G-1 INTRODUCTION

Appendix G describes the design changes to the stabilizer trim system for the 737-7/-8/-9 (hereafter referred to as the 737 MAX), the applicable Federal Aviation Administration (FAA) and European Aviation Safety Agency (EASA) regulatory requirements, and the method of compliance to those requirements.

(b) (4)

This safety analysis was developed in order to ensure the safe operation of the 737 MAX stabilizer trim system and to show compliance with certification agency requirements. As a result of this analysis, it is concluded that the changes to the 737 MAX stabilizer trim system comply with all applicable FAA Regulations and EASA Requirements.

The Functional Hazard Assessment (FHA) in Section G-4 of this appendix identifies the severity of potential hazards to the airplane due to the implementation of the 737 MAX stabilizer trim system changes.

The Failure Modes and Effects Analysis (FMEA) in Section G-5 of this appendix ensures that continued safe-flight-and-landing is possible, without requiring exceptional pilot skill or strength, following any single failure of the 737 MAX stabilizer trim system. Each single failure meets the requirements of the CFRs and CSs.

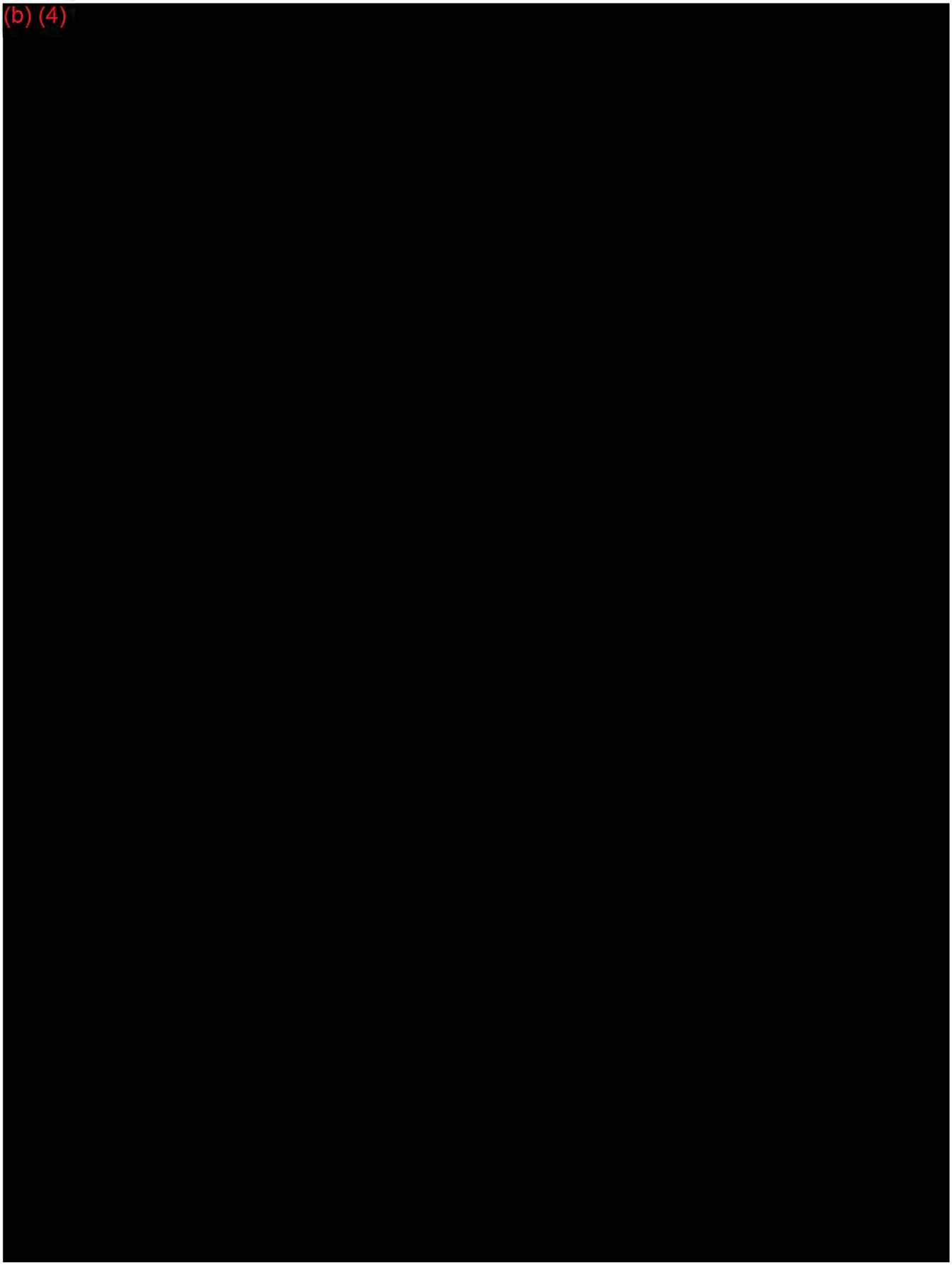
A Fault Tree Analysis (FTA) in Section G-6 of this appendix ensures that continued safe-flight-and-landing is possible, without requiring exceptional pilot skill or strength, following any combination of failures not extremely improbable for the 737 MAX stabilizer trim system.

G-2 DESCRIPTION OF SYSTEM CHANGES

(b) (4)

[redacted]

(b) (4)



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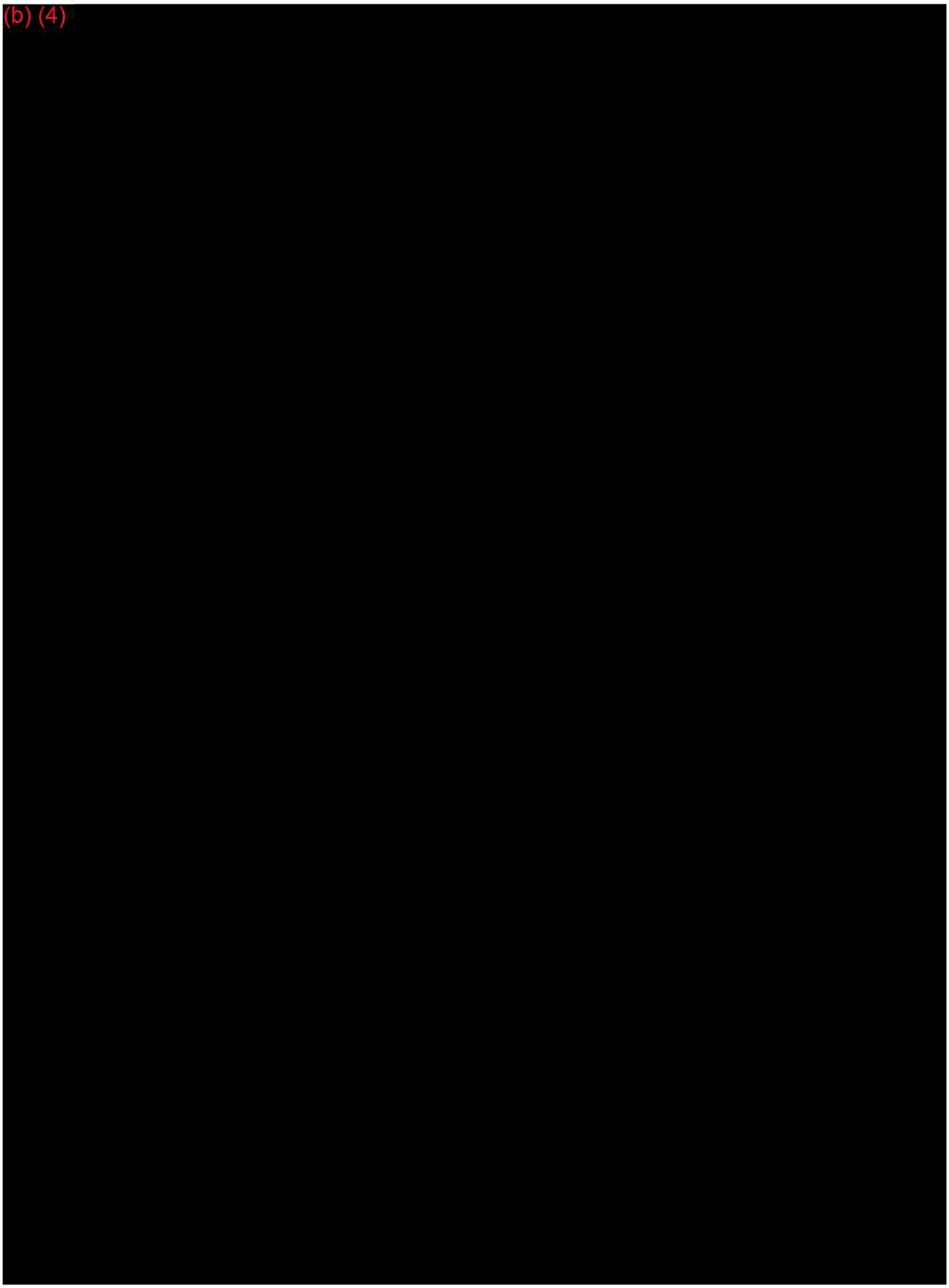

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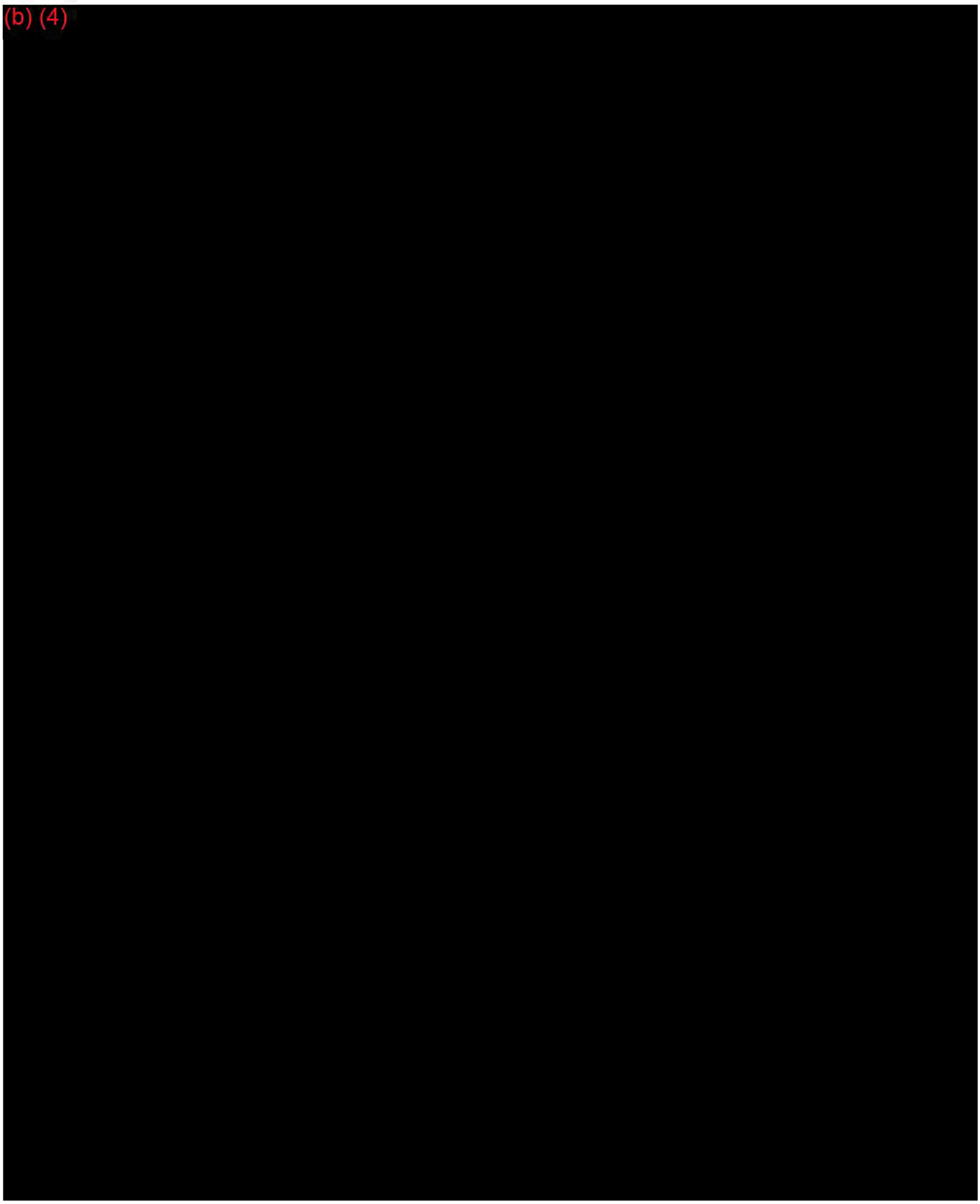

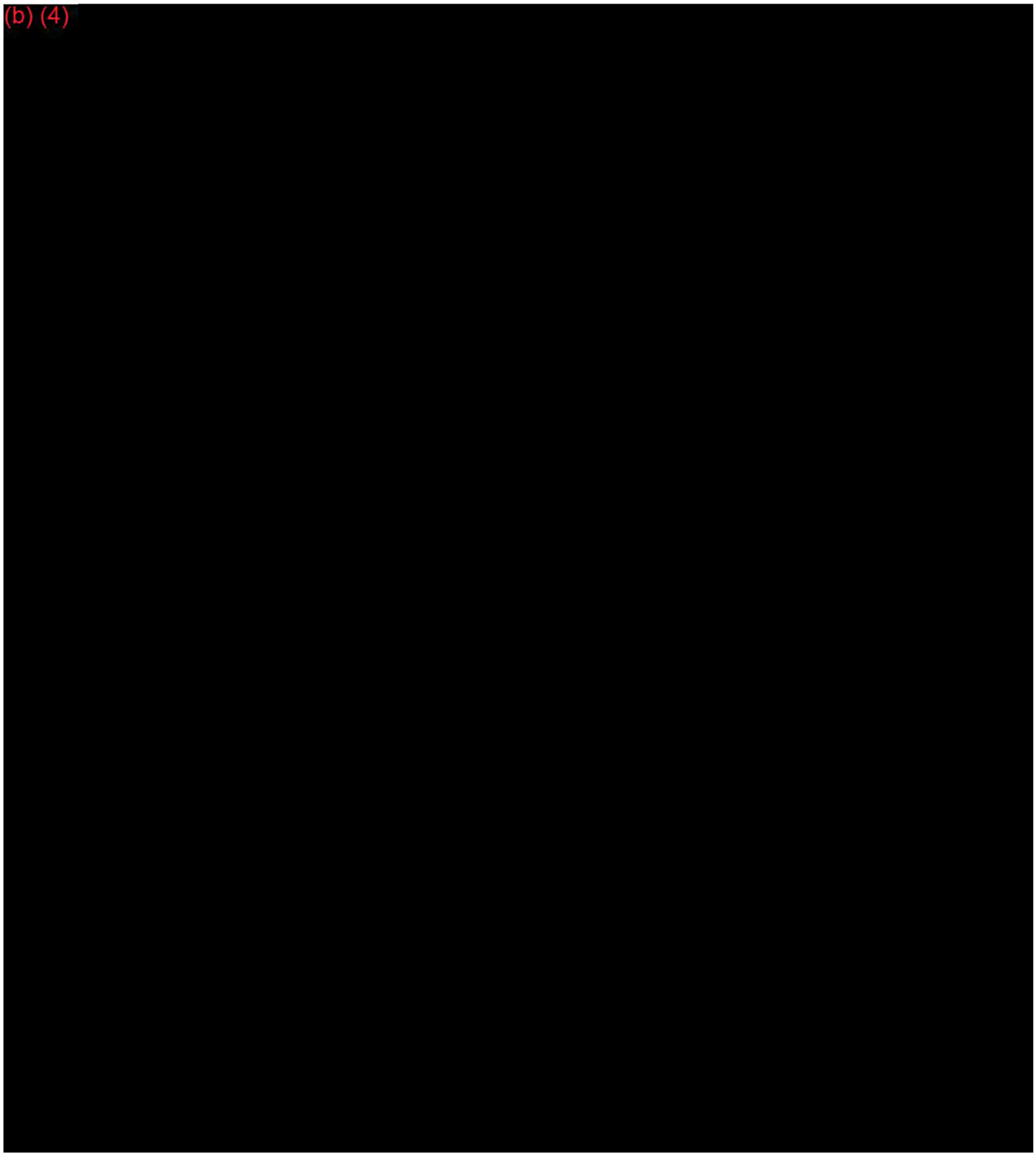
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G-3 CERTIFICATION REQUIREMENTS AND MEANS OF COMPLIANCE

The 737 MAX Stabilizer System complies with all the FAA and EASA regulations identified in (b) (4) Table G3-1 shows the compliance findings for each applicable regulation, with differences between CFRs and CSs noted. (b) (4)

(b) (4)

When it is stated that compliance is shown through safety analysis, a reference to the appropriate section in this document will be made. For particular regulations, compliance may also be based on design, test or flight demonstrations, which are noted below but documented elsewhere. When appropriate, this section may point to another section of this document for supporting data.

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System

CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.21 Proof of Compliance			(b) (4)
25.21(e)	(b) (4)	(e) If compliance with the flight characteristics requirements is dependent upon a stability augmentation system or upon any other automatic or power-operated system, compliance must be shown with §25.671 and §25.672.	
25.601 General			
25.601	(b) (4)	The airplane may not have design features or details that experience has shown to be hazardous or unreliable. The suitability of each questionable design detail and part must be established by tests.	
25.607 Self-Locking Nuts			
25.607	(b) (4)	No self-locking nut may be used on any bolt subject to rotation during airplane operation.	
25.611 Accessibility Provisions			
25.611(a)	(b) (4)	(a) Means must be provided to allow inspection (including inspection of principal structural elements and control systems), replacement of parts normally requiring replacement, adjustment, and lubrication as necessary for continued airworthiness. The inspection means for each item must be practicable for the inspection interval for the item. Nondestructive inspection aids may be used to inspect structural elements where it is impracticable to provide means for direct visual inspection if it is shown that the inspection is effective and the inspection procedures are specified in the maintenance manual required by Sec. 25.1529.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.655 Installation			
25.655(b)	(b) (4)	(b) If an adjustable stabilizer is used, it must have stops that will limit its range of travel to the maximum for which the airplane is shown to meet the trim requirements of § 25.161.	(b) (4) [redacted]
25.671 General			
25.671(a)	(b) (4)	14 CFR (a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function. CS (a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function. (See AMC 25.671 (a).)	
25.671(b)	(b) (4)	14 CFR (b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of incorrect assembly that could result in the malfunctioning of the system. CS (b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimise the probability of incorrect assembly that could result in the malfunctioning of the system. (See AMC 25.671 (b).)	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.671(c)	(b) (4)	14 CFR (c) The airplane must be shown by analysis, tests, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag, and feel systems), within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot. (1) Any single failure, excluding jamming (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as actuators, control spool housing, and valves). (2) Any combination of failures not shown to be extremely improbable, excluding jamming (for example, dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure). (3) Any jam in a control position normally encountered during takeoff, climb, cruise, normal turns, descent, and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable. CS (c)(1) Any single failure not shown to be extremely improbable, excluding jamming (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as actuators, control spool housing, and valves). (See also AMC 25.671 (c) (1).)	(b) (4) [redacted]
25.671(d)	(b) (4)	(d) The airplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.	
25.672 Stability Augmentation and Automatic and Power-			
25.672	(b) (4)	If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this part, such systems must comply with § 25.671 and the following:	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System

CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.672(a)	(b) (4)	(a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring his attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot were not aware of the failure. Warning systems must not activate the control systems.	(b) (4) [redacted]
25.672(b)	(b) (4)	(b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures of the type specified in § 25.671(c) without requiring exceptional pilot skill or strength, by either the deactivation of the system, or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.	
25.672(c)	(b) (4)	14 CFR (c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system– (1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered; (2) The controllability and maneuverability requirements of this part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and airplane configurations) which is described in the Airplane Flight Manual; and (3) The trim, stability, and stall characteristics are not impaired below a level needed to permit continued safe flight and landing. CS (c) (1) The aeroplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered. (See AMC 25.672 (c)(1).)	
25.675 Control System Stops			
25.675(a)	(b) (4)	(a) Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.675(b)	(b) (4)	(b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely affect the control characteristics of the airplane because of a change in the range of surface travel.	(b) (4) [redacted]
25.677 Control System – Trim Systems			
25.677(a)	(b) (4)	(a) Trim controls must be designed to prevent inadvertent or abrupt operation and to operate in the plane, and with the sense of motion, of the airplane.	
25.677(b)	(b) (4)	(b)There must be means adjacent to the trim control to indicate the direction of the control movement relative to the airplane motion. In addition, there must be clearly visible means to indicate the position of the trim device with respect to the range of adjustment. The indicator must be clearly marked with the range within which it has been demonstrated that takeoff is safe for all center of gravity positions approved for takeoff.	
25.677(c)	(b) (4)	(c) Trim control systems must be designed to prevent creeping in flight. Trim tab controls must be irreversible unless the tab is appropriately balanced and shown to be free from flutter.	
25.677(d)	(b) (4)	(d) If an irreversible tab control system is used, the part from the tab to the attachment of the irreversible unit to the airplane structure must consiste of a rigid connection.	
25.679 Control System – Gust Locks			
25.679(a)	(b) (4)	14 CFR (a) There must be a device to prevent damage to the control surfaces (including tabs), and to the control system, from gusts striking the airplane while it is on the ground or water. If the device, when engaged, prevents normal operation of the control surfaces by the pilot, it must– (1) Automatically disengage when the pilot operates the primary flight controls in a normal manner; or (2) Limit the operation of the airplane so that the pilot receives unmistakable warning at the start of takeoff. CS (a)(2) Limit the operation of the airplane so that the pilot receives unmistakable warning at the start of takeoff. (See AMC 25.679(a)(2).)	
25.679(b)	(b) (4)	14 CFR (b) The device must have means to preclude the possibility of it becoming inadvertently engaged in flight. CS (b) The device must have means to preclude the possibility of it becoming inadvertently engaged in flight. (See AMC 25.679 (b).)	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System

CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.685 Control System Details			
25.685(a)	(b) (4)	14 CFR (a) Each detail of each control system must be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture. CS (a) Each detail of each control system must be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, loose objects or the freezing of moisture. (See AMC25.685 (a).)	(b) (4) [redacted]
25.685(b)	(b) (4)	(b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.	
25.685(c)	(b) (4)	(c) There must be means to prevent the slapping of cables or tubes against other parts.	
25.689 Cables Systems			
25.689(a)	(b) (4)	(a) Each cable, cable fitting, turnbuckle, splice, and pulley must be approved. In addition – (1) No cable smaller than 1/8 inch in diameter may be used in the aileron, elevator, or rudder systems; and (2) Each cable system must be designed so that there will be no hazardous change in cable tension throughout the range of travel under operating conditions and temperature variations.	
25.689(b)	(b) (4)	(b) Each kind and size of pulley must correspond to the cable with which it is used. Pulleys and sprockets must have closely fitted guards to prevent the cables and chains from being displaced or fouled. Each pulley must lie in the plane passing through the cable so that the cable does not rub against the pulley flange.	
25.689(c)	(b) (4)	(c) Fairleads must be installed so that they do not cause a change in cable direction of more than three degrees.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.689(d)	(b) (4)	(d) Clevis pins subject to load or motion and retained only by cotter pins may not be used in the control system.	(b) (4)
25.689(e)	(b) (4)	(e) Turnbuckles must be attached to parts having angular motion in a manner that will positively prevent binding throughout the range of travel.	
25.689(f)	(b) (4)	(f) There must be provisions for visual inspection of fairleads, pulleys, terminals, and turnbuckles.	
25.703 Takeoff Warning System			
25.703	(b) (4)	A takeoff warning system must be installed and must meet the following requirements:	
25.703(a)(2)	(b) (4)	14 CFR (a) The system must provide to the pilots an aural warning that is automatically activated during the initial portion of the takeoff roll if the airplane is in a configuration, including any of the following, that would not allow a safe takeoff: (2) Wing spoilers (except lateral control spoilers meeting the requirements of § 25.671), speed brakes, or longitudinal trim devices are in a position that would not allow a safe takeoff.	
25.703(b)	(b) (4)	14 CFR (b) The warning required by paragraph (a) of this section must continue until– (1) The configuration is changed to allow a safe takeoff; (2) Action is taken by the pilot to terminate the takeoff roll, (3) The airplane is rotated for takeoff; or (4) The warning is manually deactivated by the pilot. CS (b) The aural warning required by sub-paragraph (a) of this paragraph must continue until– (1) The take-off configuration is changed to allow a safe take-off; (2) Action is taken by the pilot to terminate the takeoff roll; (3) The aeroplane is rotated for take-off; or (4) The warning is manually silenced by the pilot. The means to silence the warning must not be readily available to the flight crew such that it could be operated instinctively, inadvertently, or by habitual reflexive action. Before each take-off, the warning must be rearmed automatically, or manually if the absence of automatic rearming is clear and unmistakable.	
25.703(c)	(b) (4)	14 CFR (c) The means used to activate the system must function properly throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested. CS (c) The means used to activate the system must function properly for all authorised take-off power settings and procedures, and throughout the ranges of take-off weights, altitudes, and temperatures for which certification is requested.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System

CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.777 Cockpit Controls			
25.777(a)	(b) (4)	(a) Each cockpit control must be located to provide convenient operation and to prevent confusion and inadvertent operation.	(b) (4) [redacted]
25.777(b)	(b) (4)	(b) The direction of movment of cockpit controls must meet the requirements of § 25.779. Wherever practicable, the sense of motion involved in the operation of other controls must correspond to the sense of the effect of the operation upon the airplane or upon the part operated. Controls of a variable nature using a rotary motion must move clockwise from the off position, through an increasing range, to the full on position.	
25.777(c)	(b) (4)	(c) The controls must be located and arranged, with respect to the pilots' seats, so that there is full and unrestricted movement of each control without interference from the cockpit structure or the clothing of the minimum flight crew (established under § 25.1523) when any member of this flight crew, from 5'2" to 6'3" in height, is seated with the seat belt and should harness (if provided) fastened.	
25.779 Motion and Effect of Cockpit Controls			
25.779	(b) (4)	Cockpit controls must be designed so that they operate in accordance with the following movement and actuation:	
25.779(a)(2)		(a) Aerodynamic controls: (2) *Secondary.* **Controls** / **Motion and effect** Flaps (or auxiliary lift devices) — Forward for flaps up; rearward for flaps down. Trim tabs (or equivalent) — Rotate to produce similar rotation of the airplane about an axis parallel to the axis of the control.	
25.863 Flammable Fluid Fire Protection			
25.863(a)	(b) (4)	CFR (a) In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazards if ignition does occur. CS (a) In each area where flammable fluids or vapours might escape by leakage of a fluid system, there must be means to minimise the probability of ignition of the fluids and vapours, and the resultant hazards if ignition does occur. (See AMC 25.863 (a).)	
25.863(b)	(b) (4)	(b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered: (1) Possible sources and paths of fluid leakage, and means of detecting leakage. (2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials. (3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices. (4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents. (5) Ability of airplane components that are critical to safety of flight to withstand fire and heat.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1301 Function and Installation			
25.1301(a)	(b) (4)	14 CFR (a) Each item of installed equipment must - (1) Be of a kind and design appropriate to its intended function; (2) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors; (3) Be installed according to limitations specified for that equipment. (4) Function properly when installed. CS (See AMC 25.1301) (2) Be labelled as to its identification, function, or operating limitations, or any applicable combination of these factors. (See AMC 25.1301 (a)(2).)	(b) (4) [redacted]

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1309 Equipment, Systems and Installation			(b) (4)
25.1309(a)	(b) (4)	14 CFR (a) The equipment, systems, and installations whose functioning is required by this subchapter, must be designed to ensure that they perform their intended functions under any foreseeable operating condition. CS (See AMC 25.1309) (a) The aeroplane equipment and systems must be designed and installed so that: (1) Those required for type certification or by operating rules, or whose improper functioning would reduce safety, perform as intended under the aeroplane operating and environmental conditions. (2) Other equipment and systems are not a source of danger in themselves and do not adversely affect the proper functioning of those covered by sub-paragraph (a)(1) of this paragraph.	
25.1309(b)	(b) (4)	14 CFR (b) The airplane systems and associated components, considered separately and in relation to other systems, must be designed so that— (1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable, and (2) The occurrence of any other failure conditions which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions is improbable. CS (b) The aeroplane systems and associated components, considered separately and in relation to other systems, must be designed so that- (1) Any catastrophic failure condition (i) is extremely improbable; and (ii) does not result from a single failure; and (2) Any hazardous failure condition is extremely remote; and (3) Any major failure condition is remote.	
25.1309(c)	(b) (4)	14 CFR (c) Warning information must be provided to alert the crew to unsafe system operating conditions, and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors which could create additional hazards. CS (c) Information concerning unsafe system operating conditions must be provided to the crew to enable them to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. Systems and controls, including indications and annunciations must be designed to minimise crew errors, which could create additional hazards.	
25.1309(d)	(b) (4)	14 CFR (d) Compliance with the requirements of paragraph (b) of this section must be shown by analysis, and where necessary, by appropriate ground, flight, or simulator tests. The analysis must consider– (1) Possible modes of failure, including malfunctions and damage from external sources. (2) The probability of multiple failures and undetected failures. (3) The resulting effects on the airplane and occupants, considering the stage of flight and operating conditions, and (4) The crew warning cues, corrective action required, and the capability of detecting faults. CS (d) Electrical wiring interconnection systems must be assessed in accordance with the requirements of CS 25.1709.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1309(e)	(b) (4)	(e) In showing compliance with paragraphs (a) and (b) of this section with regard to the electrical system and equipment design and installation, critical environmental conditions must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this chapter, except equipment covered by Technical Standard Orders containing environmental test procedures, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other aircraft.	(b) (4)
25.1316 Electrical and Electronic System Lightning Prote			
25.1316(a)	(b) (4)	CFR (a) Each electrical and electronic system that performs a function, for which failure would prevent the continued safe flight and landing of the airplane, must be designed and installed so that— (1) The function is not adversely affected during and after the time the airplane is exposed to lightning; and (2) The system automatically recovers normal operation of that function in a timely manner after the airplane is exposed to lightning. CS (a) For functions whose failure would contribute to or cause a condition that would prevent the continued safe flight and landing of the aeroplane, each electrical and electronic system that performs these functions must be designed and installed to ensure that the operation and operation capabilities of the systems to perform these functions are not adversely affected when the aeroplane is exposed to lightning.	
25.1316(b)	(b) (4)	CFR (b) Each electrical and electronic system that performs a function, for which failure would reduce the capability of the airplane or the ability of the flightcrew to respond to an adverse operating condition, must be designed and installed so that the function recovers normal operation in a timely manner after the airplane is exposed to lightning. CS (b) For functions whose failure would contribute to or cause a condition that would reduce the capability of the aeroplane or the ability of the flight crew to cope with adverse operating conditions, each electrical and electronic system that performs these functions must be designed and installed to ensure that these functions can be recovered in a timely manner after the aeroplane is exposed to lightning.	
25.1317 High-Intensity Radiate Fields (HIRF) Protection			
25.1317(a)	(b) (4)	(a) Except as provided in paragraph (d) of this section, each electrical and electronic system that performs a function whose failure would prevent the continued safe flight and landing of the airplane must be designed and installed so that— (1) The function is not adversely affected during and after the time the airplane is exposed to HIRF environment I, as described in appendix L to this part; (2) The system automatically recovers normal operation of that function, in a timely manner, after the airplane is exposed to HIRF environment I, as described in appendix L to this part, unless the system's recovery conflicts with other operational or functional requirements of the system; and (3) The system is not adversely affected during and after the time the airplane is exposed to HIRF environment II, as described in appendix L to this part.	
25.1317(c)	(b) (4)	(c) Each electrical and electronic system that performs a function whose failure would reduce the capability of the airplane or the ability of the flightcrew to respond to an adverse operating condition must be designed and installed so the system is not adversely affected when the equipment providing the function is exposed to equipment HIRF test level 3, as described in appendix L to this part.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1353 Electrical Equipment and Installations			
25.1353(a)	(b) (4)	CFR (a) Electrical equipment and controls must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to safe operation. Any electrical interference likely to be present in the airplane must not result in hazardous effects on the airplane or its systems. CS (a) Electrical equipment and controls must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to the safe operation. Any electrical interference likely to be present in the aeroplane must not result in hazardous effects upon the aeroplane or its systems except under extremely remote conditions. (See AMC 25.1352 (a).)	(b) (4)
25.1365 Electrical Appliances, Motors, and Transformers			
25.1365(d)	(b) (4)	(d) Unless compliance with §25.1309(b) is provided by the circuit protective device required by §25.1357(a), electric motors and transformers, including those installed in domestic systems, must have a suitable thermal protection device to prevent overheating under normal operation and failure conditions, if overheating could create a smoke or fire hazard.	
25.1431 Electronic Equipment			
25.1431(a)	(b) (4)	(a) In showing compliance with §25.1309 (a) and (b) with respect to radio and electronic equipment and their installations, critical environmental conditions must be considered.	
25.1431(c)	(b) (4)	(c) Radio and electronic equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other radio or electronic unit, or system of units, required by this chapter.	
25.1431(d)	(b) (4)	(d) Electronic equipment must be designed and installed such that it does not cause essential loads to become inoperative as a result of electrical power supply transients or transients from other causes.	
25.1535 ETOPS Approval			
25.1535	(b) (4)	14 CFR Except as provided in Sec. 25.3, each applicant seeking ETOPS type design approval must comply with the provisions of Appendix K of this part. CS To determine an aircraft configuration capable of ETOPS, the following must be complied with: (a) Comply with the requirements of CS-25 considering the maximum flight duration and the longest diversion time for which approval is being sought. (b) Consider crew workload and operational implications and the flight crew's and passengers' physiological needs of continued operations with failure effects for the longest diversion time for which approval is being sought. (c) Establish appropriate capability and limitations. (See AMC 20-6.)	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1541 Markings and Placards – General			
25.1541(a)	(b) (4)	(a) The airplane must contain– (1) The specified markings and placards; and (2) Any additional information, instrument markings, and placards required for the safe operation if there are unusual design, operating, or handling characteristics.	(b) (4)
25.1541(b)	(b) (4)	(b) Each marking and placard prescribed in paragraph (a) of this section– (1) Must be displayed in a conspicuous place; and (2) May not be easily erased, disfigured, or obscured.	
25.1703 Function and Installation: EWIS			
25.1703(a)	(b) (4)	14 CFR (a) Each EWIS component installed in any area of the aircraft must: (1) Be of a kind and design appropriate to its intended function. (2) Be installed according to limitations specified for the EWIS components. (3) Perform the function for which it was intended without degrading the airworthiness of the airplane. (4) Be designed and installed in a way that will minimize mechanical strain. CS (a) Each EWIS component installed in any area of the aeroplane must: (1) Be of a kind and design appropriate to its intended function. (2) Be installed according to limitations specified for the EWIS components. (3) Function properly when installed. (4) Be designed and installed in a way that will minimise mechanical strain.	
25.1703(b)	(b) (4)	(b) Selection of wires must take into account known characteristics of the wire in relation to each installation and application to minimize the risk of wire damage, including any arc tracking phenomena.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1703(c)		(c) The design and installation of the main power cables (including generator cables) in the fuselage must allow for a reasonable degree of deformation and stretching without failure.	(b) (4)
25.1703(d)	(b) (4)	(d) EWIS components located in areas of known moisture accumulation must be protected to minimize any hazardous effects due to moisture.	
25.1705 Systems and Functions: EWIS			
25.1705(a)	(b) (4)	(a) EWIS associated with any system required for type certification or by operating rules must be considered an integral part of that system and must be considered in showing compliance with the applicable requirements for that system.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1705(b)		14 CFR (b) For systems to which the following rules apply, the components of EWIS associated with those systems must be considered an integral part of that system or systems and must be considered in showing compliance with the applicable requirements for that system. (1) §25.773(b)(2) Pilot compartment view. (2) §25.981 Fuel tank ignition prevention. (3) §25.1165 Engine ignition systems. (4) §25.1310 Power source capacity and distribution. (5) §25.1316 System lightning protection. (6) §25.1331(a)(2) Instruments using a power supply. (7) §25.1351 General. (8) §25.1355 Distribution system. (9) §25.1360 Precautions against injury. (10) §25.1362 Electrical supplies for emergency conditions. (11) §25.1365 Electrical appliances, motors, and transformers. (12) §25.1431(c) and (d) Electronic equipment. CS (b) For systems to which the following rules apply, the components of EWIS associated with those systems must be considered an integral part of that system or systems and must be considered in showing compliance with the applicable requirements for that system. (1) CS 25.773(b)(2) Pilot compartment view. (2) CS 25.854 Lavatory fire protection (3) CS 25.858 Cargo compartment fire detection systems (4) CS 25.981 Fuel tank ignition prevention. (5) CS 25.1165 Engine ignition systems. (6) CS 25.1203 Fire-detector systems (7) CS 25.1303(b) Flight and Navigation Instruments (8) CS 25.1310 Power source Capacity and Distribution (9) CS 25.1316 System lightning protection (10) CS 25.1331(a)(2) Instruments using a power supply (11) CS 25.1351 General. (12) CS 25.1355 Distribution system. (13) CS 25.1360 Precautions against injury. (14) CS 25.1362 Electrical supplies for emergency conditions. (15) CS 25.1365 Electrical appliances, motors, and transformers. (16) CS 25.1431(c) and (d) Electronic equipment.	(b) (4)
25.1707 System Separation: EWIS			
25.1707(a)	(b) (4)	(a) Each EWIS must be designed and installed with adequate physical separation from other EWIS and airplane systems so that an EWIS component failure will not create a hazardous condition. Unless otherwise stated, for the purposes of this section, adequate physical separation must be achieved by separation distance or by a barrier that provides protection equivalent to that separation distance.	
25.1707(l)	(b) (4)	(l) Each EWIS must be designed and installed so there is adequate physical separation between it and other aircraft components and aircraft structure, and so that the EWIS is protected from sharp edges and corners, to minimize potential for abrasion/chafing, vibration damage, and other types of mechanical damage.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System

CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1711 Component Identification: EWIS			
25.1711(a)	(b) (4)	(a) EWIS components must be labeled or otherwise identified using a consistent method that facilitates identification of the EWIS component, its function, and its design limitations, if any.	(b) (4) [redacted]
25.1711(c)	(b) (4)	(c) The identifying markings required by paragraphs (a) and (b) of this section must remain legible throughout the expected service life of the EWIS component.	
25.1711(d)	(b) (4)	(d) The means used for identifying each EWIS component as required by this section must not have an adverse effect on the performance of that component throughout its expected service life.	
25.1711(e)	(b) (4)	(e) Identification for EWIS modifications to the type design must be consistent with the identification scheme of the original type design.	
25.1713 Fire Protection: EWIS			
25.1713(c)	(b) (4)	(c) Insulation on electrical wire and electrical cable, and materials used to provide additional protection for the wire and cable, installed in any area of the airplane, must be self-extinguishing when tested in accordance with the applicable portions of Appendix F, part I, of 14 CFR part 25.	
25.1715 Electrical Bonding and Protection Against Static			
25.1715(a)	(b) (4)	(a) EWIS components used for electrical bonding and protection against static electricity must meet the requirements of §25.899.	

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
25.1715(b)	(b) (4)	14 CFR (b) On airplanes having grounded electrical systems, electrical bonding provided by EWIS components must provide an electrical return path capable of carrying both normal and fault currents without creating a shock hazard or damage to the EWIS components, other airplane system components, or airplane structure. CS (b) Electrical bonding provided by EWIS components must provide an adequate electrical return path under both normal and fault conditions, on aeroplanes having earthed electrical systems (see CS 25.1353(e)).	(b) (4)
25.1719 Accessibility Provisions: EWIS			
25.1719	(b) (4)	14 CFR Access must be provided to allow inspection and replacement of any EWIS component as necessary for continued airworthiness. CS Means must be provided to allow for inspection of EWIS and the replacement of its components as necessary for continued airworthiness.	
25App-K25.1 Extended Operations (ETOPS)			
25.1.1	(b) (4)	The airplane-engine combination must comply with the requirements of part 25 considering the maximum flight time and the longest diversion time for which the applicant seeks approval.	
25.1.2	(b) (4)	An applicant must consider crew workload, operational implications, and the crew's and passengers' physiological needs during continued operation with failure effects for the longest diversion time for which it seeks approval.	
Issue Papers & CRIs			
(b) (4)			

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
(b) (4)			

Table G3-1 Compliance Matrix 737 MAX Stabilizer Trim Control System			
CFR/ CS #	(b) (4)	CFR/CS Text	Compliance
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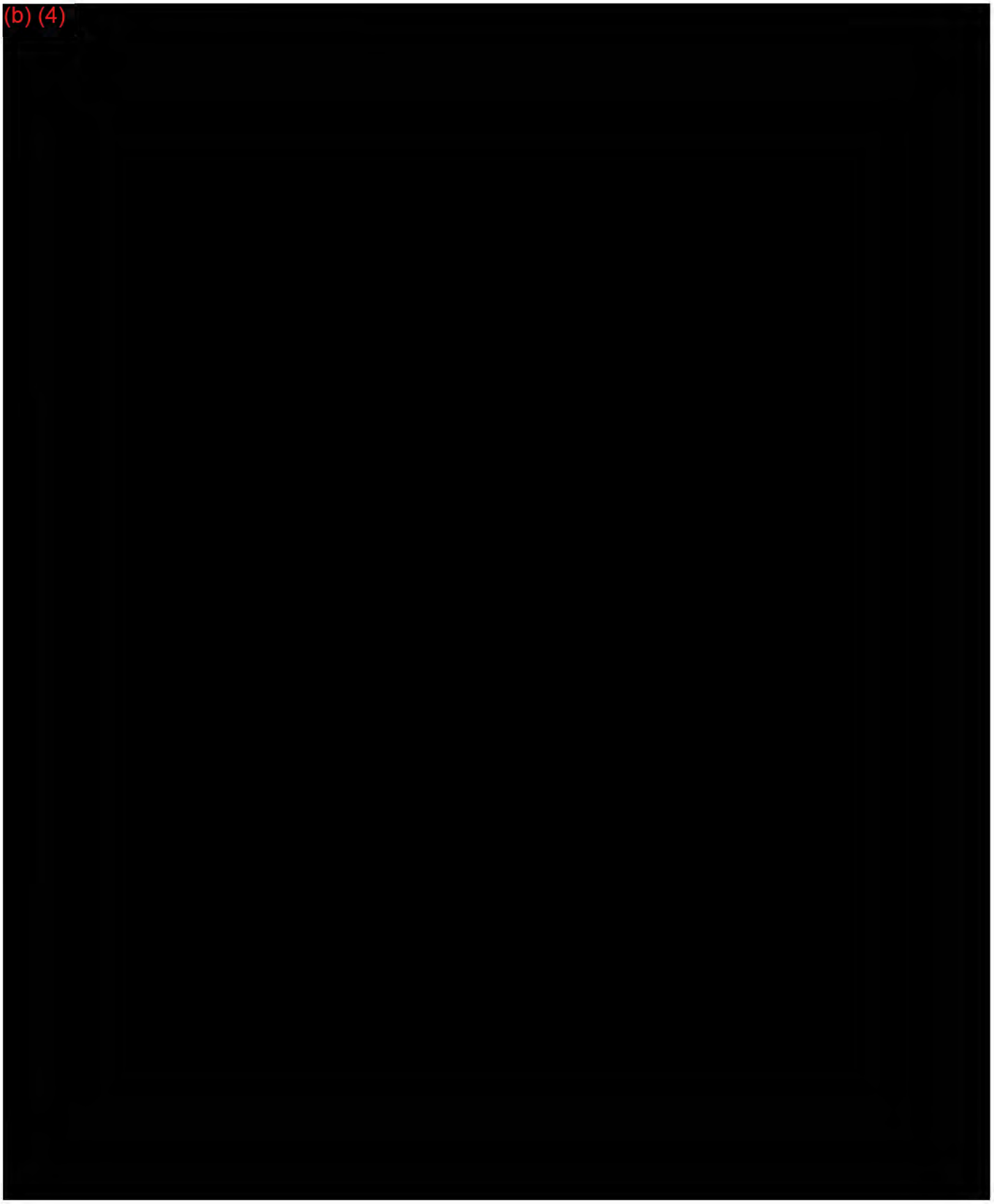

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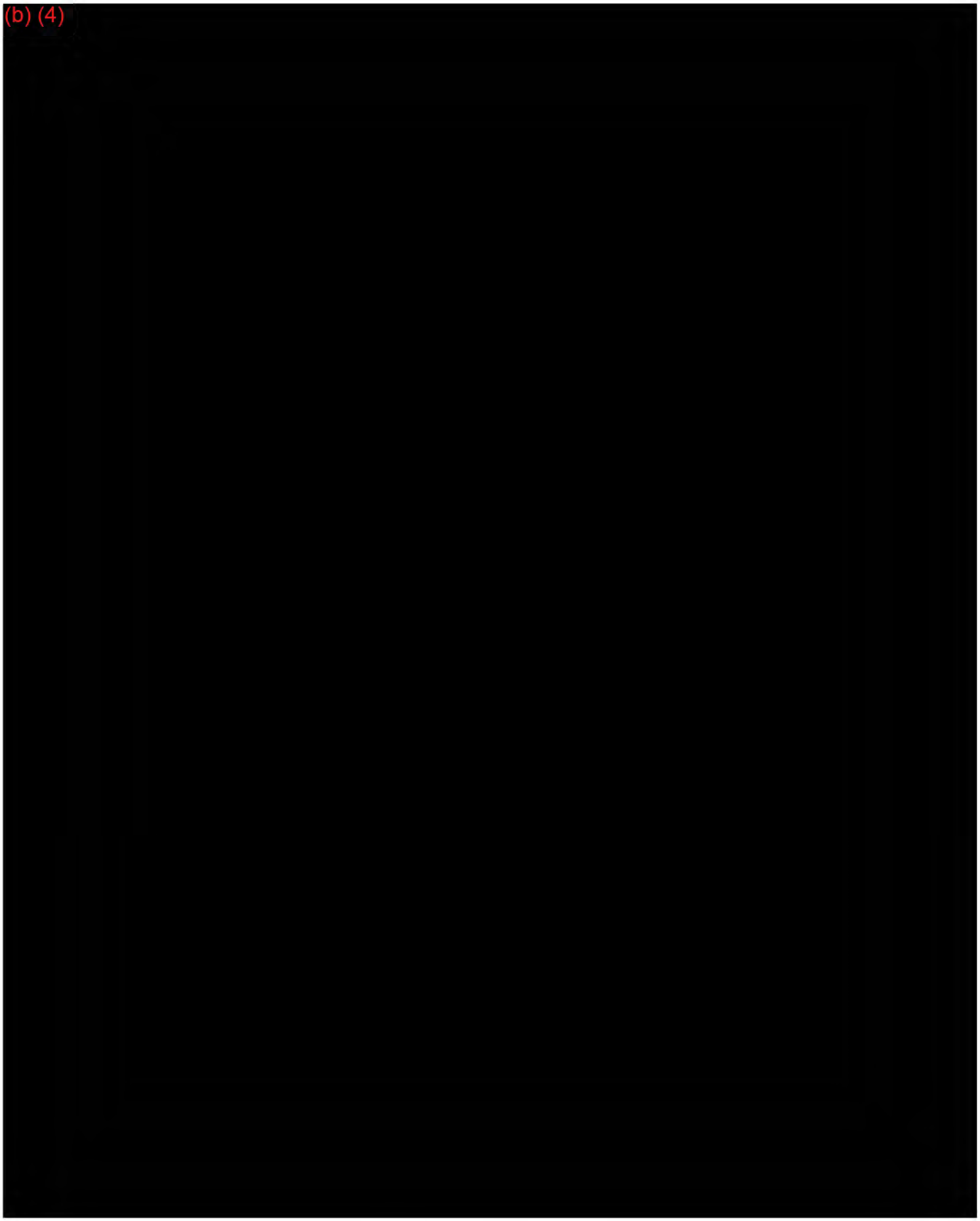

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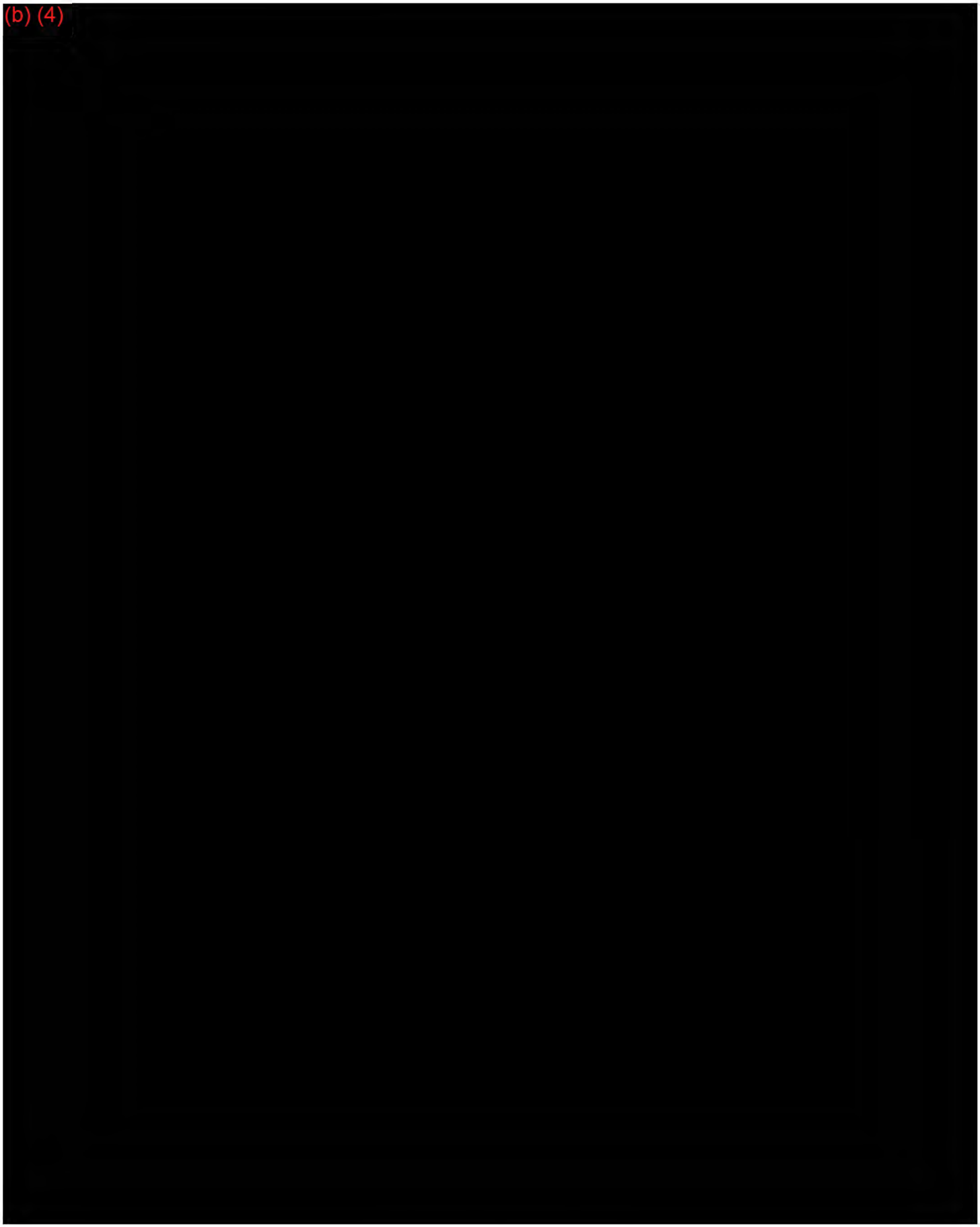

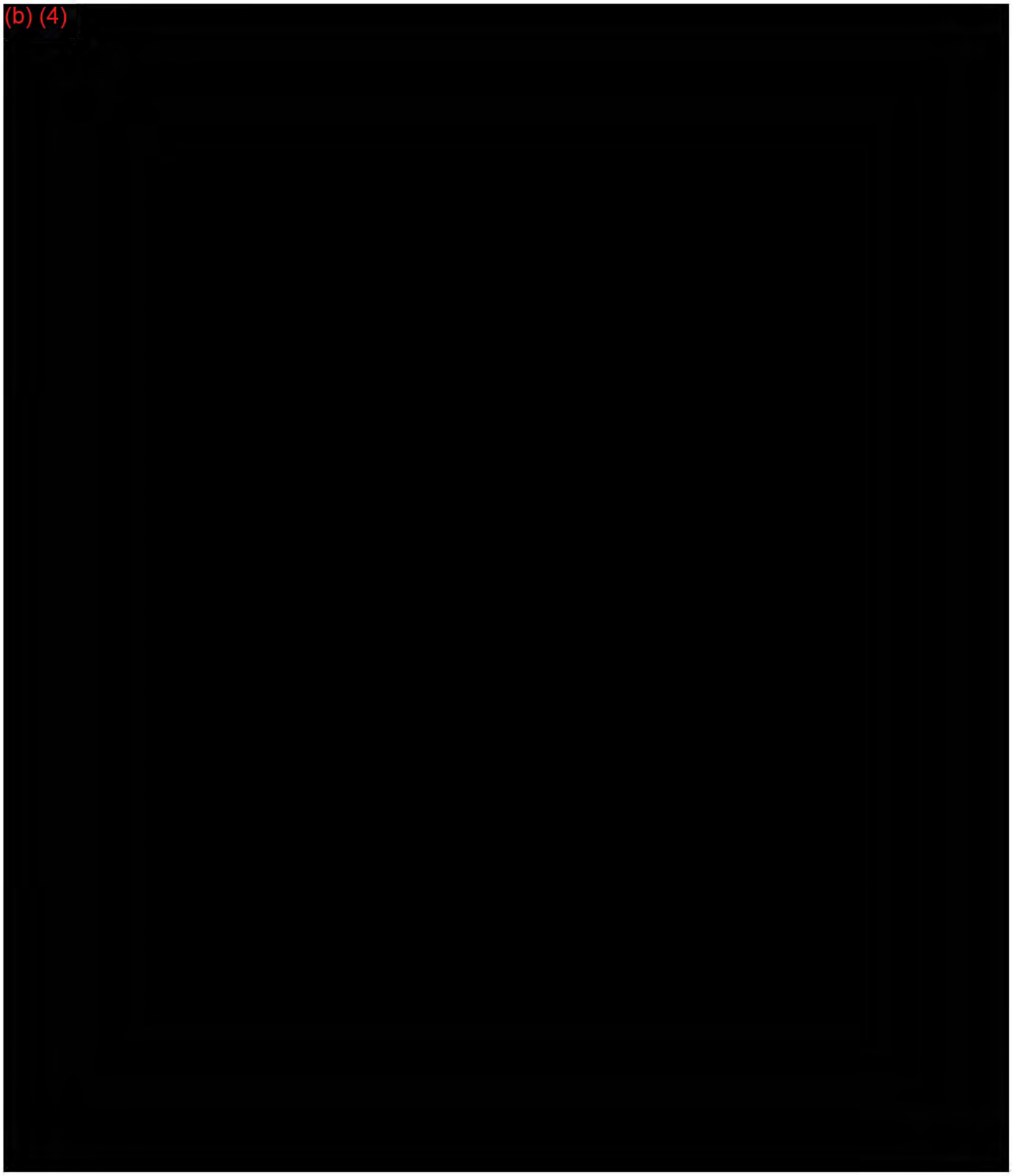
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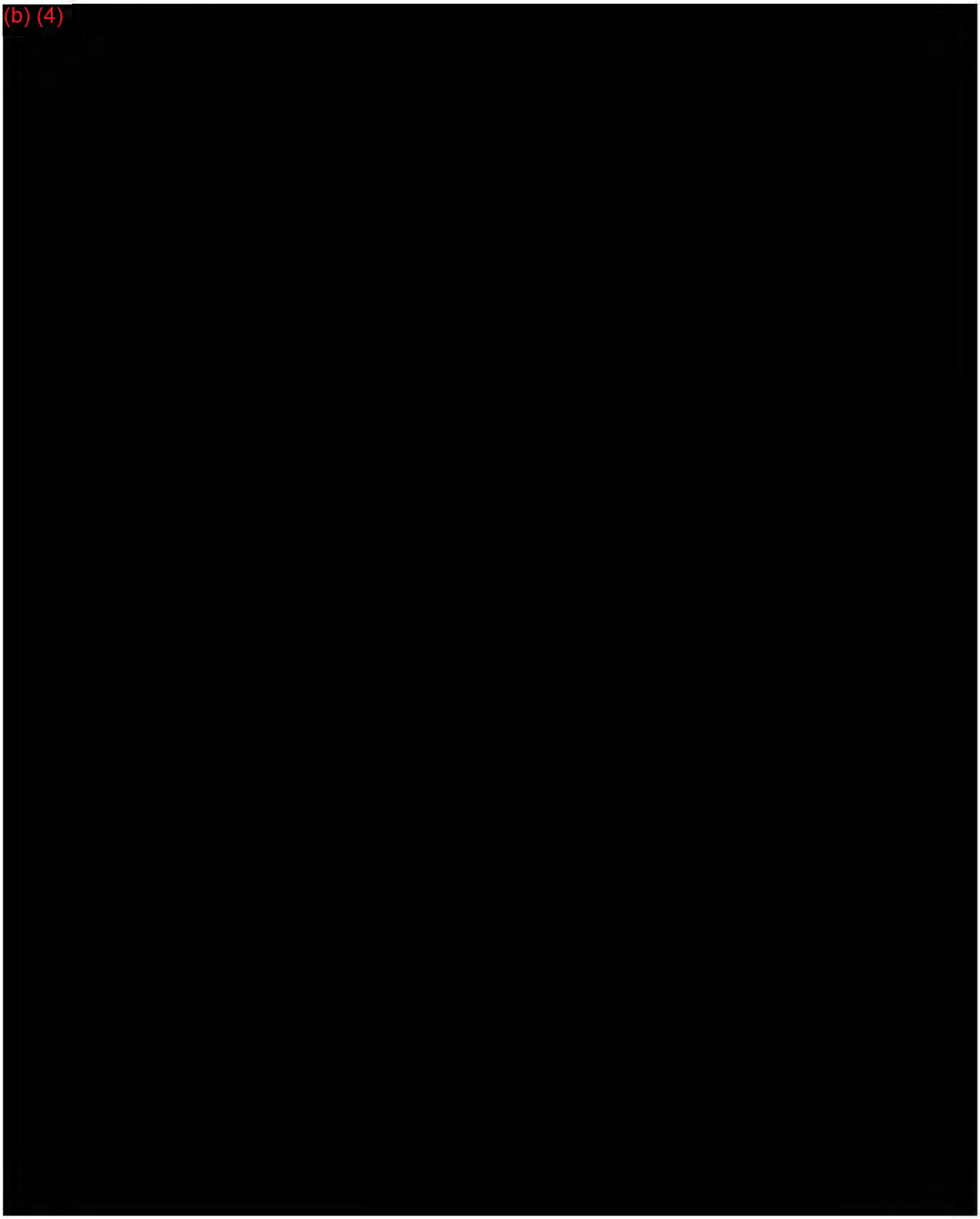

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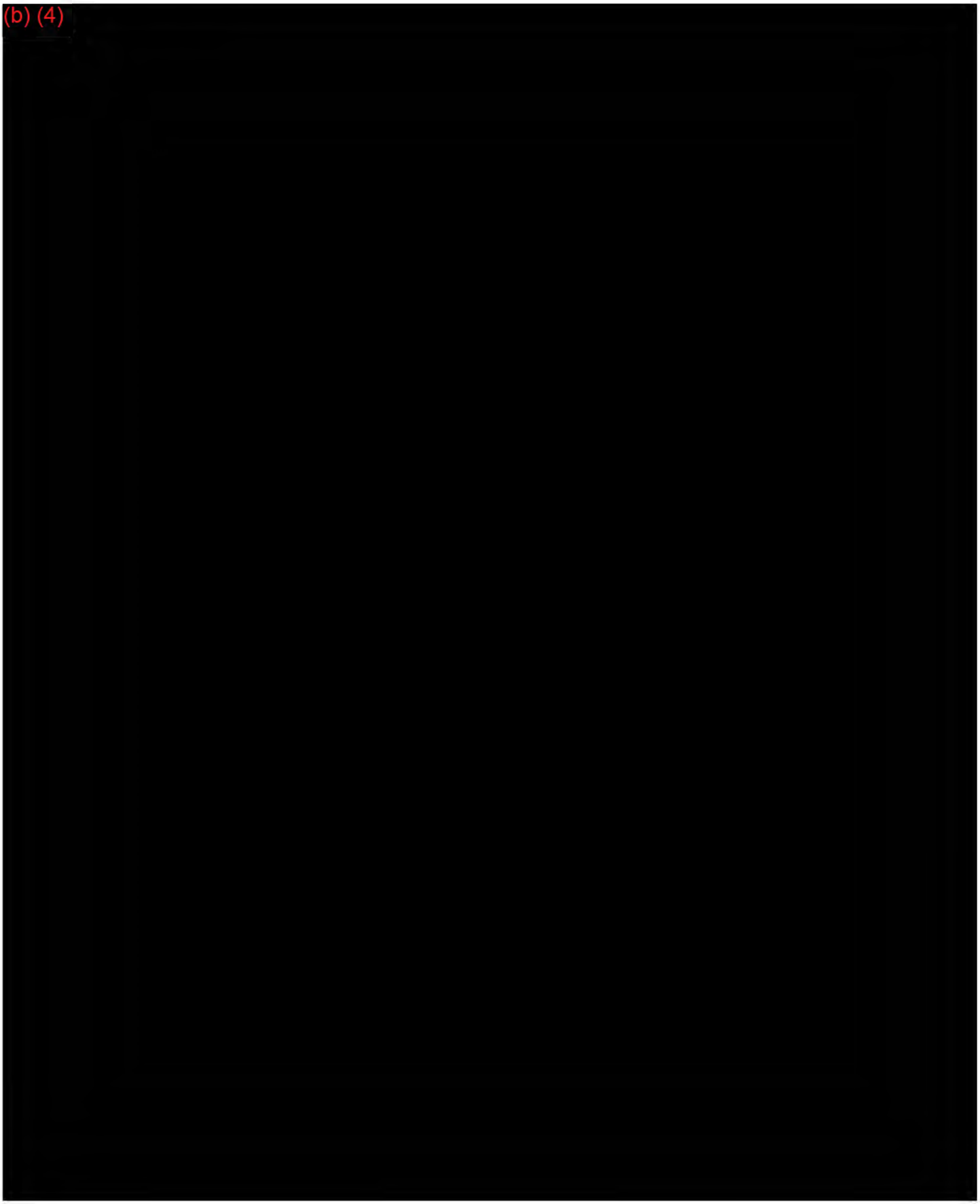

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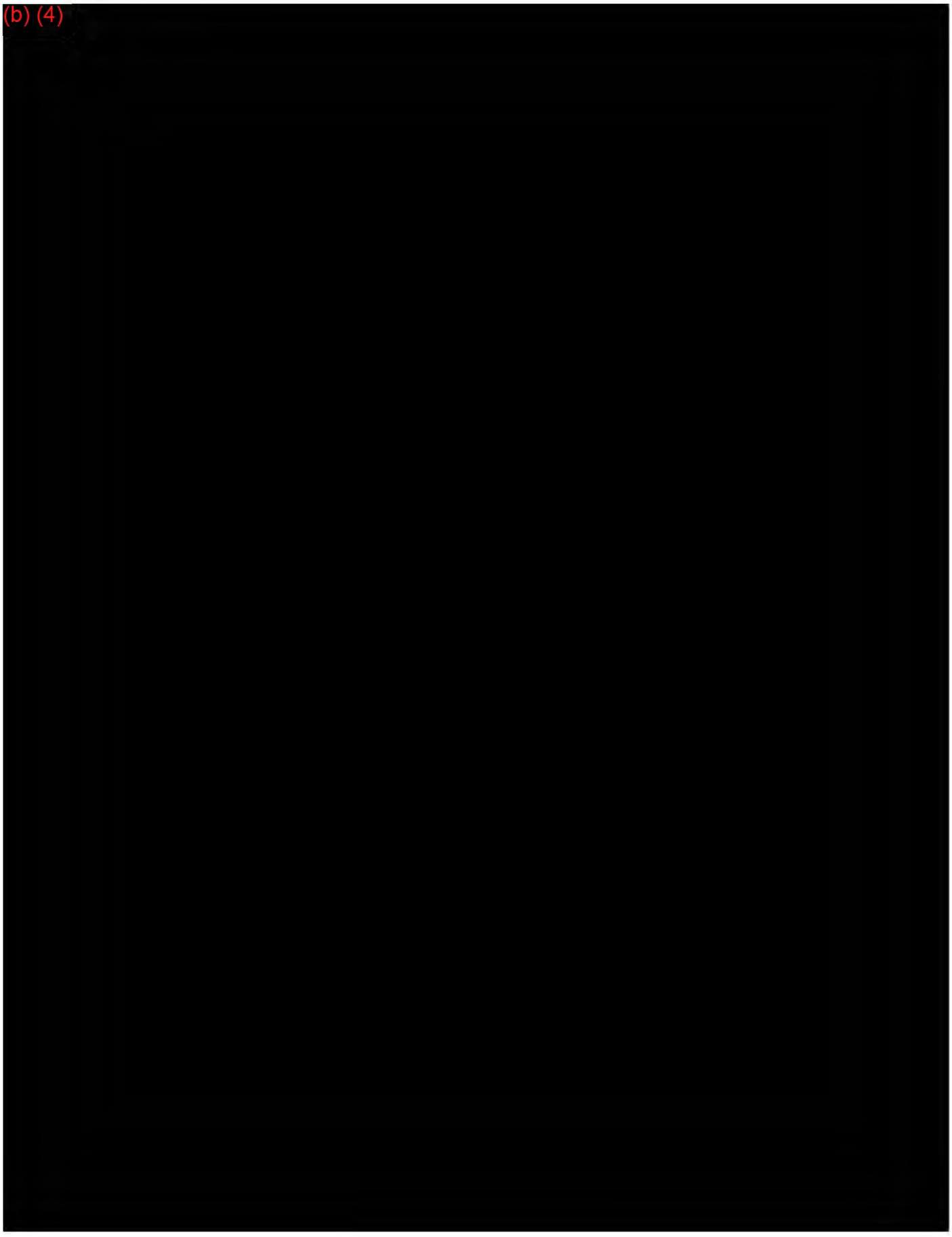

G-4 FUNCTIONAL HAZARD ASSESSMENT SUMMARY (FHA)

This section summarizes the Functional Hazard Assessment (FHA) that was performed as part of the 737 MAX Stabilizer Trim Control System Safety Analysis. This FHA addresses each system function and the result of loss of availability or loss of integrity of that function. The analysis considers the phase of flight, interfacing systems, and established effect categories for each failure condition. Hazard assessments were determined in consideration of the impact to crew workload for the maximum flight time and longest diversion time (where a diversion is required).

(b) (4) in the main body of this document shows the criticality categories used in developing the FHA and the corresponding minimum acceptable probabilities of occurrence.

(b) (4)

For ease of reference and to provide proper context, the FHA Table 4.1 from the main body of this document has been reproduced as Table G4-1 in this appendix. Some hazard assessments are unchanged from the 737 NG safety analysis, while others are new or revised for the 737 MAX. This FHA, combined with the detailed Failure Modes and Effects Analysis (FMEA) in Section G-5, provides most of the framework for the Fault Tree Analysis (FTA) in Section G-6.

(b) (4)

G-4.2 FHA Results

Functional Hazard Assessment findings for the 737 MAX Stabilizer Trim Control System are presented in Table G4-1 below. (b) (4)

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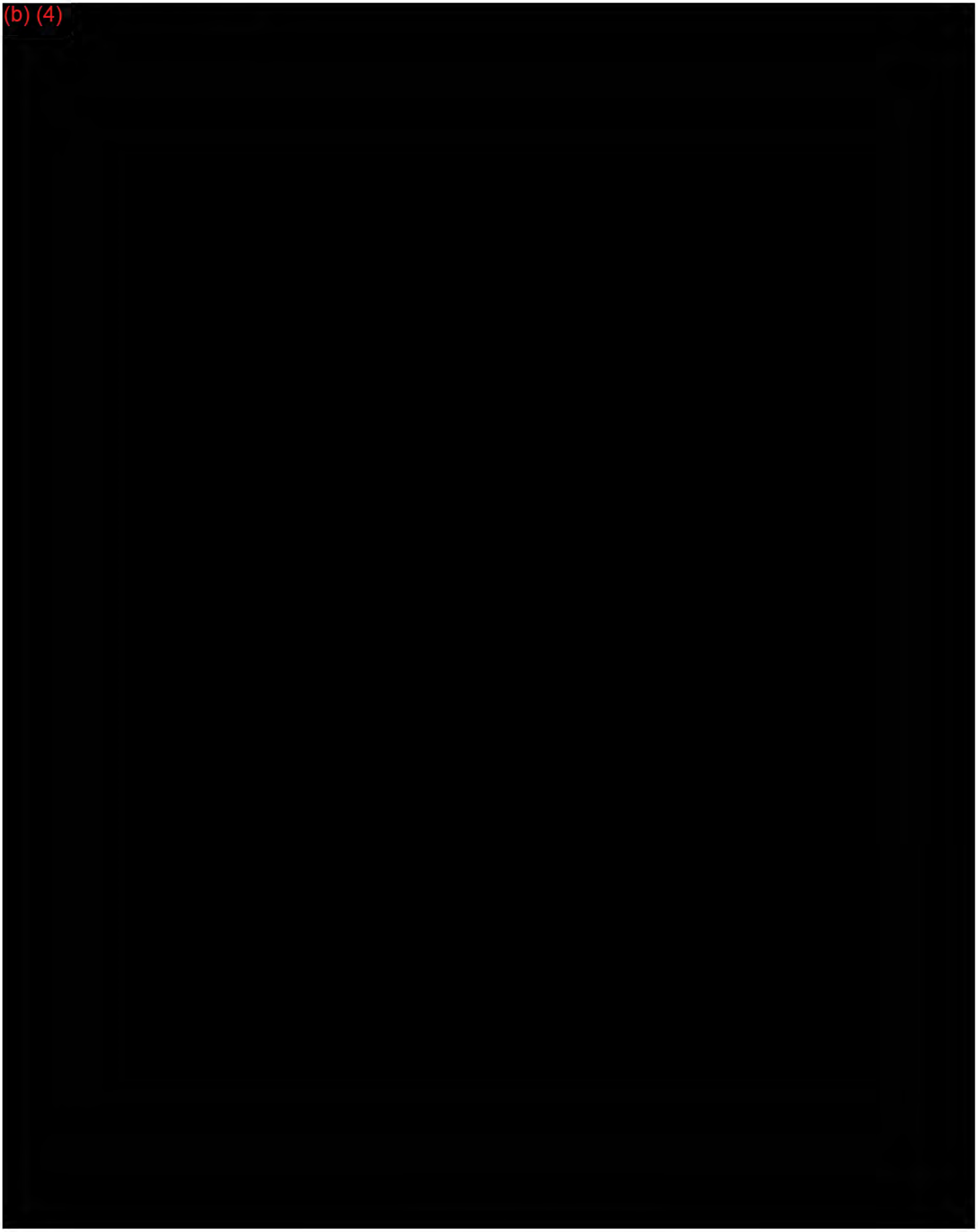

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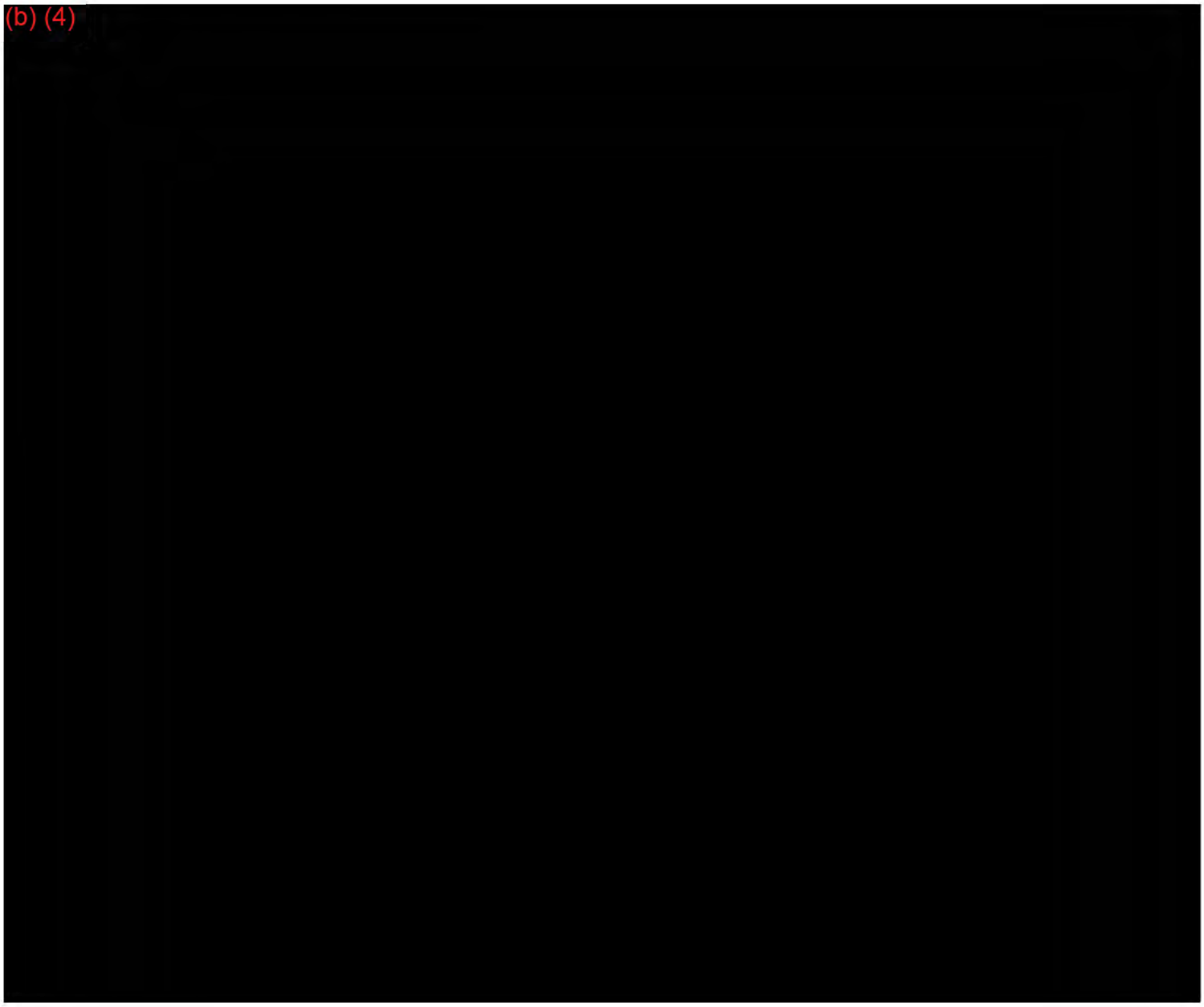

G-5 FAILURE MODES AND EFFECTS ANALYSIS (FMEA)

The Failure Mode and Effects Analysis (FMEA) provides a "bottom up" analysis of the Stabilizer Trim Control System. Due to the architectural changes made to the Stabilizer Trim Control System on the 737 MAX, an updated FMEA is provided in this appendix. (b) (4)

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G-5.1 FMEA Map

The FMEA map is a graphical representation of the functional relationships in the Stabilizer Trim Control System and is intended to aid in the understanding of the FMEA results. Each component in the Stabilizer Trim Control System has been assigned a reference number according to the outline map. These reference numbers are used in column one of the FMEA table to track each component. The figures show the reference number for various components and sub-components as follows:

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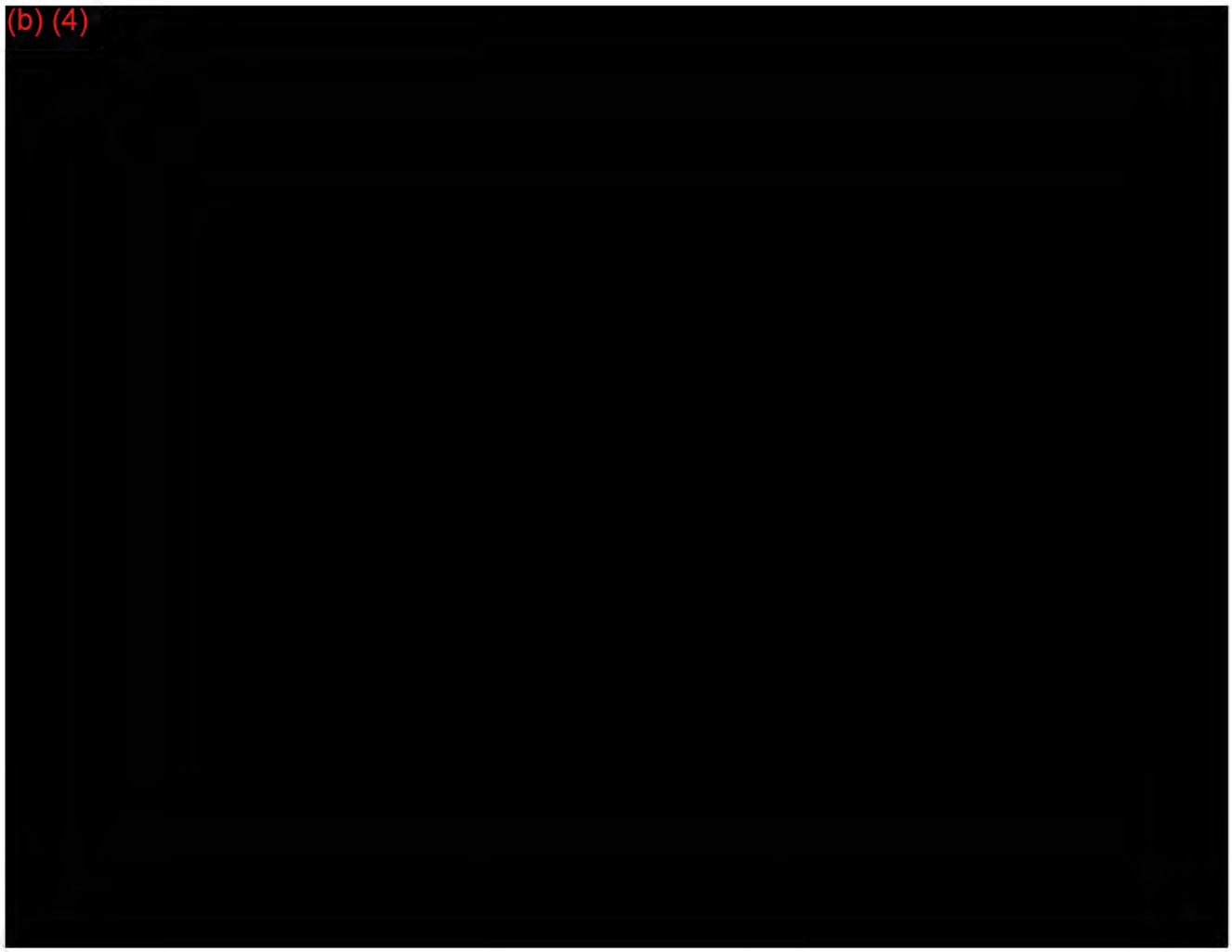

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G-6 FAULT TREE ANALYSIS (FTA)

This section presents the Fault Tree Analysis (FTA) that was developed as part of the Stabilizer Trim Control System safety analysis. The FTA is a tool that is used to quantitatively determine the numerical probability of a certain combination of events. The failure conditions defined by the FHA provide the basis for the top level events analyzed by the FTA to demonstrate compliance with 14 CFR 25.671(c)(2), (c)(3), and 25.1309(b)(1).

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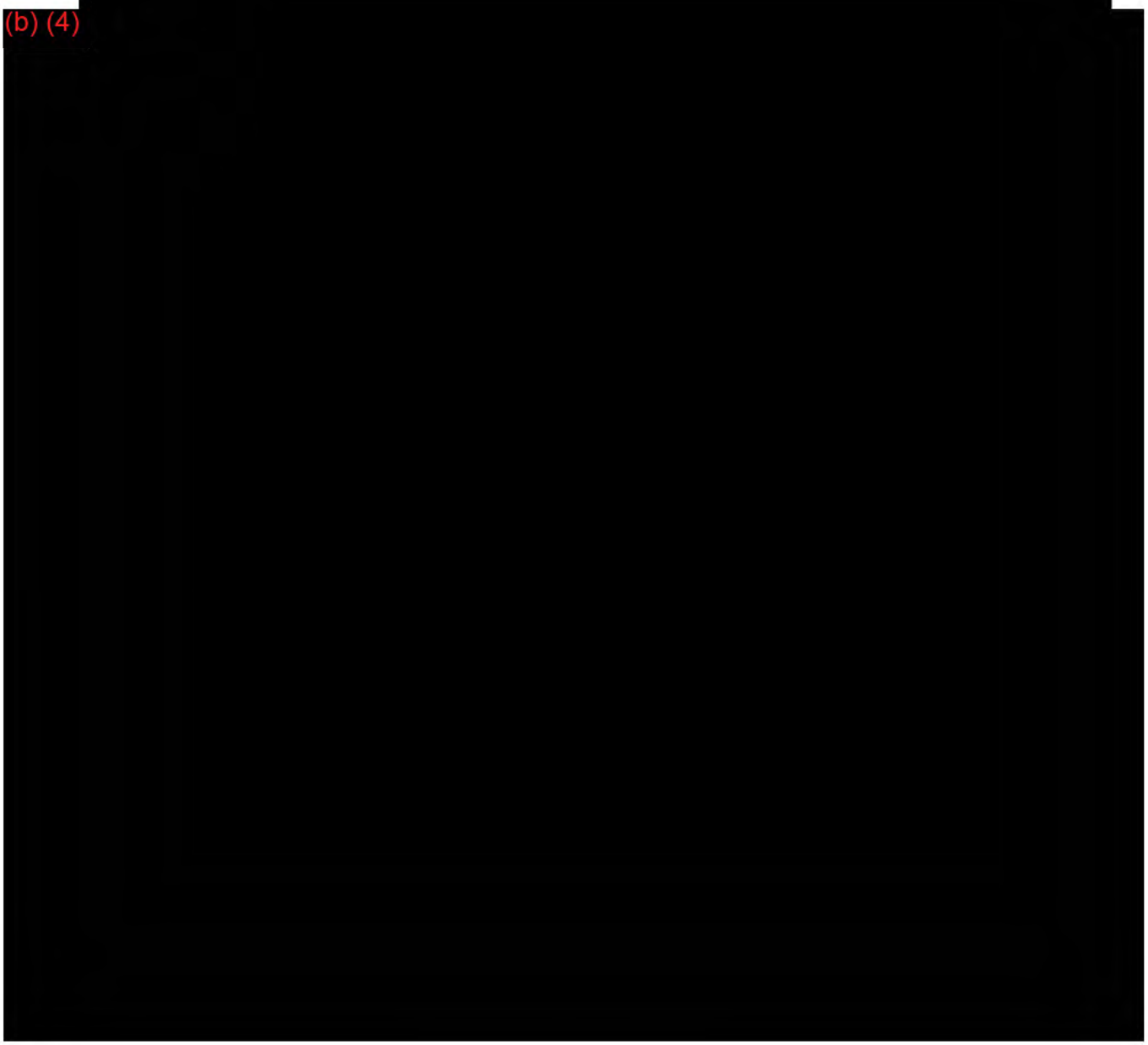

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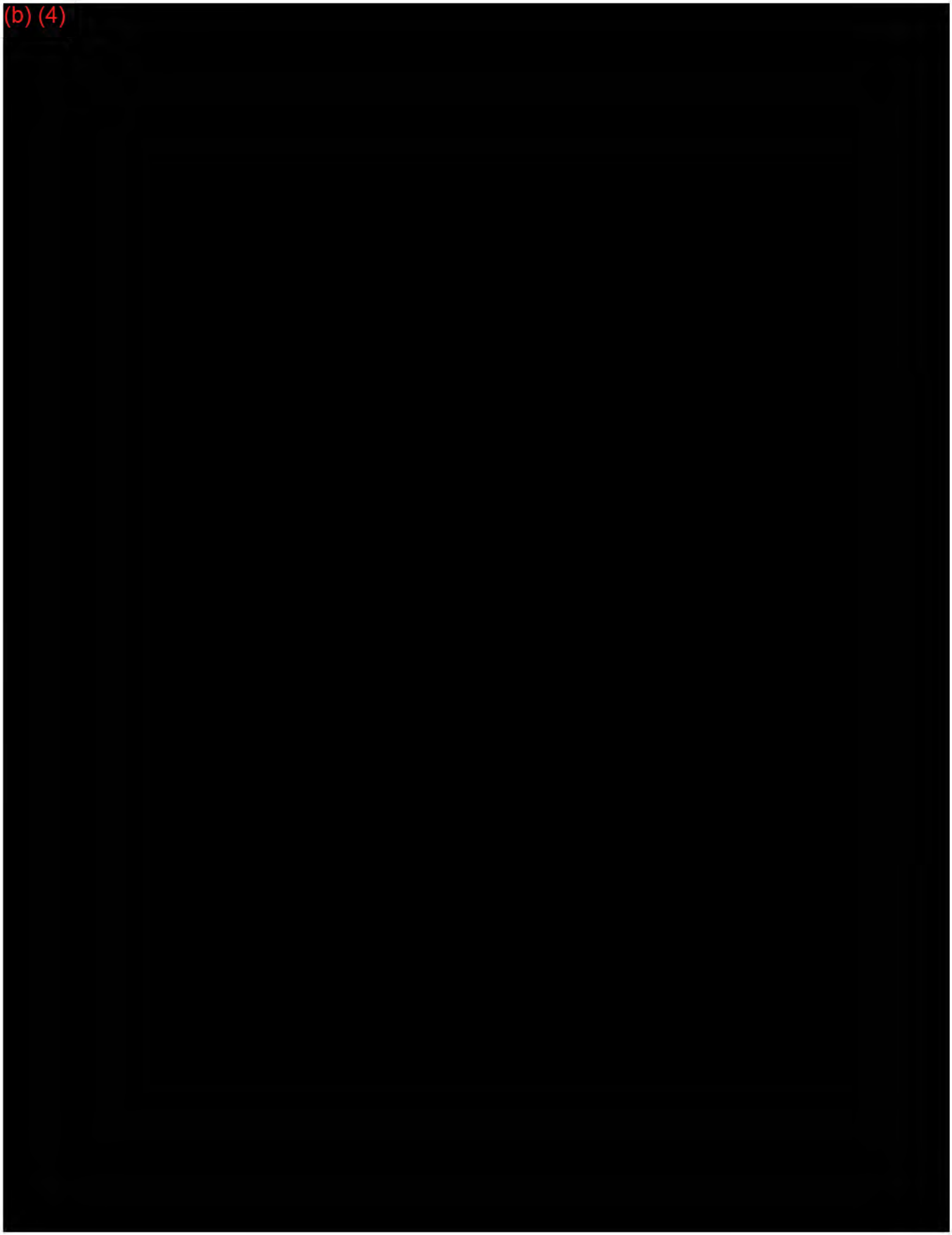


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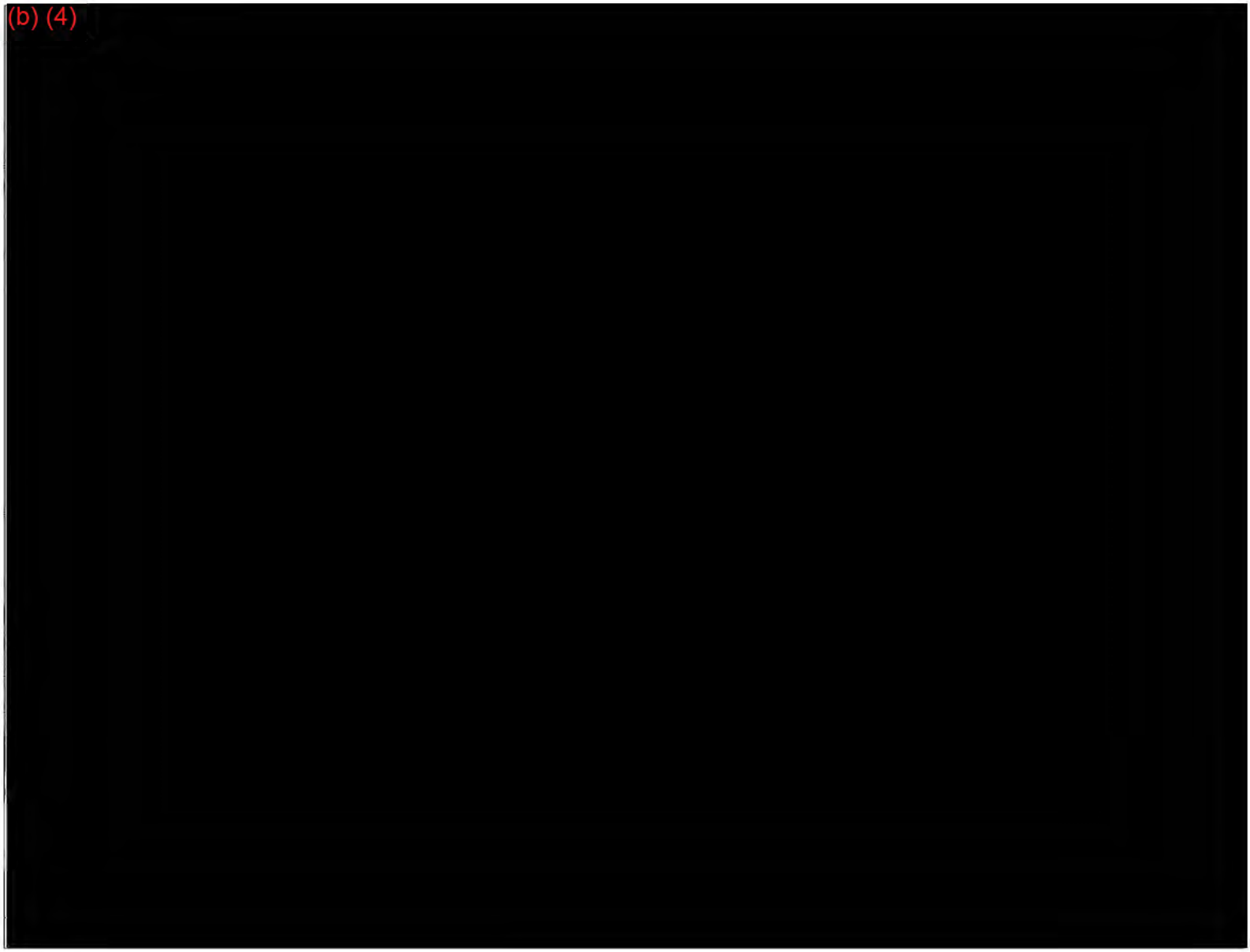
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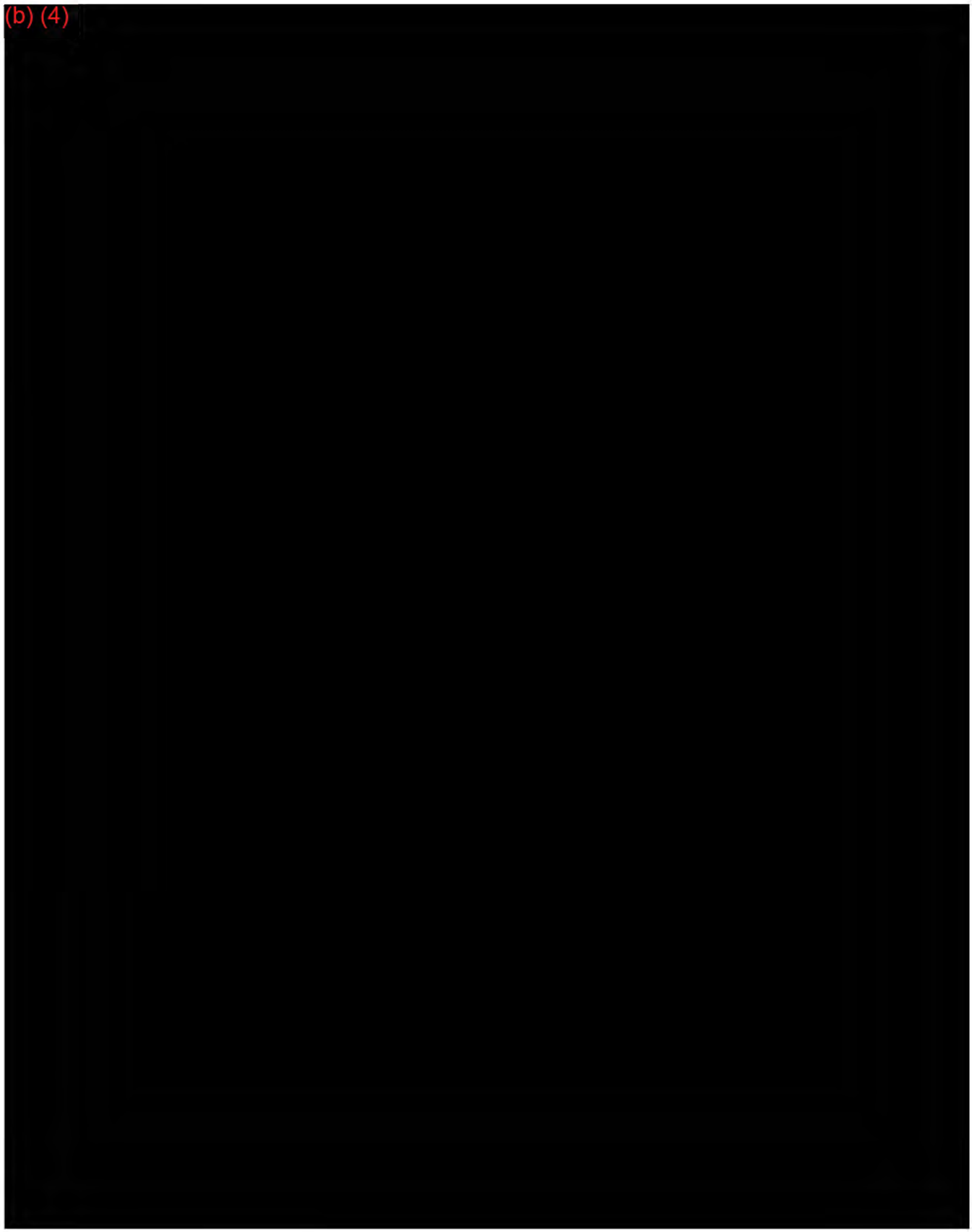
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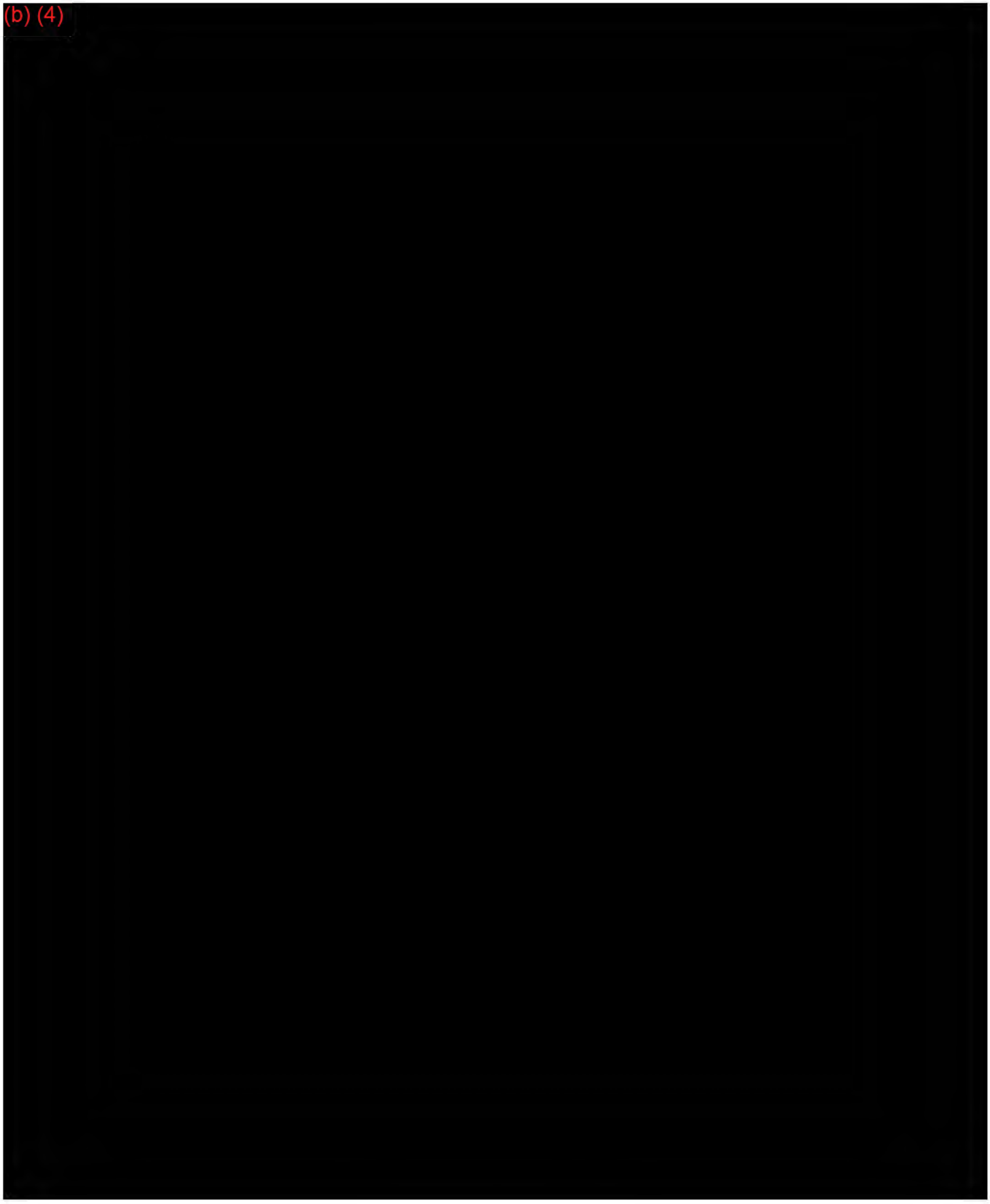

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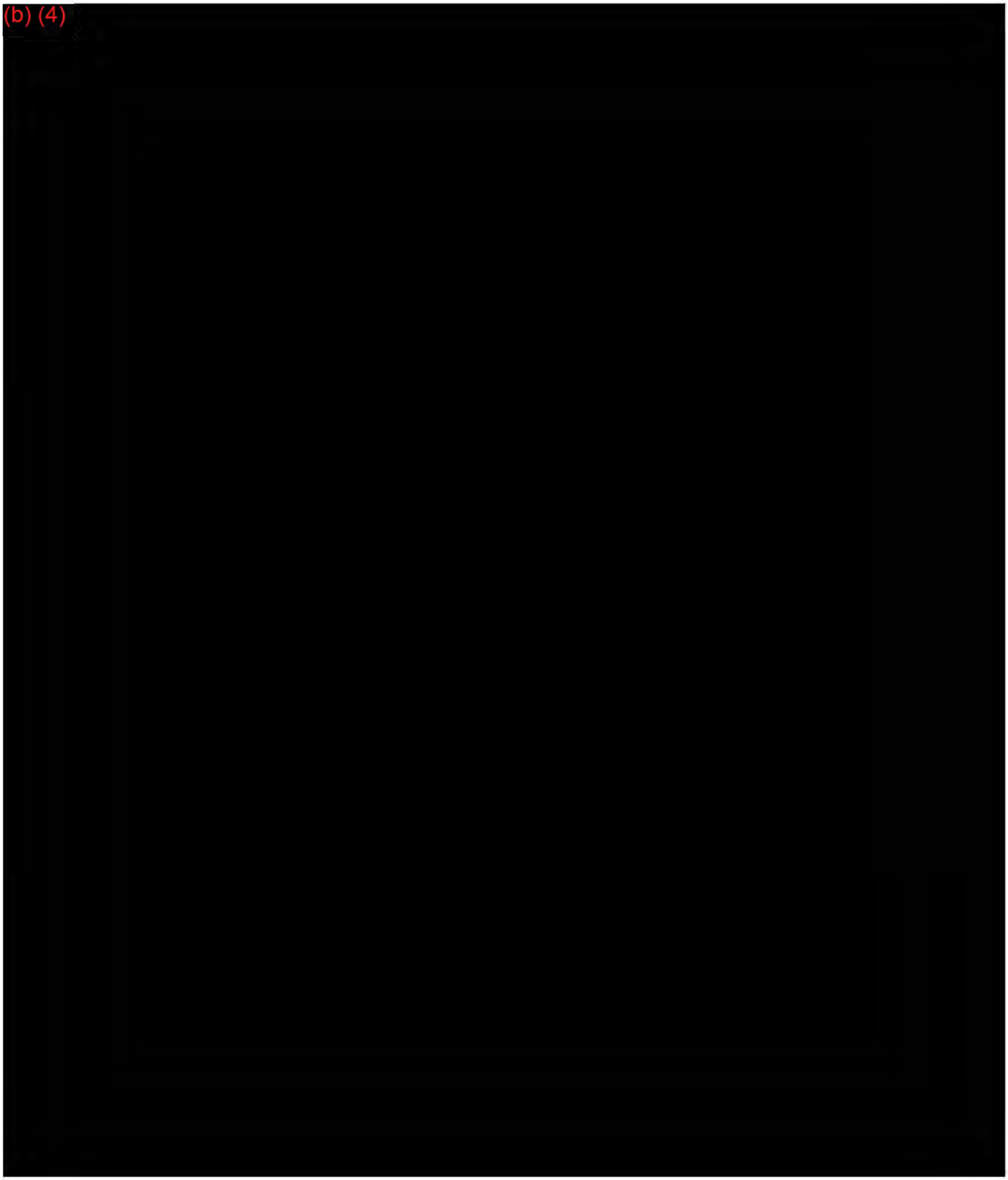

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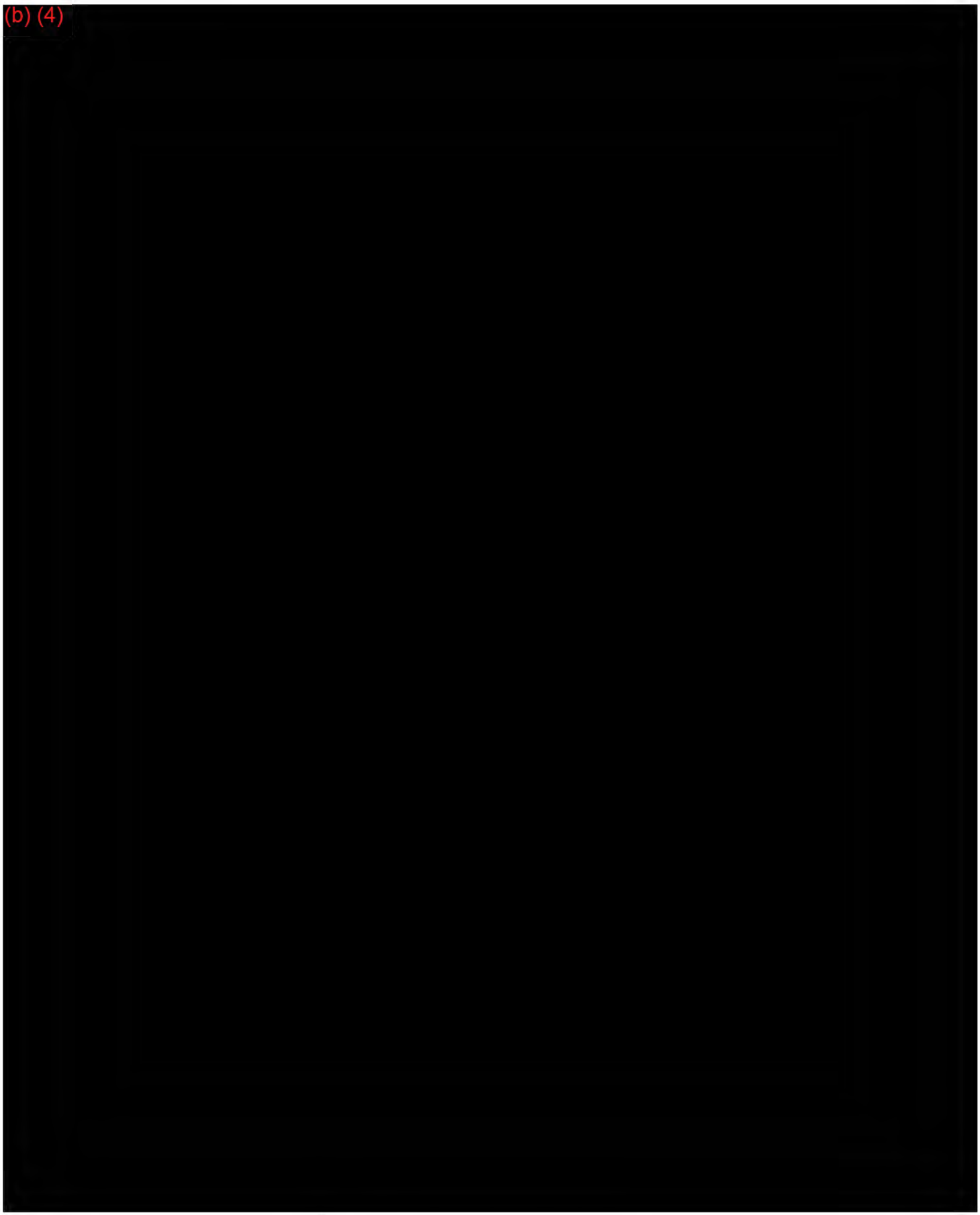

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