

MINIMIZING REGULATION OF SPACE TOURISM TO STIMULATE COMMERCIAL, PRIVATE LAUNCH CAPABILITIES

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ABSTRACT

The development of commercial, private launch capabilities to provide tourism opportunities is in a nascent stage. Until the design and engineering of launch, orbital, and reentry vehicles are validated, regulation of the industry must be flexible, liberal, and practical. The United States Federal Aviation Administration appropriately followed this approach in the promulgation of draft regulations on human space flight. Specifically, the agency weighed several competing interests and policies to avoid artificial or rigid barriers that might stifle innovation unnecessarily. To stimulate space tourism and the development of reliable spacecraft, the final version of these regulations should impose the least restrictive requirements that encourage safety, in recognition of the competence of space flight participants and crew to understand and accept the risks inherent in space travel.

FULL TEXT

RECENT DEVELOPMENTS IN PRIVATE SPACE TRAVEL SPUR LEGAL CHANGES

Space travel has long been the fodder for futuristic science fiction. A scan of top news stories, however, reveals that the future is at hand. Entrepreneurs who can pay the twenty-million dollar (US) fee are training for flights to the International Space Station, brokered by Space Adventures under an agreement with the Russian Federal Space Agency.ⁱ For an additional fifteen million dollars (US), the space tourist may be able to take a 90-minute spacewalk or extravehicular activity.ⁱⁱ

The European Space Agency announced in the summer 2006 an initiative called "The Survey of European Privately-funded Vehicles for Commercial Human Spaceflight" as part of its General Studies Programme.ⁱⁱⁱ The initiative is designed to fund the development and study of technologies for the next-generation launchers.

In July 2006, Bigelow Aerospace launched Genesis 1, an inflatable spacecraft designed as the first in a series of habitats.^{iv} To stimulate development of transportation alternatives to the habitats, Bigelow Aerospace has created America's Space Prize, a fifty-million dollar (US) inducement to an American company which can dock with the Bigelow space habitat, remain on station for at least six months, carry a crew of no fewer than five people, and perform two consecutive, safe, and successful orbital missions within a sixty-day period. The test missions must be completed by January 10, 2010, when Bigelow hopes to have a fully-habitable module on orbit.^v

Given the increased activity by well-funded, non-governmental ventures to provide opportunities for human space travel, the United States (US) Congress recognized the need for additional oversight and regulation. Under the 1972 Convention on International Liability for Damage Caused by Space Objects (Liability Convention),^{vi} the US government bears

responsibility as a launching state for activities conducted on its territory or by its citizens which launch or procure a launch. The Commercial Space Launch Activities Act of 1994, as significantly amended in 1998 (CSLA),^{vii} constituted the first comprehensive legislation to regulate US launch and reentry activities. By delegation from the US Secretary of Transportation, the Federal Aviation Administration (FAA) became the agency authorized to oversee, license, and regulate launches, reentries, and the operation of launch and reentry sites carried out by US citizens or from US territory.^{viii} Historically, the FAA licensed only operators of expendable launch vehicles which did not carry crew or passengers.^{ix} Its regulation of the industry addressed primarily the safety of the uninvolved public.

That changed in 2004, when the FAA issued two reusable launch vehicle (RLV) licenses for missions involving an on-board pilot: one for Scaled Composites and one for XCOR Aerospace, both of which were competing for the ten million dollar (US) Ansari X Prize.^x Later that year, the US Congress adopted amendments to the CSLA to specifically address the regulation of private industry engaged in human space transportation for hire.^{xi}

Policy of CSLA and Scope of Authority Delegated to FAA to Regulate Human Space Flight.

The US Congress gave general guidance to the FAA, but also imposed specific limitations on the FAA's authority to regulate human space flight. As is common in (US) statutes affecting the space industry, the CSLA first enumerates the policy reasons for the amendments, which are primarily safety-driven:

- the goal of safely opening space to the American people and their private commercial, scientific, and cultural enterprises should guide

Federal space investments, policies, and regulations;

- private industry has begun to develop commercial launch vehicles capable of carrying human beings into space, and greater private investment in these efforts will stimulate the Nation's commercial space transportation industry as a whole;
- space transportation is inherently risky, and the future of the commercial human space flight industry will depend on its ability to continually improve its safety performance;
- a critical area of responsibility for the Department of Transportation is to regulate the operations and safety of the emerging commercial human space flight industry;
- the public interest is served by creating a clear legal, regulatory, and safety regime for commercial human space flight; and
- the regulatory standards governing human space flight must evolve as the industry matures so that regulations neither stifle technology development nor expose crew or space flight participants to avoidable risks as the public comes to expect greater safety for crew and space flight participants.^{xiii}

In the context of these policy pronouncements, the FAA was mandated to "encourage, facilitate, and promote the continuous improvement of the safety of launch vehicles designed to carry humans, and...promulgate regulations to carry out this subsection."^{xiii} For instance, the amendments require that, as a condition to receiving a permit or license, the operator must ensure that its crew has training and satisfies medical standards; that the crew has been informed that the US government has not certified the launch vehicle as safe for carrying humans; and that the operator

has complied with all laws applying to crews.^{xiv} This delegation appears to give the FAA a good degree of leeway on how it can impose regulations in the name of safety.

As pertains to space flight participants, however, the delegation of authority was limited almost exclusively to regulating the flow of information. Under the CSLA, to obtain a license or permit, the operator must certify that it has informed the space flight participants of the risks of launch and reentry, including the safety record of the vehicle type; that the US government has not certified the launch vehicle as safe for carrying humans; that the space flight participant has provided written, informed consent to participate; and that the operator has complied with FAA regulations. The CLSA limited the FAA's initial control over qualifications for space flight participants, authorizing only "appropriate medical examinations" until 2007.^{xv} After that date, the FAA was authorized to issue additional regulations setting reasonable medical and training requirements for space flight participants.^{xvi}

Similarly, the amendments restrict how the FAA can regulate the design or operation of the launch vehicle. Until 2012, the FAA may only restrict or prohibit design features that have resulted in a serious or fatal injury to crew or space flight participants during a licensed or commercial human space flight or contributed to an unplanned event that posed a high risk of causing a serious or fatal injury.^{xvii}

Finally, the CLSA required the FAA to issue proposed regulations within one year of the amendments' adoption and a final rule within six months thereafter.^{xviii} It required the issuance of guidelines or advisory circulars as soon as practicable until the regulations could be finalized.^{xix}

FAA Issued Guidance Documents and Solicited Comments on Proposed Regulations.

The FAA's Civil Aerospace Medical Institute had previously issued its Guidance for Medical Screening of Commercial Aerospace Passengers in 2003.^{xx} This guidance memorandum was designed to identify individuals who have medical conditions that might result in an in-flight medical emergency or death or otherwise compromise the health and safety of occupants.

In February 2005, the FAA issued a related set of draft guidelines for commercial, suborbital RLV operations: one for crew and one for space flight participants.^{xxi} Where practical, the guidelines attempted to draw on aviation experience to craft recommendations for crew training and qualifications. For instance, the Crew Guidelines recommended that a pilot possess an FAA pilot certificate, hold ratings to operate aircraft with similar characteristics, and possess an FAA 2nd-class medical certificate.^{xxii} The Crew Guidelines similarly offered a set of recommendations for environmental controls, fire detection, and human factors that might implicate safe operation of the spacecraft.^{xxiii}

Consistent with the mandate of the CSLA, the focus of the Participant Guidelines was on disclosing sufficient information about risks, so that the space flight participant could make an informed judgment about whether to participate.^{xxiv} The guidelines also suggested that the participant provide a medical history and, if needed, a physical examination to a physician knowledgeable in aerospace medicine.^{xxv} Finally, they identified safety training and security measures that should be undertaken by the operator.^{xxvi}

After taking comments on these guidelines from industry and other interested parties, the FAA issued a formal Notice of Proposed Rulemaking for human space flight requirements, setting out proposed

regulations to address these areas.^{xxvii} The Proposed Rules incorporated many of the industry comments received on the guidelines. The official comment period on the Proposed Rules closed on February 27, 2006, though some comments trickled in after that date.^{xxviii} As of the writing of this article, the final rule had not been published but was expected this Fall..

HUMAN SPACEFLIGHT REGULATIONS BALANCE COMPETING INTERESTS AND POLICIES TO ENCOURAGE HUMAN SPACE FLIGHT.

In any effort to write statutory or regulatory law in a new field, the drafters must be sensitive to the competing interests and policies affected by the law. The FAA draft regulations successfully balance these interests in compliance with the agency's statutory authority.

The comments solicited on the guidelines and Proposed Rules demonstrate a wide range of interests. The remainder of this paper address the conflicts posed by those comments and the compromise achieved in the FAA regulations.

Specificity v. Flexibility in Design and Operational Requirements.

One competing tension in the regulation of human space flight is the desire to impose specific requirements to improve safety, while allowing the operators flexibility in the design and operation of their spacecraft. That is, should the regulations tightly control design and operation to prevent accidents, or should they be liberal enough to allow accidents to occur so long as the lessons learned from those accidents are used to develop safety requirements in the future?

The US Congress largely resolved this tension in favor of giving operators flexibility to creatively design and operate their spacecraft, subject to only narrow requirements for protection of the crew and space flight participants. This policy determination is most evident by the

statutory limit on the FAA's authority to regulate design and operations before 2012. By only prohibiting design features that pose a high risk of, or have resulted in, a serious or fatal injury to crew or space flight participants, the US Congress has made the policy decision that the potential loss of human life is an acknowledged risk that does not outweigh the benefits of developing our space flight capabilities. Rather, for the next six years, US operators may explore new technologies, learning as they go but not repeating mistakes that risk human life or health.^{xxix}

The draft regulations balance these competing interests by imposing only limited controls on cabin conditions, including environmental and life support systems, smoke detection, fire suppression, and security.^{xxx} They allow the operator to choose the best method for achieving these general safety requirements, employing active or passive systems, on board or remote operations, or open-loop or closed-loop systems. Inherent in this regulatory approach is an acknowledgement that mandating accepted aviation safety technologies in an untested micro-gravity environment or during the stresses of launch and reentry could actually increase risk. Systems that have not been validated under relevant conditions might fail, as might novel or complex systems designed to overcome the unique conditions of suborbital or orbital flight.^{xxxi}

For the same reasons, the regulations do not attempt to dictate whether the spacecraft must launch or land in a particular configuration or whether launch and reentry are pilot-controlled or done by remote operations. While uniformity in the application of the law is desirable, the FAA readily agreed that these design and operations decisions must be made by the operator based on the evolution of technology; they cannot be driven by inflexible regulations that attempt to anticipate the technological advances to a diverse family of RLVs and, thereby, stifle

the innovation needed to move the industry forward.

Duty of Government to Protect Space Flight Participants and Crew v. Duty of Government to Respect Individual Right to Choose.

Some comments on the Proposed Rules strongly spoke out on the government's legal or moral obligation to protect citizens from physical harm. From this view, the government should dictate specific requirements for crew and space flight participant training. The government should require the operator to provide gap insurance to the space flight participant. The FAA should carefully examine the content of any disclosures to ensure they are both comprehensive yet understandable, and a government representative should be present when the consent form is signed to judge the mental competence of the space flight participant.^{xxxii}

To balance this view, other comments suggested the government should acknowledge the capacity of space flight participants and crew to understand risks and make informed decisions. Individuals should consult with their own advisors (physicians, attorneys, insurers) to protect their interests. In this view, giving more information to the space flight participant only increases the risk that none of it will be read.^{xxxiii}

To balance these views, the proposed regulations focus on making sure the crew and space flight participants are sufficiently trained so as not to create additional perils, but only trained as needed for their particular roles. As proposed, crew training requirements give the operators flexibility to determine the best training methods. Crew training devices must "realistically represent the vehicle's configuration and mission" or the operator must advise the crew members of the differences.^{xxxiv} The training must be updated to reflect lessons learned and to ensure that crew qualifications are current.^{xxxv} Rather than apply a one-size-

fits-all approach to training, the FAA believes that it can more appropriately account for the diversity in vehicles by adding terms and conditions specific to the vehicle in the license or permit.^{xxxvi} While this creates initial uncertainty about the regulatory process, it appears to be the only practical means for achieving the goal of encouraging adequate training of crew members.

The regulations are largely silent on training and medical requirements for space flight participants. The space flight participant must be trained to respond to emergency situations and must not be able to jeopardize the safety of the flight crew or the public.^{xxxvii} However, the rider does not need to possess the same medical certifications as the flight crew.^{xxxviii} Rather, the FAA relies on the space flight participant's self-interest in obtaining medical advice, until a demonstrable need arises to mandate medical examinations through regulation.^{xxxix} As one of the commenters noted in a very practical way: "FAA should not set an artificially high barrier to space flight on medical grounds. Tolerance should not be interpreted to mean absence of symptoms; it should be interpreted to mean absence of permanent injury. If the space flight participant passes out because he or she forgot to execute his or her straining maneuver, no harm will be done."^{xl}

Apart from training, the draft regulation ensure that the crew and space flight participants are adequately informed of the mission risks, but are not overwhelmed with data. The operator must present information "in a manner that is understandable to the space flight participant."^{xli} In particular, the regulations require the operator disclose to the space flight participant the known hazards and risks that could result in a serious injury, death, disability, or total partial loss of physical or mental function; the fact that participation may result in a serious injury, death, disability, or total partial loss of physical or mental function; and the safety

record of all crewed vehicles. The safety record must include statistics about death or injury to people on the flights, the number of catastrophic failures, the number of vehicle flights, the number of safety-related anomalies or failure, and any corrective actions taken to resolve them.

In turn, the space flight participant must sign an informed consent acknowledging that the participant understands the risks and that his or her presence on board the vehicle is voluntary. While the informed consent provides evidence of the participant's knowledge and state of mind, it may be insufficient to protect the operator from liability in many jurisdictions. For protection of the operator, a contractual waiver and release should accompany any informed consent. Waivers and releases are not otherwise mandated by the regulations except for reciprocal waivers vis-à-vis the government.^{xliii}

Companies and others offering comments on the Proposed Rules almost universally agreed on one point related to these disclosures: if a safety record of all crewed vehicles must be maintained and disclosed to the space flight participant, then the FAA should maintain it.^{xliii} Failing to satisfy disclosure obligations can nullify an informed consent, and so the operators wanted to put the onus of determining the content of that disclosure on the government. This is especially appropriate because an operator typically would not have access to the data from other operators or governments with which to complete a full safety record. Conversely, out of concern that operators would not provide a complete disclosure reflecting safety problems, others wanted to have an independent body maintain the safety record and apply uniform standards.

The disclosure of this safety record raises other concerns as well. Some of the information regarding mishaps and, particularly, corrective actions is likely to be proprietary. The operators objected to

disclosure of proprietary information that could benefit their competitors. At another level, disclosure of some information to non-US citizens could violate export control requirements, particularly the International Traffic in Arms Regulations (ITAR)^{xliv}, unless an export license or technical assistance agreement were obtained.

Creating Meaningful Safety, Training, and Disclosure Requirements v. Containing the Cost of Regulatory Compliance.

In a nascent industry expected to have enormous research and development, verification, and operational expenses, the cost of regulatory compliance must be manageable. In connection with its Proposed Rules, the FAA evaluated the monetary impact on affected companies of regulatory compliance.^{xlv} The study concluded that the cost of compliance to operators would range from one million nine-hundred thousand dollars (US) to three million eight-hundred thousand dollars (US) over a ten-year period.^{xlvi} This estimated cost was based on a range of missions over the same time period between 5,000 and 10,000, and it excluded costs that were consistent with current and expected practice (such as crew training, environmental and life support systems, etc.).^{xlvii} Spread over each mission, it was believed that the cost of the mission increased by less than three hundred dollars (US), which was deemed an insignificant increase.^{xlviii}

Not all operators agreed with this analysis. Although compared against total revenues or total expenses, the increased cost of compliance might be small, a comparison against expected profit might tell a very different story.^{xlix}

At this stage of industry development, however, the FAA has taken conscious steps to minimize the regulatory requirements. Moreover, the regulations spell out when an operator can use alternate means of compliance, mitigating the cost of regulatory requirements when cheaper but

equally appropriate alternatives are available.ⁱ

Regulating Safety Through Government Agencies v. Self-Regulation by the Affected Industry.

In its purest sense, the regulation of conduct can be strictly imposed by a government agency or it can develop, formally or informally, by the industry itself. Where an industry self-regulates successfully, the government can take a more laissez-faire approach. Because this segment of the launch industry is in a formative stage, reliance on self-regulation may be risky.

The FAA regulations nonetheless recognize that operators have an incentive to operate safely. Doing so minimizes the cost associated with operational failures. Logically, an operator with a better safety record is more likely to attract space flight participants. Operators likewise have an incentive to apply pressure on other companies to follow safety protocols because safe operations may lower industry costs, such as insurance, and enhance the overall market demand for the services offered.

The comments to the Proposed Rules reflect a secondary incentive to self-regulate: the promotion of businesses which provide safety services or products. These comments encouraged both training of flight crew and participants and verification of spacecraft design and operation, and proposed the formation of a Blue Ribbon Panel or standards-setting body to oversee these efforts.ⁱⁱ Other comments noted the existence of training facilities or services available to ensure regulatory compliance.ⁱⁱⁱ

It may be premature to expect the private launch industry to self-regulate human spaceflight for hire. Each potential operator is facing more immediate challenges in the research, development, and verification of its spacecraft that override the long-term need to develop and conform to standards that would be

applicable to every type of spacecraft in each operational phase of flight. At this stage, it is sufficient that the FAA regulations not prohibit the formation of industry standards and best practices. Because the current regulations implicitly tolerate more restrictive self-regulation on an industry-wide basis, the industry maintains appropriate flexibility to set its own governing bodies and standards in years to come.

SUMMARY

The draft FAA regulations represent a solid, initial attempt to regulate an evolving industry. They accord adequate flexibility to individual operators in the design and operation of the spacecraft and in the training of crew and participants, without sacrificing safety unnecessarily. In recognition of the inherent risks of human space flight, the regulations are designed to give crew and space flight participants sufficient information to make informed decisions about whether to take part in a mission. This approach balances competing interests while stimulating the development of the next-generation launch and reentry vehicles necessary to sustain our human spaceflight program.

ⁱ "First Woman Tourist? U.S. Entrepreneur Determined to Reach Orbit," by Tariq Malik, *Space News*, Aug. 14, 2006, at 12.

ⁱⁱ <http://www.spaceadventures.com/flight/spacewalk/details> (Aug. 30, 2006).

ⁱⁱⁱ http://www.esa.int/SPECIALS/GSP/SEM2YABUQPE_0.html (July 20, 2006).

^{iv} "Space News: 10 Who Made a Difference in Space," *Space News*, Aug. 28, 2006, at 9.

^v http://www.bigelowaerospace.com/multiverse/space_prize.php (Aug. 30, 2006); "Space News: 10 Who Made a Difference in Space," *Space News*, Aug. 28, 2006, at 9.

^{vi} *Convention on International Liability for Damage Caused by Space Objects*, Mar. 29, 1972, 961 UNTS 187, at Art. I(c).

^{vii} 49 U.S.C. § 70101 *et seq.* (1994).

^{viii} 49 U.S.C. §§ 70104, 70105; US Federal Aviation Administration, Commercial Space Transportation Delegations of Authority, N1100.240 (Nov. 21, 1995).

^{ix} On August 25, 2006, the FAA promulgated its most recent amendments to regulations of expendable launch vehicles. *See* 71 Fed. Reg. 50508 (Aug. 25, 2006).

^x *Human Space Flight Requirements for Crew and Space Flight Participants*, 70 Fed. Reg. 77262 (2005) (notice of proposed rulemaking) (proposed Dec. 29, 2005).

^{xi} *Commercial Space Launch Amendments Act of 2004*, 118 Stat. 3974 (Dec. 23, 2004).

^{xii} *Id.* at Sec.2(b).

^{xiii} *Id.* at Sec. 2(c).

^{xiv} *Id.* at Sec. 2(d).

^{xv} *Id.* at Sec. 2(d)

^{xvi} *Id.*

^{xvii} *Id.* at Sec. 2(d)(14).

^{xviii} *Id.* at Sec. 2(d)(25).

^{xix} *Id.*

^{xx} *Guidance for Medical Screening of Commercial Aerospace Passengers*, FAA (Mar. 31, 2003).

^{xxi} *Draft Guidelines for Commercial Suborbital Resuable Launch Vehicle Operations with Flight Crew*, ver. 1.0, FAA Office of Commercial Space Transportation (Feb. 11, 2005) (hereinafter “Crew Guidelines”); *Draft Guidelines for Commercial Suborbital Resuable Launch Vehicle Operations with Flight Space Flight Participants*, ver. 1.0, FAA Office of Commercial Space Transportation (Feb. 11, 2005) (hereinafter “Participant Guidelines”).

^{xxii} Crew Guidelines at § 6.

^{xxiii} Crew Guidelines at §§ 10-12.

^{xxiv} Participant Guidelines at §§ 6-7.

^{xxv} Participant Guidelines at § 8.

^{xxvi} Participant Guidelines at §§ 10-11.

^{xxvii} *Human Space Flight Requirements for Crew and Space Flight Participants*, 70 Fed. Reg. 77262 (2005) (notice of proposed rulemaking) (proposed Dec. 29, 2005) (hereinafter “Proposed Rule”).

^{xxviii} <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).

^{xxix} 14 C.F.R. §460.7

^{xxx} 14 C.F.R. §§ 460.11, 460.13, 460.53.

^{xxxi} Comments of Predesa, LLC, Feb. 27, 2006, <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006), at 9.

^{xxxii} Comments of James Michael Snead, Feb. 20, 2006, <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).

^{xxxiii} Comments of XCOR Aerospace on Review of James Michael Snead’s Comments, Mar. 1, 2006, <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).

^{xxxiv} 14 C.F.R. § 460.7.

^{xxxv} *Id.*

^{xxxvi} Proposed Rule at 77265.

^{xxxvii} 14 C.F.R. §§ 460.51, 460.53.

^{xxxviii} Proposed Rule at 77264 n.2 (“The FAA has decided against prescribing specific medical requirements for space flight participants at this time.”).

^{xxxix} Proposed Rule at 77271.

^{xl} XCOR Aerospace Review of Guidance for Medical Screening of Commercial Aerospace Passengers, May 30, 2005, <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).

^{xli} 14 C.F.R. § 460.45(a).

^{xlii} Appendix E to 14 C.F.R. Part 440.

^{xliii} <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).

^{xliiv} 22 C.F.R. Parts 120-130.

^{xlv} *Draft Regulatory Evaluation, Draft Regulatory Flexibility Analysis, International Trade Impact Assessment, and Unfunded Mandates Assessment*, Office of Aviation Policy and Plans, Operations Regulatory Analysis Branch, FAA (June 10, 2005).

^{xlvi} *Id.* at 9.

^{xlvii} *Id.* at 9, 32.

^{xlviii} *Id.* at 11.

^{xlix} Comments of Spaceport Associates, Feb. 25, 2005, <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).

ⁱ *See, e.g.*, 14 C.F.R. § 460.5.

ⁱⁱ Comments of Dii Aerospace Laboratories, Feb. 27, 2006, at 9; and Joint Comments of the International Ass’n of Space Entrepreneurs and the Institute for Space Policy and Law, Feb. 27, 2006, at 10-11, <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).

ⁱⁱⁱ *E.g.*, “Wyle Creates Unit for Space Tourism Business,” *Space News*, Aug. 7, 2006, at 9; Rocket Academy Spaceflight Training, <http://x-rocket.com/rocket-academy.htm> (Aug. 29, 2006); Comments of Aerospace Medical Ass’n, Feb. 1, 2006, <http://dms.dot.gov/search/searchResultsSimple.cfm?numberValue=23449&searchType=docket> (Aug. 31, 2006).