Master Comment Log
AC 20-Laser

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
1	Dan Hewett, FDA	Section 7.b. page 5	One omission in the FDA variance paragraph is that IEC Classes 1, 2 and 3R are acceptable class limits for invisible emission SLA.		Accepted. Added the following to section 7.b. ".: For products labeled under the classification system of the IEC, classes 1, 2 and 3R are acceptable class limits for an invisible emission and therefore do not require a variance."
2	Tom Knott, Structural DER	Sect. 1.a., page 1	The statement "If you use the means described in this AC, you must follow it in its entirety" is too restrictive, and defeats the purpose of an Advisory Circular which is "**a** means, but not the **only** means" of compliance.	Remove the statement. It stifles future development that may not have been envisioned when the AC was written, but otherwise would be possible if not for this statement.	Not accepted. In order to claim compliance with the AC, the applicant must follow it in its entirety. In applicant can always propose another means of compliance
3	Tom Knott, Structural DER	Sect. 1.a., page 1, Sect. 9., page 9	Add xx.601 to the list of regulations.	This is a common regulation used in equipment installations.	Not accepted. The AC only addresses unique laser airworthiness installation requirements. It is not comprehensive installation guidance for airborne equipment with lasers since it does not address all the applicable installation airworthiness requirements such as those discussed in paragraph 7. Paragraph 7 states that "the installation

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
					must meet all other applicable airworthiness requirements such as those involving…..structural……
4	Tom Knott, Structural DER	Sect. 1.e., page 1	This section states "This AC is only intended for invisible lasers. This AC does not apply to visible lasers since they pose additional hazards (e.g. flash blindness) which are not addressed in this AC." Could this AC also cover visible lasers with minimal change? Section 3.c. on page talks about eye hazards (invisible) but the topic is also applicable to visible lasers. There are also many references to external documents which cover visible lasers.	Please consider including visible lasers. This would make the AC usable for a wider application and future developments.	Not accepted. We purposely excluded visible lasers because of the additional risk from flash blindness to other aircraft and people on the ground which is not addressed in the AC.
5	Tom Knott, Structural DER	Sect. 3., page 2	Please consider adding a section for laser communication and data transmission equipment. Perhaps after LIDAR (3.b.).	Such equipment is in the R&D stage.	Partially accepted. The AC is now not limited to just surveillance lasers and LIDARs. Changed a sentence in paragraph 1 a from "In this advisory circular (AC), we recommend one way to obtain Federal Aviation Administration (FAA) airworthiness approval for the installation of aircraft mounted, non-required,

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
					infrared surveillance laser and light detection and ranging (LIDAR) equipment." to "In this advisory circular (AC), we recommend one way to obtain Federal Aviation Administration (FAA) airworthiness approval for the installation of aircraft mounted, non-required, invisible spectrum laser equipment such as infrared surveillance laser and light detection and ranging (LIDAR) equipment. "
6	Tom Knott, Structural DER	Sect. 8., pages 8-9	The term "electrically disabled" is used in several locations. While this is the primary means of disabling laser systems, they can also be disabled by mechanical means (shutters).	Change to just "disabled" or "disabled by positive means" or "electrically or physically disabled"	Accepted. Made multiple changes deleting the word electrically disabled.
7	Airbus Helicopters	§ 7.c.(1) item b) page 5 § 5. item f) page 3	**Major comment** § 7.c. item b) states: "*Reflections off any part of the aircraft (e.g., structure, blades, skids, landing gear, etc.) should be considered specular.*" whereas the definition of specular	Suggestion: open the opportunity that the installer takes into account material optical properties within its eye safety analyses. Rationale: optical properties of aircraft materials are known (reflectance, absorptions, albedo).	Not accepted. Analysis involving reflections leading to aircraft occupant eyes being exposed to laser light should be conservative. In addition, any changes or degradation to paint and surfaces could affect this analysis and invalidate the

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
			reflection is reminded in § 5: "***f. Specular Reflection***. *A mirror-like deviation of radiation (light) following incidence on a surface*." The structure of the aircraft should not be considered as perfect mirrors.		installation approval.
8	Airbus Helicopters	§ 7.c.(1) item c) page 6	**Major comment** "*For laser illuminators, spotters, range finders and other non-scanning lasers, the NOHD exposure duration should be based on the maximum exposure duration expected, but not less than 10 seconds.*" 10s should be applied only for laser emitting non visible radiation (λ >700 nm). If a visible source is used (400 nm – 700 nm) the eyelid reflex should be considered.	Follow EN 60825-1 & ANSI Z136.1 recommendations : 10s exposure for IR source and 0.25s for visible sources	Not accepted. The AC scope is only non-visible wavelength lasers. So only the 10 second exposure duration is applicable.
9	Airbus Helicopters	§ 7.c.(6) item a)1) page 7	**Major comment** "*The laser should not be used to intentionally radiate other flying aircraft*" Beyond NOHD, no limitation should be	Add mention to the NOHD within this recommendation. Suggested sentence: "*The laser should not be used to intentionally radiate other aircrafts within NOHD.*"	Not accepted. For two moving aircraft, it could be very difficult for the laser operator to determine and maintain a separation which is greater than the NOHD. Also, we are unaware of any

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
			applied on the use of the laser.	Rationale: no risk beyond NOHD	valid civil uses where an aircraft operator would be illuminating another flying aircraft.
10	Airbus Helicopters	§ 7.c.(6) item a)2) page 7	**Major comment** "*The laser should not be used during taxi, take-off or landing.*" If nobody is exposed within NOHD around the aircraft, the pilot could decide to use the laser.	Suggestion: take into account the NOHD and pilot judgment for possible use of a laser during landing or take off. Rationale: the laser might be used during taxi and landing to help pilots.	Not accepted. We consider the risk of inadvertent laser exposure to be too high during ground, taxi, take-off and landing. Also some FLIR manufacturers recommend that FLIR be stowed during taxi, take-off and landing to prevent damage.
11	Airbus Helicopters	§ 7.c.(6) item a)2) page 7	**Major comment** "*For Class IIIa and IV lasers, the key switch must be in the off position during taxi, take-off and landing.*" Key switch are not always the best safety measure to prevent unintended laser switch on. Other safety means than key switch can be proposed as long as they satisfy objectives defined in the System Safety Analysis.	Suggestion: follow standard System Safety Analysis rules and ARP 4761 for safety means implemented on aircraft. Rationale: performance based approach, rather than prescriptive solution.	Partially accepted. A key actuated master control is required by Title 21, part 1040.10 for Class IIIa and IV lasers. Changed "key switch" to "key control" to be consistent with part 1040.10. The FDA's "Compliance Guide for Laser Products", 86-8260 does state: "A computer password may serve as an adequate key control provided that the password must be reentered each time the computer is turned on or

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
					the laser operation sequence is begun."
12	Embraer	Section 3.a., page 2	Delete the word "designator".	To delete the word "designator". Rationale: Laser designators are used to aim at a target in order to precisely create a recognizable spot, which can be detected by Laser Spot Trackers (LST) and/or Laser Guided Weapons (LGW). Although some laser designators can also determine target range, as well as designate targets, they are not ordinarily used as surveillance equipment, but rather as part of weapon aiming systems, which, per item 1.d is outside of the purpose of the AC. Therefore, for these reasons, it is best to not include Laser Designators as part of the Laser Surveillance Equipment.	Accepted. Deleted the word "designator"
13	Embraer	Section 3.a., page 2	The expression "laser illuminators" should be replaced by "laser surveillance equipment".	<u>Suggested change:</u> The text sentence: *"The laser illuminators can illuminate large areas with infrared, invisible light for viewing with a FLIR or night vision goggles."* should be changed to:	Accepted. Suggested text incorporated.

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
				"Laser surveillance equipment may be used to support several kinds of tasks and missions, varying from target range-finding to the illumination of small spots or large areas." Rationale: The laser illuminator is only one type of laser Surveillance Equipment. This section, which is named "Laser Surveillance Equipment", should reference laser surveillance equipment rather than just illuminators.	
14	Embraer	Section 3.a., page 2	The expression "laser illuminators" should be replaced by "laser surveillance equipment".	Suggested change: The text sentence: *"The laser illuminators are typically Class IIIb or IV lasers."* should be changed to: *"The laser surveillance equipment is typically Class IIIb or IV lasers."* Rationale: The laser illuminator is only one type of laser Surveillance Equipment. This section, which is named "Laser Surveillance	Partially accepted. Change the sentence to: " Laser surveillance equipment typically use Class IIIb or IV lasers."

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
				Equipment", should reference laser surveillance equipment rather than just illuminators.	
15	Embraer	Section 3.c., page 2	The ultraviolet A (UVA) laser should also be considered as part of the spectrum that can cause damage to the cornea or lens or both.	Suggested change: The text sentence: *"FLIRs and LIDARs with lasers that operate in the far infrared (1400 – 10,600 nm) spectrum can cause damage to the cornea or lens or both."* should be changed to: *"Laser Surveillance Equipment that operates in the ultraviolet A (315 – 400 nm) and the in the far infrared (1400 – 10,600 nm) spectrum can cause damage to the cornea or lens or both."* Rationale: Some laser systems used to perform oil spill detection (a kind of Surveillance mission) operate in the ultraviolet A (UVA) spectrum. The UVA can cause damage to the cornea or lens or	Accepted. Text changed to the following: *"Laser Surveillance Equipment that operates in the ultraviolet A (315 –400 nm) and the in the far infrared (1400 – 10,600 nm) spectrum can cause damage to the cornea or lens or both."*

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
				both eye structures.	
16	Embraer	Section 3.c., page 2	The FLIR and LIDAR laser operation wavelength, typically, ranges from 800 to 1570 nm.	Suggested change: The text passage: *"Most FLIR and LIDAR lasers operate with a wavelength from 800 to 1550 nm."* should be changed to: *"Typically the Laser Surveillance Equipment operates with a wavelength from 800 to 1570 nm."* Rationale: Typically, Laser Surveillance Equipment includes a Laser Rangefinder operating with a pulsed beam at a wavelength of 1570 nm.	Accepted. Changed 1550 to 1570.
17	Embraer	Section 7.a., page 4	The Laser Surveillance Equipment nomenclature should be used and harmonized throughout the document.	Suggested change: The text sentence: *"Installers of surveillance systems with laser equipment and LIDARs must install the laser equipment according to the manufacturer's specifications as certified by the manufacturer to the FDA."*	Partially accepted. The updated text which follows is more general and could be also used for ultraviolet laser: *"Installers of invisible spectrum laser equipment must install the laser equipment according to the manufacturer's specifications as certified by the*

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
				should be changed to: *"Installers of Laser Surveillance Equipment must install it according to the manufacturer's specifications as certified by the manufacturer to the FDA."* <u>Rationale:</u> The expression laser surveillance equipment should be used throughout the document, as much as possible, in order to avoid misinterpretations and assure text consistency.	*manufacturer to the FDA."* The definition of surveillance which follows does not include the LIDAR surveying function:" the act of carefully watching someone or something especially in order to prevent or detect a crime." Therefore laser surveillance equipment will not be used throughout the document as an equipment category which includes LIDARs.
18	Embraer	Section 7.b., page 5	The Laser Surveillance Equipment nomenclature should be used and harmonized throughout the document.	<u>Suggested change:</u> The text sentence: *"According to the FDA, surveillance lasers and LIDAR systems are considered "surveying, leveling and alignment laser products," which are specific purpose laser products described in 21 CFR 1040.11(b) and limited to Class I AEL for the invisible laser wavelengths.."* should be changed to: *"According to the FDA, surveillance laser equipment is*	Not accepted. The definition of surveillance which follows does not include the LIDAR surveying function:" the act of carefully watching someone or something especially in order to prevent or detect a crime." Therefore laser surveillance equipment will not be used throughout the document as an equipment category which includes LIDARs.

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
				considered "surveying, leveling and alignment laser products," which are specific purpose laser products described in 21 CFR 1040.11(b) and limited to Class I AEL for the invisible laser wavelengths. Rationale: The expression laser surveillance equipment should be used throughout the document, as much as possible, in order to avoid misinterpretations and assure text consistency.	
19	MAPPS	Section 2, page 2	It is the opinion of MAPPS, Aerial Survey Professionals, and LIDAR manufacturers (i.e., the professional mapping industry), that since temporary installation of non-required, non-essential, portable electronic LIDAR devices on part 23 and 27 aircraft does not have any appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product, airworthiness approval is not required for LIDAR, while operating pursuant to 14 C.F.R. § 119.1(e)(4)(iii).		Partially accepted - Depending on the specific temporary installation of non-required LIDAR equipment, the installation can have an appreciable effect on structural characteristic, cabin safety, electromagnetic compatibility, air data, lightning, electrical power, aircraft flight performance etc. Any changes to the LIDAR equipment need to

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
			More specifically, the temporary installation of non-required, non-essential, portable electronic LIDAR devices on part 23 and 27 aircraft, does not meet the definition of a change in type design under 14 C.F.R. § 21.93. Therefore, no airworthiness approval is required under a type certificate (TC),		be assessed for possible airworthiness affects. If the new LIDAR equipment installation complies with specific type design minor change criteria or minor alteration criteria, the new LIDAR equipment installation may be considered a minor change to type design or a minor alteration. Appendix B provides examples of minor design change and minor alteration criteria.
20	MAPPS		Recommendation - , the FAA Design, Manufacturing & Airworthiness Division (AIR-100), as well as the Systems Integration Section (AIR-134), should determine that operators conducting aerial photography or survey flight operations pursuant to 14 C.F.R. § 119.1(e)(4)(iii), do not require airworthiness approval for the temporary installation and use of LIDAR, through either a type certificate (TC), supplemental type certificate (STC), amended type certificate (ATC), or amended supplemental type certificate (ASTC), under the following limited circumstances: 1. Flight operations must be limited to part 23 and 27 aircraft conducting aerial photography or		Partially accepted. Under specific criteria, change in type design may be deemed minor by the FAA. A minor change in type design may be approved under a method acceptable to the Administrator. Therefore a process which is accepted by the administrator would be required. Appendix B provides example criteria that could be used to assess if change is minor. The MAPPS recommended

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
			survey flight operations pursuant to 14 C.F.R. § 119.1(e)(4)(iii). 2. Any aircraft modification(s), including but not limited to electric system modification(s), which have been made to accommodate the temporary installation of Airborne LIDAR equipment, shall have received FAA airworthiness approval through either a type certificate (TC), supplemental type certificate (STC), amended type certificate (ATC), amended supplemental type certificate (ASTC), or FAA field approval. 3. The LIDAR equipment shall be tested and found to comply with RTCA DO-160 technical standards. 4. The manufacturer shall certify that the LIDAR equipment has met Food and Drug Administration (FDA) performance standards of 21 C.F.R. part 1040. 5. The LIDAR shall contain a label or tag permanently affixed to, or inscribed on, the equipment certifying that it complies with performance standards under 21 C.F.R. part 1040. 6. The LIDAR temporary installation shall meet all applicable airworthiness requirements such as those involving electrical system capacity, electrical circuit protection, lightening direct effects, ice protection, flammability, environmental		"limited circumstances" described in items 1 through 9 have been considered in the development of these criteria.

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
			qualification, changes to flight and handling characteristics, vibration, structures, static and pitot systems, and electrical wiring interconnection systems. 7. The LIDAR equipment shall be temporarily installed according to the manufacturer's specifications, as certified by the manufacturer to the FDA. 8. The LIDAR equipment shall be Non-essential, Non-required Aircraft Cabin Systems & Equipment (CS&E), which shall meet all applicable airworthiness requirements. 9. The normal operation of the LIDAR, or failure of it to perform its intended function, shall not adversely affect the safety of the aircraft or its occupants, or the proper functioning of required equipment and systems, ensuring that there is no adverse effect on the level of safety. 10. Pursuant to 14 C.F.R. § 91.21, the temporarily installed portable electronic LIDAR shall not be used while the aircraft is operated under Instrument Flight Rules (IFR). 11. The portable electronic LIDAR shall not cause interference with the navigation or communication system of the aircraft on which it is to be used.		
			If all of the above-described conditions are met, the portable electronic LIDAR equipment may be temporarily installed and used on a part 23 or 27 aircraft, pursuant to the following conditions: 1. Airworthiness approval for the temporary installation and use of portable electronic		Partially accepted. Under specific criteria, change in type design may be deemed minor by the FAA. A minor change in type design may be approved under a method

#	Commenter	Section # & Page #	Comment	Suggested Change & Rationale	Disposition
			LIDAR equipment does not require either a type certificate (TC), supplemental type certificate (STC), amended type certificate (ATC), amended supplemental type certificate (ASTC), or FAA field approval. 2. A System Safety Analysis is not required to assess whether the temporarily installed portable electronic LIDAR meets 14 C.F.R. 23.1309 or 27.1309. 3. An approved Aircraft Flight Manual Supplement (AFMS) is not required where the airframe limitations, operational procedures, or flight characteristics of the basic aircraft do not change, and where no changes to the aircraft limitations are caused by the temporary installation of the portable electronic LIDAR. 4. Instructions for Continued Airworthiness (ICA) of the portable electronic LIDAR is not required, as long as the equipment is maintained pursuant to the manufacturer's recommended procedures.		acceptable to the Administrator. Therefore a process which is accepted by the administrator would be required. Appendix B provides example criteria that could be used to assess if change is minor. The MAPPS four conditions have been considered in the development of these criteria.