceiling height has been calculated over a range of weight, centre of gravity (if applicable), altitude, temperature and airspeed by the manufacturer and submitted in "document name". however as per the CSUAS Scheme the same has been restricted to 400feet/120M by the manufacturer and defined in "document name" is verified and accepted. During the witness assessment the ceiling height is "value" is verified as per the 'witness flight test reference'.	same as 2.4
2.7	Propeller speed and pitch for safe operation	a) Determine propeller speed and pitch (if multiple/variable pitch props are used or intended to be used in the design) limits that ensure safe operation under normal operating conditions.		The propeller speed and pitch are "values" and defined in the "document name" is verified and accepted.	• Specification sheet of propeller to be provided in Design document RPM vs thrust graph to be plotted by manufacturer in their propeller test bench and verified by ATE. • For propeller integrity, how the propeller has been mounted and made secured should be written in the design document. With max RPM,

					propeller integrity to be checked and verified by ATE • Test procedure and result sheet to be prepared by manufacturer.
		b) Determine integrity of propeller and its mounting at maximum rpm	Bench test	During the witness assessment the bench test have been witnessed as per defined procedure and bench test report "report name" has been submitted, the values observed are as following: "Values"	
2.8	Stability and control	a) Determine that UAS is able to maintain a stable flight without pilot input	Flight Test report with all parameters demonstration with FCS augmented or manual, demonstrations of failsafe features longitudinally, directionally and laterally stable in any condition.	During the witness assessment the UAS is able to maintain the stable flight without pilot inputs and pilot was able to control UAS with ease: The report has been submitted "report name" during the witness the flight trails was conducted with payload "in case of multiple payload use all payload one by one" and demonstration was witnessed in both operating mode Flight Control Systems augmented or Manual (if applicable) which included the failsafe features longitudinally, directionally and laterally stable in any condition normally encountered in service.	• Manufacture needs to define stability in reference to vibration and characteristics of autopilot in design documents. • Explain how stability is achieved by the autopilot. For control, desired graph of Roll, pitch and yaw against actual graph of roll, pitch and yaw is required.

		b) Determine that pilot is able to control UAS with ease.			
3					
3.1	Powerplant (Engine Operated)	a) Determine that fan blade can withstand ultimate load of 1.5 times the centrifugal force resulting from operation	S1 – Design analysis S2- Flight test +logs		
		b) Determine that engine installation is such that it prevents excessive vibration from any part			
		c) Ensure that exhaust is firmly mounted to the structure and free from any obstructions			

		d) Determine that there is no fuel leak in the system under pressure during operational tests on ground			
3.2	Powerplant (Battery Operated)	a) Determine that safe cell temperatures and pressures are maintained during charging / discharging cycle		The R-number “value” is defined in the “document name” by the manufacturer, and ATE is verified on BIS portal, and having validity from: “date” to “date”, During the witness assessment the R-number and BIS logo was verified on the battery and picture has been attached in “Name of the document”.	• For (a), (b), & (c) BIS R Number verification screenshot to be attached in the document. • Map the respective safety requirements of IS 16046 standards. Follow Battery Guidelines updated on QCI website.
		b) Determine that no explosive or toxic gases are emitted in normal operation		Same as above	Same as above
		c) Determine that no corrosive fluid is discharged which may		Same as above	Same as above

		damage the surrounding structures / equipment			
		d) Ensure that motor / motor controller has overcurrent / overheating protection		The over current and overheating protection system has been defined in the “document name”. which is verified during the witness assessment and procedure of the bench was verified as defined in the “document name”, The following values were observed during the bench test, 1. Cut of Current: “value” 2. Cut of Temperature: “value” Hence the overcurrent and overheating protection compliance with the scheme requirements.	• Manufacturer to explain over current overheating protection system incorporated in the design. The current range, temperature range of motor and ESC. How it is ensured that over current and overheating will not take place. Or if it takes place how the protection is provided. • To show that ESC does not allow over current, short circuit (of load) test can be done to show that in short circuit condition also how ESC is limiting the current. • If the manufacturer has taken some design assumptions in respect of over current and overheating, the same to be validated in bench test.
		e)Battery Storage design and installation		The Battery Storage and charging mechanisms are defined in the “document name” and same was verified during the witness assessment.	• Battery storage and charging mechanisms to be defined in design document. Log book for each battery should be available to log charging and usage data. Safety precaution to be observed during

					charging should be mentioned in the battery log book and maintenance/flight manual.
3.2.1	Battery performance (energy, power capability)	Determine rate of discharge of battery as per manufacturers' specifications (C-rate, cut off conditions, Ah and Wh, energy and power density)		The following values were observed in the accredited lab test report "name of document" and original test report was verified during the witness assessment, 1. C-rate: 2. Cut off conditions: 3. Ah: 4. Wh: 5. Energy and power density	As clause 1.5 ii
3.2.2	Battery performance (life cycle)	Determine life cycle up to 80% Depth of Discharge (DoD) for various atmospheric conditions (flying conditions of drone).		The following number of life cycle were observed in the accredited lab test report "name of document", and original test report was verified during the witness assessment: number of life cycle: "value".	As clause 1.5 ii
4					
4.1	Strength requirements	a) Demonstrate that airframe structure shall be able to withstand flight limit loads	load test report	The load test report was submitted by the manufacturer "document name" and during the witness assessment the ATE has verified the original load test report and	• Input to FEA analysis should include environmental condition, limit load. 1.5 factor of safety to be ensured. All

		without failure, malfunction or permanent deformation		successfully demonstrate that UAS is capable to with stand with flight limit load, If possible, write the values of S-N Curve and max. load as per the design document.	inputs /values given for FEA analysis should be justified. • List all PSEs in the design document and also shown in the drawing.
		b) Applicant has to provide analysis of the structure showing that a factor of safety of 1.5 has been used	analysis report + design documents	The manufacturer has submitted the structural analysis along with design documents “documents name respectively”, ATEs has verified the submitted and original report during the witness assessment, hence it’s complied with scheme requirement that 1.5 FoS has been used.	
		c) Determine that each user removable bolt, screw, nut, pin or other fastener whose loss could jeopardize the safe operation of the UAS, shall incorporate a locking device or redundancy.	physical verification	During the witness assessment the ATEs has verified that each user removable bolt, screw, nut, pin or other fastener, whose loss could jeopardize the safe operation of the UAS is as per the scheme compliance.	

		d) Determine that UAS is free from excessive vibrations under any operational speed and power condition.	flight test + log	The Design document which has submitted by the manufacturer “document name” the vibrational limits are as following: 1. In X axis: “Value” 2. In Y axis: “Value” 3. In Z axis: “Value” During the witness assessment the values which has been derived from the flight log after the flight test, “reference of document” and the vibrations are found as following: 1. In X axis: “Value” 2. In Y axis: “Value” 3. In Z axis: “Value” Therefore, the limits are in defined limits, hence it is complied to the scheme requirements.	• Manufacturer to give vibration limits in the design documents. Must explain how they have arrived at the limits. It should be on the basis of substantial flight data. Or, • If it is taken from the autopilot characteristics then should be validated by actual vibration data from flight logs.
		e) Determine that propeller blade clearance is sufficient from structure and/or components, and from ground.	Design document + physical verification	The Design document which has submitted by the manufacturer “document name” the blades clearance is as following: 1. Form the tip to nearest object: “value 2. From the tip to ground is: “value” During the witness assessment the actuals value which has been derived, “reference of document” and are as following: 1. Form the tip to nearest object: “value	• Propeller tip to nearest object and ground clearance. Should be mentioned in design document with drawing showing the clearance and also measured reading as objective evidence.

				2. From the tip to ground is: "value" Therefore, the values are a line with defined values by the manufacturer, hence it is compiled to the scheme requirements.	
4.2	Shock absorbing mechanism of UAS, if applicable	a) It must be shown that the limit load factors selected for design will not be exceeded.	Design document + test		
		b) The landing gear may not fail, but may yield, in a test showing its reserved energy absorption capacity	Design document + test		
5					

5.1	Type of material for construction	The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must: a) be established on the basis of experience or tests;	Material test report	The Material Test report/FEA/Data sheet is submitted by the manufacturer “document name”, the selection of the material is based on their S-N curve and following are the values: 1. Limits load: value 2. Strength of Material: value The original reports have been verified during the witness assessment and found in compliance to the scheme requirements.	• Manufacturer to define their strength requirements, and justification for the same to be given • If standard material used then its data sheet supplied by the material supplier or made available form open source should be acceptable. or, • material test report from NABL accredited lab to be submitted. or • FEA analysis for the materials used for its strength against the requirements.
		The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must: b) meet approved specifications, which will ensure that strength and other properties	Material test report	Same as above	

		assumed in the design data are correct;			
		The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must: c) take into account the effects of environmental conditions, such as temperature and humidity, expected in service.	Material test report	Same as above	
5.2	Fabrication Method	a) Methods of fabrication used must produce consistently sound structures	Manual + verification	The QA/QC process related documents have been submitted by the manufacturer and has been verified during the witness assessment.	• Manufacturer to clearly bring out the manufacturing process followed for the drone under evaluation. The process flow charts, assembly procedure, testing etc. from raw material to finished product should be clearly explained in the documents. The documents should show that these are for

					the UAS model under evaluation. • Manufacturer to explain QA/QC process followed during manufacturing from raw material to finished product. Quality check points, quality check list, quality records etc.
		b) In a fabrication process, such as gluing, spot welding, heat-treating, etc. requires close control, the process must be performed according to an approved process specification.	Manual + verification		In case of fabrication of steel structure, following to be ensured by manufacturer: i) QA process includes WPS, PQR preparation and demonstration of the same during certification audit. ii) Material traceability from raw material to fabricated structure/frame to be established and demonstrated.
		c) Fabrication method must be substantiated by a test program Note: Requirement	Manual + verification		

		of a test program is applicable for a new fabrication method Which is not yet established/ proved in any industry			
5.3	Means of protection against deterioration or loss of strength in operation due to any cause i.e. weathering, corrosion and abrasion.	a) Effect of in-service wear on the loading of critical components should be determined	Lab test	The documents related to the critical component has been submitted by the manufacturer "document name", the details of the components are mentioned which will go under in-service wear, same has been mentioned in the maintenance manual, the justification has been accepted by the ATEs, and same has been verified during the witness assessment report.	• List of critical components should be available in the design as well as maintenance manual. The components which can undergo in-service wear should be clearly mentioned in the design as well as maintenance manual. • Mitigating the problems of critical components or in-service wear at operator level, if applicable, should be identified and mentioned in maintenance manual. Justification for identifying those components should be explained in the design document.
		b) Effect of temperature and moisture should be determined in	Lab test	The test report has been submitted by the manufacturer "document name" and following values has been identified from the report: Temp: value	• Temperature, and humidity test report from NABL lab is sufficient.

		computing the material design values		Humidity: value, Justification “incase the different values has been chosen” is accepted by the ATE and same has been mentioned in the design document “document name”	• However, if the drone has not been tested at -10 to 50 degrees, then manufacturer to give justification as to why a different limit has been chosen.
5.4	Fire resistant identification plate on UAS for inscribing UIN.	a) Determination of ID plate material which should be fire resistant	Fire proof, location + fixture	The design documents/Material report submitted by the manufacturer “document name” which is resistance to the fire as melting temperature is “value” hence it compliance to the scheme requirement.	• ID plate material should be fire resistant. Design drawing should show the location. • Material test report or standard data sheet of the material used should suffice
		b) Determine location of ID plate along with its secure fixing on UAS		The Id plate location as described in the design document “document name”, was verified during the witness assessment, snapshot of the same has been attached in the ATEs report “document name”	Material Test Report of other fire-resistant components to be provided by manufacturer
6					
6.1	Type of data link used for communication (C2 data link, frequency band etc.)	a) Determine full functioning of data link communication	ETA/License ATE to verify ETA certificate and check that the actual transmitter	The ETA details submitted by the manufacturer in the “document name” was verified during the witness assessment, ETA certificate “Number and date”. During the witness assessment the flight test was conducted and following are the results, which has been described in “witness	• Manufacturer should clearly explain the operation of data link used for communication. The details of equipment make, model, specification, various components, ground components, airborne components, details of GCS, how they are interconnected,

			used in the design is same as in the ETA.	assessment report” The following things were observed during the flight test, 1. Data link tested for distance communication in all azimuth angles and maximum altitude and range “values” 2. C2 data link capability for demonstrating flight parameter like, altitude, speed distance battery status signal strength was updated on GCS screen 3. Witness the RTH when data link was lost. 4. The Aural and visual warning was visible and audible from the GCS during the signal lost, The above parameters are submitted in “report name” along with the flight log of same.	how signal / commands are linked to various components. • All these should be clearly explained with the help of a schematic of C2 data link. Details of GCS, model, make, GCS App version, schematic of GCS operation, and various signal channels for interconnection of GCS with other ground-based equipment etc. All these to be given in the design document. • Manufacturer to carry out and submit test report verifying all parameters / functionalities as given in the clause-6. One test report covering all functionalities. Functioning of data link, verification of range, minimum SNR required with various range, measurement of SNR or signal strength in the GCS and ascertaining if it is sufficient, test in all azimuth angle, verification of signal strength for entire duration of flight, implementation of contingency, alert to remote pilot, audio visual warning, sufficiency of communication range, data link loss strategy, in the event of data link loss

					(for how many seconds?) UAS should RTH, etc. • Manufacturer to take screenshot of each and every parameter / test verification and submit in design document.
		b) Demonstration of system to alert the remote pilot with aural and visual signal, for any loss of command and control data link		As per manufacturer claim “document name” the details of aural and visual signal was verified during the witness assessment flight test, and found compliance to the scheme requirements, snapshots/video attached in the “document name”.	
		c) Determine that communication range is sufficient to have a permanent connection with the UAS		As per manufacture claim “document name” the range is “value” but during the witness assessment flight test the test was conducted to the VLoS only and the during that range “value” the signal was not lost, snapshot/video & flight logs has been attached in the report “document name”.	
		d) Determine that when data link is lost or in other contingencies, the UAS follows a predefined		As per the manufacture claim in the “document name”, during the witness assessment flight test, the path was set before the take off and when data link loss was simulated, the UAS waited for “value in second” after that RTL was trigged and UAS followed the	

		path to ensure safe end of flight within the required area restrictions		predefined path and return to the location, Snapshot/video and flight log of same has been attached in the report " document name"	
		e) Determine the capability of system to inform remote pilot by means of a warning signal in the event of data link loss		As per clause "6.1b"	
		f) A command and control data link loss strategy must be established, approved and presented in the UAS Flight Manual		As per manufacture claims "document name" the RTL is executed by the UAS, if C2 link is loss in "value in sec". The same has been verified during the witness assessment flight test and found as per the claim, snapshot/video and flight log attached in the report "document name"	
7					

7.1	Firmware tamper avoidance	a) Protection of onboard computer firmware from tampering (software) UAS should not function if firmware is changed by any procedure other than authorized update procedure.	Document verification + witness ATE to collect code and data checksum and digitally signed point is missing	Firmware security architecture explained in document "……" verified and accepted. Manufacturer has used a private & public key combination to ensure that once firmware uploaded, user cannot tamper. Firmware is therefore, secured using a private & public key combination. Firmware once uploaded cannot be changed unless authorized private key is decrypted based on the code and data checksum provided. Procedure was tested and demonstrated by the manufacturer and tamper proof was verified. Verification report "……" Refers. Copy of the Code & Data Checksums has been provided to CB.	• Manufacturer to give details and explain software architecture used in the UAS. • Details and the methodology of the tamper avoidance system incorporated in the software / firmware should be explained in the design documents. • The public / private key or any other mechanisms implemented in the system should be explained. • User should not have any access to change the flight parameters. It should be clearly defined in the design as well as in flight manual what all operating parameter change is possible at user level. • Manufacturer to explain in design document how system update is made secured. It should be explained if only manufacturer has access to update or user can also do the update. • How change of flight parameter is made secured should be explained in design documents. • Procedure for secured change of parameters should be

					mentioned in the design documents. • Along with the explanations on how it has been implemented, a test report of generating checksum, demonstration of check sum mismatch during unauthorized changes, secured upgrade of firmware, secure change of flight parameters should be attached in the design document. • Screenshot wherever applicable should be included in the report.
		b) Safety and security of firmware update		Manufacturer has explained details of Safety and security of firmware by private & public key combination. Firmware update can be done only through private key – public key pairing and is securely protected. The procedure “document reference” has been verified and verification report attached to Stage-2 report “Document reference”.	
		c) Secure change of flight parameters		Document “document reference No.” submitted has been verified. Manufacturer has used secured process for change of flight parameter.	

				Changing of flight parameters is through an authorized key pair matching process and it has been documented in detail. The keys are hashed using a SHA256 algorithm. Change of flight parameters will not be possible if there is a key mismatch and it can be executed only by the manufacturer. Procedure to securely change flight parameters were demonstrated and verified "verification report No. refers".	
7.2	Hardware Tamper Avoidance	a) Protection of onboard computer from tampering (physical)	Design + Verification ATE to confirm whether any standard tools or special tool recommended by the manufacturer for tampering	Manufacturer has used "write the method used" as hardware tamper proofing mechanism. Procedure for hardware protection has been documented in detail through flowcharts & pictorial representation. The location where all hardware tamper avoidance incorporated has been clearly explaind in "Document".	• Pressure switch / GSM SIM to detect hardware tampering and UAS not arming in such situation or use of void tape to detect hardware tampering or any other credible method is acceptable for hardware tamper proofing. • However, in the design drawing it should be clearly mentioned where all these systems are installed or where all and how many places the void tapes have been put etc.
		b) Mechanism to replace crucial hardware like radio modules,		Detailed SOP on replacement and post replacement functional checks of critical hardware given in "Document" and has been verified and accepted.	

		GPS and flight controller			
8					
8.1	All on-board electrical and electronics equipment's / components	Following are to be complied in respect of all on-board electrical and electronics equipment: i) Adequate source of electrical energy, where electrical energy is necessary for operation of UAS ii) Wiring is installed in such a manner that operation of any equipment will not adversely	V&V	The document submitted by the manufacturer "document name" regarding the all-on board electrical equipment was verified during the witness assessment, ● General wiring lay out ● Wiring carried out as per wiring diagram. ● No loose cable ● Looms are tied ● No kink ● No bend near any sharp edge ● No soldering connection between wires ● Connectors are secured ● Charging connectors for reverse polarity ● General lay out of the systems and wiring. Furthermore the current rating of the wires and connectors used in UAV was also verified and are as	• Manufacturer to prepare a wiring diagram showing electrical interconnection of all components. Manufacturer should include in design document or in the wiring diagram the specification of all cables / wires used, its current carrying capacity, the signal or the current it is carrying etc. Other common points as per this clause should be mentioned in the design documents. • SIL Certification for onboard CRITICAL electronic/electrical components may be sought from manufacturer.

		affect the simultaneous operation of any other equipment iii) Wiring lay out is according to the wiring diagram iv) All wiring is suitable for the current and voltage passing through it. v) No kinks in the wiring exist vi) Wiring routing is not along the sharp edges vii) Soldering connections between cables are not there		following values “values of same” and snapshot/videos are submitted in report “document name”	

		viii) All equipment are connected with adequately secured connections to prevent loosening during vibrations ix) Minimum operating voltage x) Maximum operating current			
	a) Global Navigation Satellite System (GNSS) receivers (if applicable)	Determine whether the capability of GPS receiver meets the requirements and functionality of the UAS		The details of the GPS submitted by the manufacturer in design document "document name" And during the witness assessment flight test, the way point navigation was conducted as per the procedure defined by the manufacturer, the test was found satisfactory and snapshot and flight logs are submitted in report "document name"	• GPS make, model, specifications, accuracy, latency etc. should be mentioned in the design document.

	b) Flashing anti-collision strobe lights Mandatory for Night Flight Operations and Optional for Day Flight Operations	Provision for flashing anti-collision light in the UAS		In case applicable, Kindly provide the night flight test report and following parameters values, which has been verified during the witness assessment flight test report, -How to determine orientation of the UAS at night using the strobe light. -SoP for night flying -How much is the night range -Lux meter reading -Payload during night flying	• Anti-collision light is compulsory for night flying. • If the UAS is for night operation also, then the manufacturer should clearly bring out the following: • How to determine orientation of the UAS at night using the strobe light. • SoP for night flying • How much is the night range • Payload during night flying
	c) Actuators d) Servo controllers e) Other UAS components	Determine whether Actuators, Servo controllers, and Other Components are installed in the UAS			
	f) Geo-fencing capability (Mandatory)	Determine whether Geo-fencing capability has been implemented.		The submitted design document by the manufacturer “document name” The procedure was verified during the flight test in witness assessment,	• How to define the fence should be mentioned in the design document as well as in the flight manual.

				The geo-fence was created before the flight and has been verified via. Manual and automated mode the UAV was not breaching the boundaries which was created before the flight irrespective the pilot was giving command. Snapshot and flight logs attached in report “document name”	• A report of geo-fencing test to be attached as objective evidence.
	g) SSR transponder (Mode ‘C’ or ‘S’) or ADS-B OUT equipment Applicable for UAS intending to operate above 400 feet AGL.	Determine whether UAS has SSR transponder (Mode ‘C’ or ‘S’) or ADS-B OUT equipment. UAVs operating in controlled airspace must have SSR Transponder (Mode C or S) or ADS-B Out equipment.			
	h) Detect and Avoid capability (Optional)	Determine whether Detect and Avoid capability option has	S-1 Documentation review S-2 Flight Test	If applicable, Provide the values of the following parameters, -Make model of the D&A equipment.	Following should be provided in the design document: • Functioning of D&A • Make model of the D&A equipment. • Specification

		been implemented. Detect and Avoid capability is recommended for Drones operating in controlled airspace and for BVLOS category.		-Specification -Range of detection -Sensors used -Principle of operation -FoV the D&A is covering -Test procedure As per the flight test during the witness assessment "Document name"	• Range of detection • Sensors • Principle of operation • FoV the D&A
	i)Flight controller with flight data logging capability	Determine whether UAS has flight controller with flight data logging capability		The data log of the flight test during the witness assessment was verified and attached in report "document name"	
	j) Barometric equipment with capability for remote subscale setting **Applicable for BVLOS operations.**	Determine whether UAS has Barometric equipment with capability for remote subscale setting. Justification: Barometric equipment in			

		drone enables altitude tracking during flying and setting of flight level, altitude (QNH) and height (QFE). Remote subscale settings enable setting these parameters remotely from GCS. Barometric equipment is a safety feature and required for safe operation, maintaining correct altitude separation in high density flying area and in BVLOS operation. Failure to set the appropriate barometric sub-scale			

		pressure may result in a significant deviation from the cleared altitude or Flight Level which is unsafe. Barometric equipment with remote subscale setting is therefore recommended for drones operating in controlled airspace and for BVLOS categories			
	k) RFID and GSM Sim Card (Optional)	Determine whether UAS has provision for RFID and GSM SIM Card			

9					
9.1	Environmental tests	Determine that instruments and equipment withstand the following: a) Effects of voltage spikes from power source;	Test reports	"Provide the lab test report and along the values verified from the test report" In case on board powerplant, The in-house test report submitted by the manufacturer "document name" , The following details is verified from the submitted report 1. Nominal voltage: 'values" 2. Current range at various loading condition: "values" 3. Peak current: value Etc. Same has been verified during the witness assessment and following values observed, 1. Nominal voltage: 'values" 2. Current range at various loading condition: "values" 3. Peak current: value Etc. Snapshot and flight logs attached in report "document name"	• Manufacturer should do the required analysis and, in the conclusion, show that as per the technical analysis voltage spike is not possible. • Power consumption of each component. Manufacturer should provide graph of current and voltage at all flight conditions as a supporting document in the analysis.

		Determine that instruments and equipment withstand the following: b) Susceptibility to HIRF; **Applicable if UAS is intended**	Test reports	If applicable “provide the test report and along the values verified from the test report”	• If the UAS is not designed for operation in HIRF environment, the same should be mentioned in the flight manual.

		to be operated in environment with HIRF			
		Determine that Instruments and equipment withstand the following: c)Temperature and humidity variations;		The test report has been submitted by the manufacturer “document name” and following values has been identified from the report: Temp: value Humidity: value, Justification “incase the different values has been chosen” is accepted by the ATE and same has been mentioned in the design document “document name” During the witness assessment the original test report was verified and found satisfactory	
		Determine that Instruments and equipment withstand the following: d) Shock resistant, etc.		Same as above	

		Determine that instruments and equipment withstand the following: e)Ingress Protection (IP) Certification		Same as above if applicable	• If the UAS is not designed for IP and that manufacturer has not defined the IP code, then the same should be mentioned in the flight manual.
9.2	EMI / EMC test	Determine that each electrical instrument and equipment is protected against EMI coming from the operational environment to ensure normal operation.	Test Report	Same as above	• Drone should be in power on condition during test • Functionality of the Drone before and after test must be check and flight log same has to be given.
9.3	Software	a) Determine impact of loss of function and malfunction of UAS			• Manufacturer to do a risk analysis and bring out the same in design documents. Risk analysis report should show the risks involved due to failure of various software or hardware components, its safety & reliability and the consequences. How to mitigate the risk should also be mentioned.

					• Manufacturer should define statement of independence of software and hardware. Define various components and bring out how failure of one will not affect the operation of others. Details are to be brought out in the design document with explanation in respect of each component. • Manufacturer should define and carry out IV&V of the software and hardware. Report should be part of design documents.
		b) Determine that sufficient independence exists between software components with respect to both function and design			
9.4	Hardware	a) Determination of hardware design life cycle through established quality control procedure,	QC/QA procedure	Same as clause 5.2	• Manufacturer to provide details of internal QA/QC process, quality check points, check list, record of checks in the entire manufacturing process flow starting from the raw material to finished product.

		b)Component performance and reliability to be monitored on a continuous basis.			• Manufacturer should specify and explain component performance and reliability monitoring process. SOP, if applicable should be prepared to enhance the monitoring process effectiveness. • The monitoring process should record all failures encountered, root cause analysis, rectification carried out, remedial measures taken to ensure no future occurrences. This should be at the user level as well as at manufacturer level. Necessary annotation should be there in the maintenance manual also for the user level monitoring. Manufacturer should prepare a flow chart / proforma to monitor the component performance.
10					
10.1	UAS Flight manual	UAS flight manual should contain the following			Flight manual should contain: • List of information as mentioned in the compliance criteria.

		information: 1) Limitations / operating conditions/ operating envelope 2) Normal Procedures, pre-flight checklist, etc. 3) Emergency procedures 4) Performance (at various combination of weight, altitude, temperature and wind conditions) Any other relevant information required for safe operation of UAS			General, how to operate. What to operate. What not to operate. • Do's and Don'ts • Warranty clauses. • Calibration process • Specifications • Brief description of the systems with a schematic • Emergency procedure • About the drone. Operational requirements, how to operate in normal condition, emergency condition • Payload details. What is in box. Installation / removal / filling etc. of pay loads. • Should strictly be version controlled • Any other information as deemed important and useful from users' point of view, operation and safety point of view should be included.

10.2	UAS Maintenance Manual	UAS maintenance manual should consist of the following: 1) Maintenance procedures of the UAS. 2) Continuous Monitoring process for UAS components			• List of information in the compliance criteria • User level maintenance only to be provided in the maintenance manual • List the maintenances for which the user should approach manufacturer. • List or the level of maintenance beyond the scope of user should be mentioned. • Don't provided manufacturer level maintenance in the Maintenance Manual • Life of components to be mentioned in the maintenance manual

10.3	UAS Log book	UAS log book should consist of the following: 1) Provision to maintain UAS Operation Logs 2)Provision to maintain UAS Maintenance Logs			• Logbooks should be as per serial number of the UAS. Each UAS should have its logbook. • Useful and easy to record information should be there in the logbook. • Flight logbook and Maintenance logbook should be separate.
10.4	Other design documents	1. Bill of material and country of origin	Approved by authorized signatory Verified by CB		
		2. Analysis reports			
		3. Test reports			
		4. Detailed drawings			

		5. Consolidated hardware and software independently verified and validated reports			
		6. Material procurement record			
		7.Manufacturing process records			

The following points that ATEs/CBs should keep in mind while processing the case: -

a) Documents should be checked properly by the evaluators
b) Only corrected and version-controlled documents to be submitted with SoC.
c) Data / value/ parameters discrepancy mismatch should not be there across the documents.
d) The Clauses should be correctly interpreted with a focus on reliability and safety of the UAS.
e) All witnessing, demonstrations, testing, trials etc. should be supported by a report generated by manufacturers. All such Stage-2 test reports should be sequentially collated in one document.
f) As many as possible screenshot should be taken as objective evidence.
g) Flight logs extracts should be in a readable format
h) Verification report for stage 2 should be provided with screenshots. Log file with date to be explained
i) Stage 2 reports on ATE letter head to be signed.
j) Annexure D should be signed by ATE

k) SoC, annexure D and stage 2 verification report. To be signed by ATE.
l) MTOW and payload should be clarified to manufacturers
m) SoC page dates should be clear and correct.
n) Compliance matrix should be updated every time when observation raised.
o) Record maintenance procedure to be followed.
p) Details given in the checklist should be from design document.
q) If ATE finds a different value during checks, then that value to be recommended in the SoC check list.

Approval of Flight Manual, Maintenance Manual and UAS Log Book: ***"Manufacturer Name"*** **UAS Model** ***"Model Name"***

Reference Clause: Clause 10.1, 10.2 and 10.3 of UAS Certification Scheme,

Certified that ATE has reviewed Flight Manual, Maintenance Manual and UAS Log Book of *"Manufacturer Name"* UAS Model *"Model Name"* and hereby approve the contents of the said manuals for its applicability. The approval is given as per the provisions of Clause 10.1 for Flight Manual and Clause 10.2 for Maintenance Manual and 10.3 for UAS Log Book.

Name of TL:
Date:
Signature:

Approval of Software Risk Analysis /Independence and validation of IV&V: *"Manufacturer Name"* UAS Model *"Model Name"*

Reference Clause: Clause 9.3 of UAS Certification Scheme,

Certified that ATE has verified Software risk analysis and Software Independence in respect of *"Manufacturer Name"* UAS Model *"Model Name* and the content is hereby approved within the scope of the provisions of Clause 9.3 of the UAS Certification Scheme.

It is also certified that within the provisions of the mentioned clause, the IV&V report submitted by the manufacturer has been validated.

Name of TL:

Date:

Signature:

*****

2. Guidelines for documentation:

2.1. Guidelines for Design Documentation:

2.1.1. Design Document:

- Design documents should be prepared by manufacturer
- Design documents should contain only the design related details and information
- Details of purpose, specifications, functionalities, systems, parts, equipment, components, schematics, explanations, interconnections, integrations, drawings, picture, photographs, etc.
- Essential Elements of Design Documents:
- Design Statements
- Design Assumptions
- Design descriptions
- Design analysis
- Design validation
- Design Conclusion

2.1.2. Preparation of the Design Documents

- 1st write the design information / explanation / justification etc.
- If the internal analysis reports/ test report / objective evidence / drawing / flight log extracts etc. are short description or fit in one page, they should be part of design information
- If the analysis report / internal test report / objective evidence / drawing / flight log extracts etc. runs in to multiple pages, attach them as Appendix at the end of the document
- Mention in the design document about the attached Appendix with page number
- Ensure, that the document writing style/ font/ theme/ manner is followed through out
- All documents prepared should be (Version) controlled, approved by authorized signatory and frozen
- The information should not be written in bullet form and should be in paragraph form
- Each document to be self-contained
- There should not be any reference or word/sentence like “CB, Certification Body, DGCA, QCI, Stage-1, Stage-2, CRM, shall be verified during flight trial, objective evidence, shall be demonstrated, meets the certification requirements, addresses the scheme requirements, Clause Number”, etc.
- These are purely compliance related words and can be used in CRM.

- Use prudence and rational

2.1.3. Content of Design Documents:

a. Design data, analysis, Information's etc.
b. Drawings
c. Analysis Reports
d. Internal Test reports
    i. Flight Test
    ii. Ground Test
e. Objective Evidence
    i. Photographs
    ii. Screenshots
f. External Test Reports
g. Drawings
h. Certificates
i. OEM product information / Leaflet/ Test reports

2.1.4. Drawings:

a. Drawings are design documents
b. Drawing here means Engineering / CAD drawing and not sketches or photographs, outlines etc.
c. Drawings to have various details of applicable information like materials, properties, dimensions, labels, markers, voltage, current, limits etc.
d. All drawings should be merged serially as one Design Drawing document and then suitably referred in the CRM for compliance.
e. The drawing to include assembly-drawing also**.**

2.1.5. Analysis Reports:

a. Analysis reports are part of design documents
b. These can be suitably inserted in the main design document
c. Or, it can be attached to design documents as Appendix/Annexures (referring to the chapter/section) and put at the end of the design document.
d. Manufacturer should use prudence and rational in suitably attaching the analysis reports.
e. Analysis report should have:
    1. Heading
    2. Purpose
    3. Expected out come
    4. Methodology
    5. Inputs / boundary conditions
    6. The Analysis
    7. Interpretation of Analysis
    8. Final findings and Conclusion

2.1.6. Internal Test Report and Objective Evidence:

a. All internal test reports, bench tests, measurements, objective evidences etc. generated by manufacturer
b. These are submitted as supporting document to validate the design statements/criteria's/assumptions etc.
c. Should be signed and merged in the design document or attached to design documents as annexure.

2.1.7. Key Attributes for Internal Test Reports:

a. Title of the Test
b. Purpose
c. Test Procedure / Methodology
d. Expected Outcome
e. The test and objective evidence, if any (suitably pasted in the report)
f. Outcome/Observation

g. Conclusion / Test pass / failed / accepted / rejected
h. Signature

2.1.8. Flight Logs:

a. Important document / evidence for validation of design
b. Procedure on how to read the .bin file should be mentioned
c. Wherever flight logs are referred, the required graph should be extracted, exploded. Parameter readings should be readable.
d. Report prepared with explanation and interpretation of the graph / logs in a very simple language.
e. Should be readable and self- explanatory

2.2. List of Key Documents:

2.2.1. Design documents:

a. General Information and Performance (Clause 1 & 2)
b. Structure and Materials (Clause 4 & 5)
c. Power Plant (Clause 3)
d. Data Link and GCS (Clause 6)
e. Hardware (Clause 8 & 9)
f. Software (Clause 7 & 9.3)
g. Drawings
h. Manufacturing and QA/QC Process

2.2.2. Other Documents:

a. Flight Manual
b. Maintenance manual
c. Flight Log
d. Maintenance Log
e. BoM
f. Material Procurement Records

2.3. UAS Flight Manual

The Flight Manual is issued by the Manufacturer. It should have a Title, Volume number, Issuing Authority, Proprietary Information (If any), Amendment history and applicable document control requirements.

The Flight Manual should also contain the following: -

(a) Technical specifications of the UAS and its Operational capability.
(b) General explanation of UAS operation
(c) Standard Operating Procedures (SOP)
(d) Operational Envelope, Operational Conditions & Limitations (with each payload if applicable)
(e) Performance at various combinations of weight, altitude, temperature and wind conditions
(f) Emergency Procedures.
(g) Payload information and its effect on C.G.
(h) Safety Precautions and Lethal Warnings.
(i) Any other relevant information required for safe operation of UAS

- Overview
- Equipment details
- Product Profile
- Specification
- Ground Control Station (GCS)
- GCS App

- Explanation at System level
- Un boxing
- Calibration
- Starting the Drone
- Product Flying
- Flight Modes
- GCS Controls
- GCS Modes
- Mission Planning Using Mission Planner Software
- Mission planning using GCS
- Battery details
- Charger details
- Charging procedure
- Battery installation
- Tank filling procedure
- Spray adjustment
- Flying Checklist
- Maintenance check list
- Preflight Checks
- During flight Checks / monitoring
- Post flight Checks
- Safety Instructions
- Emergency Instructions

2.4. UAS Maintenance Manual

The Maintenance Flight Manual is issued by the Manufacturer. It should have a Title, Volume No, Issuing Authority, and Proprietary Information (If any) and Amendment history and applicable document control.

Maintenance Manual describes in detail all the actions to be carried out to keep the UAS in conformity with its type definition. It covers all the tasks and activities related to maintenance. Maintenance Manual should also consist the following: -

(a) Technical specifications of the UAS and its Operational capability.
(b) General operation of the UAS with block diagram.
(c) Technical explanation of the functioning of various systems/sub-systems.
(d) Preventive and Corrective maintenance schedule of the UAS and its major systems.
(e) Life of the components as applicable.
(f) Circuit diagrams.
(g) Pre Flight-Checks, Turn Round Servicing and Post Flight Checks.
(h) Assembly and disassembly of various payloads to be used with the UAS.
(i) Battery Storage Guidelines
(j) Packing/Unpacking of the UAS
(k) Transportation of the UAS for its use in field locations.(Flight manual) to be shifted
(l)

- Maintenance Manual Overview
- Equipment details
- Purpose
- Specifications
- System Description
- Hardware
- Hardware specification
- Maintenance schedule
- Routine maintenance
- Breakdown maintenance
- GCS Error messages

- Continuous monitoring of component performance
- Maintenance Procedure
- Preventive Maintenance Plan
- Best Practice
- Motor replacement
- Flight controller replacement
- Battery replacement
- Battery charging
- Safety measure / precautions

Note: - The contact details of the Manufacturer's maintenance personnel should be mentioned so that the user/customer can contact them in case of any doubt or clarification to be sought.

2.5. UAS Log Book

UAS Log Book consists of UAS Operation/Flight Log Book, UAS Operator Log Book and UAS Maintenance Log Book.

2.5.1. UAS Operation /Flight Log Book

It is a document which is used to log/record the details of the UAS flight carried out. The indicative format for the Operation/Flight Log Book is given below: -

Make/Model/ Sl No…… UIN……											
Sl No	**Date**	**UAV Operator**	**Purpose of Fight**	**Name of payload**	**Location**	**Time**		**Duration**	**Weather Condition**	**Remarks**	**Sig.**
						From	**To**				

2.5.2. UAS Operator Log Book

It is recommended that the UAS operator maintains a personal log book in addition to the flight log book. This is filled up with actual information related to the flight (sortie). The format for the UAV Operator's Personal Log Book is given below: -

Make/Model/ Sl No…… UIN……													
Sl No	**Date**	**UAV Operator**	**Purpose of Flight**	**Name of payload**	**Location**			**Time Up**	**Time Down**	**Duration**	**Weather Condition**	**Remarks**	**Sig.**
					Place	Lat.	Long.						

2.5.3. UAS Maintenance Log Book

It is a document which is used to fill the details regarding the preventive/corrective maintenance work activities carried out on the UAS either in the field location or at the hangar. This must be carried with the UAS always. The format for the Maintenance UAS Log Book is given below: -

Make/Model/ Sl No…… UIN ……..							
Sl No	**Maintenance Activity Date**	**UAV Operator**	**Maintenance action Required**		**Maintenance Carried Out**	**Person(s) who carried out Maintenance Remarks**	**Sig.**
			Preventive maintenance	Corrective maintenance			

2.5.4. Flight Check List

This checklist covers the actual flight including the steps to be undertaken for abnormal flight, procedure for aborting the flight and return back to home as well as procedure to handle any emergency like flight hardware crash or injuries. This should be available with the UAS.

2.5.5. Post Operation Checklist

It is a standalone checklist which is used to ensure that the drone is prepared for the next usage. It includes check of removing/replacing the memory cards (as applicable), downloading of files and verifying that the unit does not need any repair.

3. Additional Guidelines

3.1 Visual Line of Sight (VLoS) Range:

Authorized Testing Entities (ATEs) should witness the range during the flight test, the range should be endorsed by the ATE until the orientation can be seen without using any external aid for sub category **"Remotely Piloted Aircraft Systems"**

Note: DGCA may decide if any range need to be mentioned on Type Certificate or a statement like "Applicable only for VLoS" can suffice the scheme requirement.

3.2 Endurance test for dispensing payload like agricultural application

A. Pre-checklist:

- Evaluate environmental conditions, including temperature, humidity, wind speed, and visibility.
- Verify battery pack charge using a calibrated voltmeter.
- Note the maximum take-off weight (MTOW) and ensure it complies with the drone's specifications.
- Check the functionality of important systems, such as the propulsion system, GPS, and payload release mechanism.

B. Flight Test 1:

Test with Maximum take-off weight without dispensing

a. Record the take-off time with MTOW.
b. Hover until the RTL is triggered due to low battery.
c. Record the landing time.

C. Flight Test 2:

Test for validate the manufacturer claim and value to be presented in SoC check list while submission SoC pack.

a. Record the take-off time and document any specific weather conditions during take-off.
b. Execute the spraying operation according to the manufacturer's guidelines, including the spraying pattern and dispense rate.
c. Monitor the drone's flight path and ensure it maintains stability and accuracy in navigation.
d. Assess the drone's responsiveness to commands, including hover, altitude adjustments, and emergency stop.
e. Measure the time it takes for the drone to complete a full tank of spraying, and note any deviations or issues encountered.
f. Refill the payload and record the time taken by the manufacturer representative, considering the efficiency of the refilling process (approx. 2mins).
g. Repeat steps (b to f) for multiple spray cycles.
h. Monitor the drone's battery level and ensure it triggers the Return to Home (RTL) function at the appropriate threshold.
i. Take note of number of tanks used in multiple spray cycles (the whole number to be noted)

A. Post-check:

- Note the final battery voltage after completing the endurance test.
- Calculate the total time taken for payload refilling, including the average time per refill cycle.
- Verify the flight log and analyze the flight log data, including flight duration, distance covered, and any logged errors or anomalies and subtract refilling time from actual flight time recorded in the log file.

3.3 Model with different payload configurations:

The following guidelines should be followed by the manufacturer for the multiple payload:

i. The addition or removal of such payload shall not change the fundamental performance, characteristics or behavior of UAS:
   a. The payload should be easily swappable.
   b. Classification of the UAS shall not be changed
   c. For multiple configuration the variation in weight limits shall not cross 5% of MTOW (at Lower Side)
   d. C.G shall be within the defined limits for each payload of UAS
   e. There should not be major deviation in Endurance
      i. Endurance of UAV should be calculated with each payload
   f. Flight test (Annexure D, part 3 of CSUAS) should be performed with each payload in stage 2 by ATEs/CBs

ii. Manufacturer shall submit the design documents of each payload i.e., which includes weight, design, C.G limits and detailed information of the payload along with others UAV performance characteristics with that payload like range, endurance etc. and each configuration details shall be defined in manuals by manufacturer

iii. Manufacturer shall define what will be delivered to customer as a finished product in a packed box i.e., a document shall be submitted by the manufacturer defining with all the details of UAS, all associated payload and accessories if applicable during stage 1 to ATEs/CBs

iv. Manufacturer may apply for an addition or change of scope request application after issuance of TC and credit of previously approved model can be given (if applicable) by ATEs/CBs

3.4 BIS R-Number registration:

Manufacturer should submit the valid R-Number certificate from the battery OEM/Vender to ATEs in Stage 1.

3.5 Clarification on ETA

1. The ETA issued by WPC Wing for any RF module (in license-exempt band) can be used by any other, including drone manufacturer in an UAS; however, before using, the user has to ensure that the product being used has got type approved (ETA).

2. If an RF module is type approved in compliance to a specific notification or GSR then the module is to be used for the application(s) as specified in the said notification/ GSR.

3. It is reiterated that the O.M. No. ETA-WPC/Policy/2018-19 dated 26/02/2019, regarding ETA through self-declaration, is applicable for the RF products-

> a- operating in the notified license exempted frequency band(s) and in compliance with respective notification; b- fall under free category of DGFT Import Policy;

- If any RF module/ product is satisfying above two conditions, ETA can be obtained through self-declaration and such ETA is treated as valid.

4. For other license-exempt devices, which fall under the 'Restricted'/ 'Prohibited' category of the DGFT Import Policy, self-declaration ETA is not applicable. For such cases, scrutiny-based ETA is to be obtained from the Regional Licensing Offices of WPC Wing.

4. General Guidelines for Battery Testing

4.1 Part A: (For Manufacturers)

4.1.1 **For clause 3.2.2 of CSUAS** – Manufacturer may define average discharge current by analysis assuming the performance of the UAS. This average value of current consumption defined by the manufacturer can be used for lifecycle test of the battery. Flight logs submitted as proof should be in readable format.

4.1.2 In case of the batteries, which are used in “series” or “parallel” manufacturer shall ensure following,

4.1.3 If the same batteries are connected in series, manufacturer may perform the life cycle test with single battery, but recommendation is to used battery pack system (connected in series) along with PDB, BMS/BTMS (if applicable).

4.1.4 If the same batteries are connected in parallel, manufacturer shall submit the battery pack system (connected in parallel) along with PDB, BMS/BTMS (if applicable) for the life cycle test.

4.1.5 If the different batteries are connected in series or parallel, manufacturer shall submit the battery pack system (connected in series or parallel) along with PDB, BMS/BTMS (if applicable) for the life cycle test.

4.1.6 Depth of Discharge (DoD) shall be reached to minimum 80% in life cycle test.

4.1.7 Details to be submitted by manufacturer to NABL Accredited Lab

Manufacturer Name		
Model Name		
Address		
E-mail		
Contact no		
Sl. No.	**Test Parameters**	
1	**Battery pack with or without BMS and BTMS**	**Pack details**
2	**Voltage**	• Nominal voltage • Upper cut-off voltage (charging voltage) • Lower cut-off voltage (discharge voltage)
3	**Current (C-rate)**	• C-rate for Energy/capacity measurement • C-rate for High discharge rate C-rate for life cycle test • Constant current or variable load profile (need to be provided by Manufacturer)

4	**Ah (capacity)**	• Ah should be provided on name plate • Nominal Capacity at defined C-rate
5	**Weight and dimension**	
6	**Maximum Continuous charge**	
7	**Max battery temperature during charge**	
8	**Full description of charging procedures for all the tests that should be carried out**	
9	**Any other parameters/ specification as applicable to particular model**	

4.2 Part B (For Testing Laboratories)

4.2.1 As per Certification Scheme for UAS clause "3.2.1." Battery performance (energy, power capability): Determine rate of discharge of battery as per manufacturers' specifications (C-rate, cut off conditions, Ah and Wh, energy and power density) required for Drone application.

4.2.2 Test 1-Energy and Capacity test:

This test verifies the rated capacity of a cell or battery.

Step 1 – The cell or battery/battery pack shall be charged in an ambient temperature of 20 °C± 5 °C, using the method declared by the manufacturer. Manufacturer/supplier has to provide detail test procedures.

Step 2 – The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 3 – The cell or battery/battery pack shall be discharged, in an ambient temperature of 20°C ± 5 °C, at a constant current of C/5 or at higher current rate if suggested by the supplier.

Step 4 – The capacity (Ah) delivered during step 3 shall be not less than 100 % of the rated capacity and energy Wh/kg should be calculated and value must be as declared by the manufacturer. Steps 1 to 4 may be repeated up to four additional times, as necessary to satisfy this requirement.

4.2.3 Test 2- High-rate discharge performance (power capability):

This test determines the capacity of a cell or battery when discharged at a high rate, maximum C-rate as permitted by supplier.

Step 1 – The cell or battery shall be charged in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer or supplier.

Step 2 – The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 3 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a higher constant current rate (Below Imax) permitted by supplier until its voltage is equal to the specified final cut-off voltage.

Step 4 – The capacity (Ah) delivered during step 3 shall be not less than that specified by customer/manufacturer for particular C-rate.

4.2.4 As per Certification Scheme for UAS clause: Cl. 3.2.2. Battery performance (life cycle): Determine life cycle up to 80% Depth of Discharge (DoD) for various atmospheric conditions (flying conditions of drone).

4.2.5 Test 3: Method Life cycle Test at laboratory:

This test determines the number of charge/discharge cycles which a cell or battery can endure before its useful capacity has been significantly depleted or the remaining capacity after a specified number of cycles.

Prior to charging, the cell or battery shall be discharged at 20 °C ± 5 °C at a constant current of 0,2 It A, down to a specified final voltage.

The following endurance test shall then be carried out, irrespective of cell designation, in an ambient temperature of 20 °C ± 5 °C. Charge and discharge shall be carried out as defined below

1. Charge: The cell or battery shall be charged in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer or supplier

2. Discharge: Discharge the battery as per the load profile declared by Customer/Manufacturer till the defined cut-off voltage defined.

Requirement: The minimum cycle required before 80% DoD.

***LAB shall be accredited for ISO/IEC 17025 by NABL.**

4.2.6 The report should have at least below mentioned details.

Table – 1

Sr. No.	Parameters	Value
1.	Battery Capacity	
2.	Weight & Dimensions	
3.	Ampere hour	
4.	Watt hour (Energy)	
5.	Energy Density	

6.	Power Density	
7.	Voltage: Nominal Voltage Maximum Voltage	
8.	Temperature	
9.	C-Rate:	
10.	Charge Current	
11.	Discharge Current	
12.	Any other Information:	

Table – 2

Charge Discharge Cycle (Battery Life Cycle Test)		
Test Parameters	**Charge Capacity (Ah)**	**Discharge Capacity (Ah)**
Initial Capacity		
Capacity After "Declared value by manufacturer" Cycles		
Capacity Determination		
Any Other Parameters		
Remarks If any		

4.3 Part C (For ATEs/CBs)

4.3.1 For Clause 3.2.1 as per CSUAS:

Stage 1: Verification of test reports from an accredited testing laboratory submitted by the manufacturer determining rate of discharge of battery with charge capacity more than 85% at all times.

Stage 2: Verification of manufacturer's test results by witnessing flight testing while ensuring less than 90% battery utilization of a fully charged battery after landing.

4.3.2 For Clause 3.2.2 as per CSUAS:

Stage 1: Verification of test reports from an accredited testing laboratory submitted by the manufacturer determining the mentioned specification.

Stage 2: Verification of manufacturer's test results by witnessing flight testing.

4.3.3 Mapping of IS 16046 Part 2 2018:

Clause 3.2: (A), (B) and (C) are mapped with IS 16046 (Part - 2): 2018, IEC 62133-2: 2017 as per below table –

Sr. No.	CSUAS 3.2 Clauses: A, B & C	Clause reference as per (IS 16046 (Part - 2): 2018, IEC 62133-2: 2017)
1	3.2 (a): Determine that safe cell temperatures and pressures are maintained during charging / discharging cycle	5.3 and 5.4
2	3.2 (b): Determine that no explosive or toxic gases are emitted in normal operation	7.2 and 7.3
3	3.2 (c): Determine that no corrosive fluid is discharged which may damage the surrounding structures / equipment	7.3.8

Note: These guidelines are compiled to help the applicant in obtaining more clarity on various requirements mentioned under the clauses 3.2 of CSUAS Scheme. In case of any perceived ambiguity arising out of the guidelines, CSUAS Scheme requirements shall prevail.

Abbreviation's:

1. PDB: Power distribution board
2. BMS: Battery management system
3. BTMS: Battery thermal management system

5. Guideline for Finite Element Analysis

This has reference to the **Finite Element Method Analysis Reports** Submitted under certain clauses of **"Certification Scheme for Unmanned Aircraft Systems":**

The following details should be provided in FEA Reports for Static Load Analysis and Fatigue Analysis:

1 Schematic Sketch of UAS Model with major Dimensions
2 Nomenclature
3 Model Information
4 Model Properties
5 Units
6 Material Properties
7 Loads and Fixtures/Constrains (boundary Conditions)
8 Mesh Information
9 Resultant Forces
    a. Reaction forces
    b. Reaction Moments
    c. Free body forces
    d. Free body moments
10 Study Results
11 Summary in tabular format showing pass or fail for comparison of stresses with allowable stress considered.
12 Conclusion
13 Software Generated file
14 Any other applicable information

Indicative format for FEA report

1. **Objective**
   Write the aim/objective
2. **Test Conditions**
   What is being tested and for what, elaborate the pass and fail conditions for the test. Who is conducting the test and when details to be provided
3. **Boundary conditions/ Inputs**
   Detailed information regarding the boundary condition and inputs and in case of flight test (Environmental condition)
4. **Procedure/ testing protocol**
   That can be elaborated (but in plain simple language) with more theoretical and practical references [drawing/ picture/ photograph/ audio/ video references/ flight logs/ graphs in legible / readable format etc.]
5. **Numerical Values/Inputs**
   All numerical values taken in calculation need to be justified even it is an assumed value.
6. **Conclusion**
   At the end of the report whether it is a pass/ fail with justification in brief.
7. **Signed by appropriate person**
8. **Any other applicable information**
9. **Annexure A – For Static Load Analysis**
   - Nomenclature
   - Model Information
   - Study Properties (can be extracted from FEA Analysis Report)
   - Units
   - Material Properties
   - Loads and Fixtures/Constrains (boundary Condition)
   - Mesh Information
   - Resultant Forces
     - Reaction forces
     - Reaction Moments
     - Free body forces
     - Free body moments
   - Study Results (can be extracted from FE Analysis Report)
   - Conclusion
10. **Annexure B – For Fatigue Analysis**
    - Nomenclature
    - Model Information
    - Study Properties (can be extracted from FEA Analysis Report)
    - Units
    - Material Properties
    - Loads and Fixtures/Constrains (boundary Condition)
    - Mesh Information
    - Study Results (can be extracted from FE Analysis Report)
    - Conclusion

6. Bill of Material

Manufacturer Name:
UAS Model:-

Sl. No	Item Description	OEM Part Number	Manufacturers Part No	Key Specification	Purchase Order Details &date	Sub Assy/ Assy	Order Qty	Qty Received & date	Country of Origin	Remarks
Raw Materials										
Mechanical Items										
Electrical & Electronic Items										
Software Items										

Calculation and their weightage:

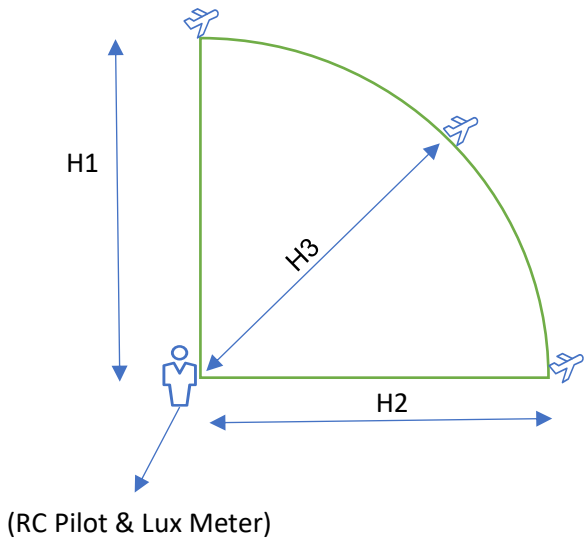
Sl No	Name of Component (Indicative)		Weightage Percentage (in %) County of Origin		Max. Weightage Percentage
			India	Foreign	
1.	Structure • Main structure body, • Landing Gears, • Load carrying bars • Etc.				
2.	Flight Controller				
3.	Battery / Engine				
4.	Payload				
5.	GNSS				
6.	GCS (Ground Control Station)	Software			
		Hardware			
7.	Motor, ESC, Propeller				
8.	On Board Equipment				
	Total (Sum)				100%

Percentage of indigenization = Sum of Weightage Percentage (Where country of Origin is India)

 # Any other parameters/information may be added as appropriate

7. Guidelines for flight test during night

Sr. No.	Parameters	Values
1	8.1 (b) Operation and functioning of flashing anti-collision / strobe lights in the UAS	Applicable/Not Applicable
2	Environmental Condition: a. Temperature b. Humidity c. Wind Speed d. Visibility in the testing area	
3	Luminosity value (to be checked with Lux Meter)	
4	Distance of visibility of strobe light	
5	Distance of visibility of Drone	
A Flight Test report along with objective evidence shall be submitted if applicable.		



H1: Vertical Length
H2: Horizontal Length
H3: Length (45 Degree)

Note: ***All these guidelines above are compiled to help the applicant in obtaining more clarity on various requirements mentioned in the UAS Scheme. In case of any perceived ambiguity arising out of the guidelines text, UAS Scheme text shall prevail.***

Amendment Sheet:

The history of changes is as below:

SL. No.	Date of Amendment/ Revision date	Section No.	Page No.	Version	Revision	Amendment Details
1	23/10/2023	4.1	72	V:01	R: 01	Model name added in battery section.
		7	79			Updated BOM Format and
			80			Removed index page from FEA