



2009 Northrop Grumman Lunar Lander Challenge

Official Questions and Answers Last Updated: Sept 28, 2009

The following are questions about the 2009 Northrop Grumman Lunar Lander Challenge (NGLLC), along with their official answers from the Chief Judge of the Challenge. All answers shall be considered binding, unless overruled by a later answer. Questions from previous years are included, and are stricken out where no longer applicable.

Q1: If a TEAM uses data from a system that is required as part of the Challenge Data System (Section A.2.3, formerly called the Gold Box) to assist in increasing the landing accuracy, can the mass of this system still be counted as part of the mass of the required Payload? If I redundant systems are carried, call all of them be counted as part of the Payload?

A1: If Challenge Data System-required systems are not necessary for flight in the opinion of the Official Judges, they may be counted as payload weight even if the Team derives some benefit from them, such as a potential improvement in landing accuracy. The ruling will not depend on how the produced data is used, but rather on whether the device that is producing the data is required for flight, required for the Gold Box requirement, both,

or neither. The mass of any system or set of systems may only be counted as part of the Payload if it is carried in order to meet the Challenge Data System requirement but it is not required for flight.

The Challenge Data System component(s) must not constitute or be a part of the primary navigation and control system for the vehicle, and it must transmit while in flight position and heading data that is still available at the termination of the flight. This provides an independent source of data, separate from the vehicle navigation and control system, that is used by the Judges to confirm flight requirements are met and time of lift-off and landing. Accuracy determinations are made by a physical measurement of the location of the vehicle on the landing pad. Vehicle GPS location data may be used as a secondary, confirmation input.

The Challenge Data System cameras are there to provide video coverage for use by XPF and are not a source of performance or accuracy data for the judges. The video information may be helpful in confirming take-off and landing time and location on the pad. However, if the video images are the primary source of navigation and control input for the vehicle, then the video camera(s) used cannot be counted as payload. A minimum of two cameras must still be furnished for the Challenge Data System.

Q2: Section A.3.9 notes that “Teams shall not be allowed to schedule any Prize Winning Attempt Visit within a week of another Team, unless these Prize Winning Attempts occur at the same site, as determined by XPF.” What is the purpose of this clause, and how will the X PRIZE Foundation (XPF) determine if two teams are indeed requesting the “same site”?

A2: This phrase is intended to make travel possible for XPF and NASA staff as well as Official Judges. Determinations will be made based on the logistics of travel and lodging.

Q3: Section A.3.9 notes that “If a Team fails to claim a Purse, the Team shall not be allowed to schedule another Prize Winning Attempt any earlier than 30 days after its previous attempt unless otherwise approved at the sole discretion of XPF.” Would this prevent a Team that is competing for both levels from requesting two Prize Winning Attempt Visits within 30 days of each other?

A3: The "If a Team fails to claim a Purse" language is meant to ease the logistics of travel for X PRIZE and NASA staff as well as Official Judges. Teams may be permitted to book two Prize Winning Attempt Visits close together if that booking is done ahead of time, but teams will not be permitted to request a second Prize Winning Attempt Visits immediately

following the first if that request is made during or just after the first such Visit, unless permission is granted by XPF. Such permission will be granted on the basis of travel and lodging logistics, as well as the schedule of Prize Winning Attempt Visits already assigned.

Q4: How will Media Rights be treated in 2009—what are Teams permitted to do? How will the “Challenge Interval” apply? What endorsements can XPF Foundation require?

A4: Teams have the right to capture, produce, and commercially exploit footage of their team as they participate in this Challenge. Teams also have the right to designate someone else to capture or produce this footage. To ensure coordination, if Teams expect to commercially exploit—that is to say, to sell for profit—this footage in the near future, they would need written permissions from XPF, which will not be unreasonably denied. If teams expect to give the footage away (e.g. via YouTube), they do not need any prior permission—doing so is considered “Promotional Use” rather than “Commercial Use.”

Teams do not have the right to capture or exploit footage of XPF personnel or of other Teams without prior permission. Similarly, teams do not have the right to commercially exploit footage that the X PRIZE Foundation or other Teams have taken or generated without prior permission. These permissions will not be unreasonably withheld by the X PRIZE Foundation.

The XPF does not have rights to use or exploit any footage of any of a Team’s activities unrelated to the Northrop Grumman Lunar Lander Challenge without express permission from the Team.

Videos and text generated by a Team or its designees that portray or describe development or testing of your NGLLC entry or entries may be posted to personal or team blogs, websites, or online video services without conflicting with the NGLLC Team Agreement. Teams that have registered for the NGLLC may use the NGLLC patch associated with the relevant year of the NGLLC in such videos or posts.

XPF has neither intention nor right to use Team or Team member likenesses to imply or create endorsements of anything except for the NGLLC itself, XPF, the NASA Centennial Challenges program, and/or the role of Northrop Grumman Corporation in supporting the NGLLC. Should XPF desire to create any other endorsement using a Team or Team member likeness, such endorsement would be subject to specific economic terms reasonably agreed upon by the Parties.

Prior to registering for a given Prize Winning Attempt Visit, no restrictions are placed on a Team inviting media or similar entities to film the Team or its efforts towards claiming the NGLCC. Between registering for such a Visit and the Visit itself, a Team is only required to provide notice of any such NGLCC-related filming activities to XPF, and does not require the permission of XPF. If a Team desires to have media or similar entities film during the Prize Winning Attempt Visit itself, they would require the permission of XPF, which may require providing a license for use of any raw footage, but which otherwise shall not be unreasonably withheld.

Q5: Section 2.4 of the Master Team Agreement notes that “PARTICIPANT must provide documentation to XPF at least 60 days prior to the Challenge proving that at least 90% of the funds used to design, build, and operate the Vehicle come from non-government (U.S. or other) sources,” whereas section A.4.3 notes that “The Team shall provide written certification to XPF 45 days prior to the Prize Winning Attempt that at least 90% of the funds used to design, build, and operate the Vehicle come from Private Sources.” Which number is correct?

A5: 45 days. A letter signed by the Team Leader or the Team’s main point of contact with XPF is required and will suffice. Further, to the intent and spirit of the Challenge, it is in all of our best interests for Teams to follow the honor system, to avoid a scenario where one Team is making accusations against one or more other Teams. Largely, the Teams will police themselves and each other.

Q6: May Teams make Level Two Point B surfaces—the Lunar pads-- more difficult than what is required? If so, could a more complex landing surface give an advantage to the Team using it in terms of how the team is scored in comparison to other teams in any potential tie breaker?

A6: To assure ease of Judging and maximum fairness, substantial alterations to the Point B surfaces are not allowed.. The design of level Two Pad must be approved by XPF prior to the competition as stated in rule A.4.8

- Q7:** In an early version of the Team Agreement, Exhibit D (“Lunar Pad Design”) had a discrepancy between the graphical layout and the written chart for obstacle “F”. Which is the correct label?
- A7:** Obstacle “F” should be a Small Boulder.
- Q8:** The Rules state that the same vehicle cannot be entered and used for both Competition Level One and Competition Level Two (90 and 180 second flight times respectively). What rules have you established to differentiate between Vehicles? For example, if two sets of propellant tanks are made for two Vehicles and all of the other subsystems (including the Challenge Data System) are taken from the first Vehicle and used to construct a second vehicle, is the second vehicle considered to be a "different Vehicle"?
- A8:** Yes, providing all other conditions stated in the 2009 Official Rules and Questions and Answers, as well as the definition of "Vehicle" found in the Team Agreement, are met. For further detail, see questions 16, 21, 23, 24, and 33.

PAST Q&A

Assumed to be still in effect unless superseded by a more recent answer or rule change. Answers or portions of answers that are now inaccurate have been retained, but are stricken through. Where terms have been replaced, the old term has been stricken through and the new term provided in italics.

- Q9:** In the event that the Vehicle first touches down and then repositions to another position(s) on the pad, either intentionally or unintentionally, what position will be considered for measuring the landing accuracy for that leg of the flight attempt?
- A9:** The position of the Vehicle will be measured after (1) it has completed the minimum flight time required for the appropriate Competition Level; (2) the Vehicle has come to rest with all parts of the Vehicle that touch the ground (see Question 20 below) within the boundaries of the pad; and, (3) the Vehicle is safe to approach. Mission flight time will be measured from the moment of first contact of the landing gear (see Question 6 below) with the

ground; however, the Vehicle position will be recorded after the Vehicle has shut down and been made safe to approach. The Vehicle may not be repositioned by hand or by other external devices in order to impact measurement of the landing location.

The position of the Vehicle will be determined by the Accuracy Judge by means of a laser transit measuring distance and location from a known ground reference point and a reflector set on a known reference point on a flat surface on top of the Vehicle. The reflector will be positioned on the Vehicle by a member of the Team and verified by ~~the Timer Judge, or by the Data Judge, if the Timer Judge is not available~~ a Judge or an X PRIZE staff member. (2008)

Q10: How will Payload weights be measured, especially if the weight is distributed among multiple locations?

A10: Prior to the ~~Competition Flight Attempt~~ *Prize Winning Attempt Visit*, the Team will document and self “certify” primary Payload weights and all components contributing to the total Payload weight, including ~~Gold Box Challenge Data System~~ elements, video cameras, and any brackets and straps associated with holding the various contributing elements in place.

All contributing elements of the Payload will be clearly identified and tagged with numbers that will remain with the element throughout the competition.

~~Numbers will have two parts separated by a dash. The first part will be the Vehicle Number. The second part will be the contributing payload element in a simple numerical sequence selected by the Team, starting with 1. Example Number 2-4 identifies Vehicle 2 and element 4. Example element description – Element 4 consists of two (2) disk weights 10 pounds each and a mounting bracket and bolts 3.3 pounds for a total weight of 23.3 pounds.~~

If a payload element is required to be changed, the ~~Timer or Data Judge will be notified to~~ *Team must* request permission for the change from the Chief a Judge. If permission is granted, the Team may make the exchange only in the presence of either *an X PRIZE Staff member or a* the ~~Timer or Data Judge~~. The replacement elements or components will be similarly tagged and identified with the same numbers as the original with the additional notation of Replacement. The Chief Judge will note the number and time/date of the replacement. If the request for change occurs during a flight attempt, the Chief Judge will make a ruling as to whether or not additional time will be added to the flight attempt.

If requested by the Judge, at the end of the competition, the qualified Teams will submit all elements of the Payload for an Official Weighing by the ~~Data Judge in the presence of the Chief a~~ Judge and an X PRIZE Foundation representative. If a Payload element has been changed, the Official Weighing will be carried out first with the replacement element(s) and second with the original element(s). Any unexplained discrepancies in meeting the total Payload Weight requirements, including substitutions, will be cause for disqualification of the Team. (2008)

Q11: May Teams substitute high-definition camera systems that do not transmit in real time for the required cameras with real-time transmission?

A11: Teams may only replace cameras with prior written permission from XPF. In all cases, Teams must carry a minimum of one camera that transmits in real time. Teams are always welcome to add additional cameras, regardless of whether or not they transmit in real time. If the additional cameras are to be considered as part of the payload weight, they must be “tagged” as specified in the Question 7 above. (2008)

Q12: May Teams replace batteries on the flight Vehicle instead of re-charging them?

A12: Teams may only replace batteries *or other components* in accordance with rule A.4.6 A.2.22.1. Batteries not carried aboard the Vehicle during a previous flight leg(s) within a given Flight Attempt Time Period may not be used on the Vehicle during the subsequent flight leg(s). (2008)

~~**Q13:** Section A.4.3 has specific requirements for the 10M cylinder surrounding the flight profile during ascent and descent. May a Team tip the 10M cylinder 10 to 20 degrees away from the crowd?~~

~~**A13:** Finalist Teams must comply with Rule A.
This ruling is made to retain uniformity of requirements and Judging for all of the Finalist Teams. (2007)~~

Q14: If a Team has a non-load-bearing structure, such as touch sensor, that hangs below the Vehicle, will takeoff / touchdown time be measured from

the moment when the main Vehicle leaves / touches the ground, or when this non-load-bearing structure leaves the ground?

A14: As stated in Rule ~~A.4.4.4~~ A.5.12 for determination of flight time, the takeoff and touchdown times will be determined by the time of last and first contact by the landing gear with the pad, respectively. Any other device or component, insofar as it is not a part of the landing gear, as defined in Rule ~~A.2.27~~ *as determined by the Judges*, would not be considered in determining either the time of take-off or the time of touchdown. (2007)

Q15: ~~During the tie breaker, if the Team crashes on a flight, does that flight count? Do the previous flights count?~~

A15: ~~As stated in Rule A.5.2.1, "All Vehicles must meet all Technical Flight Requirements (section A.4) during the Finalist Time Periods, with the exception of the minimum flight times described in sections A.4.4 and A.4.9." Rules A.4.5 and A.4.10 state that no part or portion of the Vehicle, including payload, may make contact with the ground outside of the 10 meter diameter circle centered upon Point B or upon Point A. If these conditions are satisfied and the intact Vehicle, including payload, can be returned to the assembly area by the end of the 150 minute Finalist Time Period, Rule A5.2.3, then that flight would count.~~

~~Previous flights would count as long as the Team is able to return the intact Vehicle, including payload, to the staging area by the end of the 150 minute Finalist Time Period. The governing rule (A.5.2.3) states: "If the intact Vehicle, including Payload, is not returned to the Staging Area by the end of the 150 minute Finalist Time Period, all Flights from that Finalist Time Period shall be invalidated." (2007)~~

Q16: ~~Will there be a wind limit imposed on the competition?~~

A16: ~~No specific wind limit will be imposed on the competition by the X PRIZE Foundation. However, individual Vehicles may have wind limits, as determined by their Experimental Permits. If, in the opinion of the Judges the Vehicle will not be able to fly due to wind restrictions during the Team's assigned Time Period, that Time Period may be assigned to another Team. Similarly, wind related safety or operational restrictions that may be imposed by the FAA/AST and/or Holloman Air Force Base will be subject to the same review and ruling by the Judges. (2007)~~

Q17: ~~Will the 5 Team cutoff be based solely on FAA Permit grants?~~

A17: ~~No. As noted in the Rules, the cut off will be based on the first five Teams to meet the conditions noted in Rule Sections A.3.6 through A.3.9. In short, this means the first Teams to provide their final propellants list; certification of private funding; certification of appropriate Permit, Waiver, or License to perform at the event; and test flights (if necessary). Teams should also note the conditions specified in Section A.3.15.3 in case of a tie for qualifying for the last available opening. (2007)~~

Q18: ~~May Teams change Levels when the specific layout for the “Simulated Lunar Surface” the Level Two Competition is revealed? (2007)~~

A18: ~~No. As noted in the Registration Package “Applications may be amended to transfer Vehicle registration from one Competition Level to another no later than 90 days before the competition. In the case of separate but identical Vehicles brought by a Team with accepted registrations in each Competition Level, once a given Vehicle has been flown in given Competition Level, it shall be considered locked into that Competition Level.”~~

~~XPF is not obligated to reveal the nature of the lunar pad until 60 days before the Competition, as noted in Rule A.2.15. However, XPF will work to reveal the nature of the Pad to all Teams prior to the 90 day deadline for Level switching, if at all possible. (2007)~~

Q19: ~~May the *Gold-Box Challenge Data System, or components thereof*, be shared between Vehicles?~~

A19: ~~Yes, the *Gold-Box Challenge Data System, or components thereof* can be shared between Vehicles of the same Team. However, to do so, the following conditions must apply: 1) the *Gold-Box Challenge Data System, or components thereof* to be transferred must be clearly labeled and identified to the Judges; 2) if the *Gold-Box Challenge Data System, or components thereof* is to be counted as part of the payload, it must be shown that the *Gold-Box Challenge Data System, or components thereof* systems are not essential to the operation of either of the Vehicles; and 3) the operations of the systems must be able to be verified after each switch and conform to Rule A.2.8 A.2.3. (2007)~~

Q20: ~~May a Thrust Termination System or other Safety System be counted as Payload?~~

A20: No. Safety Systems are considered to be an essential element of the Vehicle operational systems and, therefore, can not be counted as Payload. As stated in Rule ~~A.2.3~~ A.2.14, the only items that can be counted as Payload are deadweight or ~~Gold Box Challenge Data System components~~ that are not physically or functionally involved in the operation of the Vehicle. (2007)

~~Q21: What certification is required to prove compliance with the Public Financing rules?~~

~~A21: As stated in Rule A.3.6, each Team must “certify” to XPF at least 60 days prior to the Challenge that 90% or more of the funds used to design, build, and operate the Vehicle have been provided Private Sources. A letter, signed by the Team Leader is required and will suffice. Further to the intent and spirit of the Challenge, it is in all of our best interests for Teams to follow the honor system, to avoid a scenario where one Team is making accusations against one or more other Teams. Largely, the Teams will police themselves and each other. (2007)~~

Q22: May Teams replace or recharge batteries in Refueling Operations?

A22: Teams will be allowed to replace and/or recharge batteries in Refueling Operations as long as the Team remains in compliance with Rule ~~A.4.6~~ A.2.22. (2007)

Q23: How will landing accuracy be measured?

A23: As stated in Rule ~~A.2.9~~ A.2.10, Landing Accuracy will be measured as the distance from the Vehicle Reference Point to a designated target on the landing Point. For an acceptable landing, none of the landing gear contact points may lie outside of the 10m landing circle. The Vehicle may have overhangs to lie outside of the 10m circle, but may not touch the ground. (2007)

Q24: May Teams replace components and make repairs not on the official Refueling Operations approved lists between the first round and any follow on rounds *Time Periods*?

A24: Yes, Teams can make repairs and replacements to hardware between rounds, so long as: a) the operations are coordinated with and cleared by the X PRIZE Cup Flight Operations and other relevant safety Teams; b) the operations are in keeping with general rules on public financing; c) the

operations are approved by the Official Judges of the competition; d) the replacement parts must be functionally equivalent to the parts being replaced; and e) the replacement of components does not result in the building of a new Vehicle by replacing a substantial fraction of the Vehicle being repaired with different parts. (2007)

Q25: Is an air pressure sensor calibrated for altitude acceptable?

A25: Yes, provided this signal is not used for navigation. Additionally, a controlled verification to the satisfaction of the Official Judges may be required. (2007)

Q26: May Teams registering identical Vehicles in the two Competition Levels freely substitute these Vehicles?

A26: No. Rule ~~A.3.5.6~~ A.3.4.4 states, "A Vehicle may be registered for Competition Level One or Competition Level Two, but not both." Team must decide and declare 30 days before the Competition which Vehicle will be entered in Competition Level One and which Vehicle will be entered in Competition Level Two. ~~Rule A.2.23 states that a number will be assigned to each Vehicle 30 days before the competition. The same answer applies in the case of two non-identical Vehicles being entered in the two competition Levels by the same Team. However, Teams may make repairs and incorporate parts from other Vehicles, in keeping with Answer 21 from this list.~~ (2008)

Q27: May a Team "cannibalize" and use components and/or subsystems from another entry that the Team has qualified for the NG LLC to make the changes as discussed and qualified in Question 21 and 23?

A27: Yes. However, to do so, the components and/or subsystems must be clearly labeled with a serial number and identified to the Judges from a "Standard Parts List" provided by the Team prior to the start of the first Flight Attempt by either of the Vehicles entered. The "Standard Parts List" will provide a description of the "Part" and its serial number. Further, if the Vehicle from which the component and/or subsystem is borrowed is to remain in the competition and eligible for a Prize Purse, this Vehicle must be able to be returned to a flight worthy condition with only the return and installation of the same or similar component and/or subsystem. Also, the replacement of components and/or subsystems cannot result in the building of a new Vehicle by replacing a substantial fraction of the Vehicle

being repaired with replacement parts. The Official Judges shall make the sole and final determination of compliance with this rule. (2008)

Q28: May Teams replace components and make repairs not on the official Refueling Operations approved lists during a Time Period?

A28: Yes; however, Teams must still perform all of the flight requirements listed in Section A.4 A.5 in sequence and without interruption. Performance of any repair not explicitly permitted in Section A.4.6 A.5.15 will require Teams to start anew at Section A.4.4 A.5.1 without any extension of time period. The Official Judges will approve reasonable requests to replace components with functionally equivalent alternates. The replacement of components cannot result in the building of a new Vehicle by replacing a substantial fraction of the Vehicle being repaired with cannibalized parts. The Official Judges shall make the sole and final determination of compliance with this rule. (2007)

Q29: May a Team use a device such as a ring jet-o-vator vectoring nozzle just below the rocket main nozzle?

A29: Yes. So long as the primary use of the thrust vector control system is for the control of the flight of the Vehicle and is not dependent on air entrainment for its effectiveness. (2007)

Q30: May a Team make use of removable tanks to replenish propellant and/or pressurizing gases during the refueling operations for any of the Level 1 or Level 2 flight attempts?

A30: No. Teams may replace only those systems that are damaged during flight and only if the replacement parts are carried aboard the Vehicle during the previous flight segment, *as stated in Rule A.22.*—~~See Rules A.2.19.1 and A.4.6.~~ (2007)

Q31: May a Team make use of a high-pressure gas source located at the pad to pressurize the tanks aboard the Vehicle during the refueling operations?

A31: Yes, if the high-pressure gas source does not present a flight safety hazard and is transported to and from the pad by the Team as part of their Refueling Operations, *as stated in Section A.22. See Rules A.2.19.1 and A.4.6. (2007)*

Q32: What is the definition of "intact" in the context of returning the Vehicle to the Staging Area, *if applicable*, by the end of the Finalist Time Period?

A32: An intact Vehicle is defined as a Vehicle that is capable of being returned to a safe flight status either through maintenance or repair and maintenance, using equipment and/or spare parts, subsystems and material that are in the possession of the Team in the Staging Area and/or their Vehicle Storage Area, *as applicable*, at the time of the Team's assigned Time Period. Judges, in consultation with the Team Leader, will assess and make a determination of the capability and reasonableness of the Team's returning their Vehicle to a safe flight status. Should this Vehicle continue to be used in the then-year competition, the repair of the Vehicle must return it to its same entry configuration and safety and performance capabilities and be verified by the Judges. (2007)

Q33: If a Vehicle does crash during a Finalist Time Period, can a Team replace parts as allowed under *Section A.22* ~~rules A.2.19.1 and A.4.6~~ to bring it back to "intact" status before returning to the Staging Area, *if applicable*?

A33: Yes, Teams would have that option of performing an "on-pad" maintenance/repair. Teams would also have the option of returning their Vehicle to the Staging Area, *if applicable*, in the "as landed condition" and then have their Vehicle assessed for a determination by the Judges as to whether or not their Vehicle meets the criteria for being "intact", as per the answer to Question 29. (2007)

Q34: If the flights of a Team are judged to have won a prize, will there be any qualification review or requests for additional information after the Flights, or will final decisions as to Team eligibility, funding, tech qualifying, *et cetera* be made before the event?

A34: Unless compelling, egregious reasons are presented to the contrary, Teams that have satisfied and have not deviated from the Challenge Conditions as specified in Section A.3 of the Official NG-LLC Rules will be assumed qualified to participate in the Challenge. (2007)

Q35: May Teams use systems that need air cooling?

A35: Yes. The official NGLLC Rules prohibit aerodynamic or air-breathing methods of hovering, propulsion, steering, or landing (except in the case of abort). The use of air-cooling approaches for components or systems is acceptable. (2007)

Q36: May Teams share off the shelf parts such as batteries between their entries?

A36: Yes, the off-the-shelf components such as batteries can be shared between Vehicles of the same Team. However, to do so, the components must be clearly labeled and identified to the Judges. Further, if the Vehicle from which the off-the-shelf component is borrowed is to remain in the competition, this Vehicle must be able to be returned to a flight worthy condition with only the return and installation of the same or similar component as discussed and qualified in Q&A24. (2007)