

**ANNEX  
BETWEEN  
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
AMES RESEARCH CENTER  
AND RELATIVITY SPACE, INC.  
UNDER SPACE ACT UMBRELLA AGREEMENT NO. 38726  
(ANNEX NUMBER ONE)**

**ARTICLE 1. PURPOSE**

This Annex shall be for the purpose of utilizing NASA's expertise and facilities in supporting thermal protection material selection, design, analysis, manufacturing, and integration.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the Space Act, Other Transactions Authority (OTA), 51 U.S.C. § 20113(e).

**ARTICLE 2. RESPONSIBILITIES**

A. NASA ARC will use reasonable efforts to:

- 1) Provide the following design, analysis and TPS selection support activities:
  - a. Provide consultation with respect to NASA-developed technology to inform TPS selection for different locations of interest on the rocket based on peak heat flux and heat load provided by Relativity.
  - b. Provide consultation on TPS sourcing, manufacturing, refurbishment, and installation including planning and costing where appropriate.
  - c. Provide support for engine boot design including material selection, sealing and refurbishment.
  - d. For selected TPS, develop TPS thermal response numerical models for Fully Implicit Ablation and Thermal Analysis Program (FIAT) or equivalent material response code and train Relativity engineers to use those models.
  - e. Provide FIAT or equivalent material response code support and guided training including using P50 cork models on expandable sections of the rocket.
  - f. Review Pre Critical Design Review (CDR) Aerothermal Design practices applied to the launch vehicle leading up to the CDR phase of development
    - i. Review existing launch vehicle aerothermal and TPS sizing analyses.
    - ii. Identify and communicate areas of improvement to aerothermal design practices, as well as techniques for achieving such improvements.
    - iii. Provide recommendations for future aerothermal design and analysis efforts to further launch vehicle development.
  - g. Provide Data Parallel Line Relaxation Code (DPLR) support, including publicly available Orion best practices and input decks
    - i. Provide support for Computational Aerosciences Productivity & Execution (CAPE) including software improvements and development requests.
  - h. Perform DPLR simulations of the provided rocket geometry during re-entry.
  - i. Perform CDR Independent Aerothermal Analysis Verification

- i. Conduct aerothermal simulations for the launch vehicle at three points in time during flight
  - ii. Provide recommendations for further aerothermal design and analysis efforts.
- 2) Provide the following TPS testing support activities:
  - a. Provide support in defining the TPS material test program.
  - b. Provide support in executing the TPS material test program.
    - i. Conduct coupon testing of vendor-provided test articles.
      - (1) Thermal (Conductivity, TGA, Char Yield, etc.)
      - (2) Mechanical (Tension, Compression, Lap Shear, etc.)
    - ii. Conduct radiant heater testing and test article fabrication
    - iii. Conduct Arc-jet testing and test article fabrication in accordance with NASA safety requirements and Arc-jet standard operating procedures.

B. Partner will use reasonable efforts to:

- 1) Provide inputs as required for NASA tasks
- 2) Design and model a set of launch vehicle flight profiles or provide estimated peak heat flux and heat load at locations of interest
- 3) Develop and model launch vehicle Outer Mold Line (OML).
- 4) Identify locations of interest on the launch vehicle OML
- 5) Provide a list of Relativity relevant materials.
- 6) Provide materials to be tested.
- 7) Provide all required material specifications.
- 8) Provide all required material boundary conditions as inputs for thermal modelling.
- 9) Determine and supply environmental specification for TPS selection.
- 10) Provide verification in the ability to handle ITAR material and data.
- 11) Enter into a license with NASA if NASA patented TPS is selected

### ARTICLE 3. SCHEDULE AND MILESTONES

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

Milestone	Est. Start Date	Est. Duration
Report on TPS Design, manufacturing, and integration	Effective Date	3 months
Report on TPS sourcing and manufacturing	Post RS PDR	3 months
Provide guided FIAT training including P50 cork model	Effective Date	3 months
Report on engine boot design support	Post RS PDR	3 months
Report on material response analysis support	Post RS PDR	3 months

Report on Pre-CDR aerothermal analysis support of simplified geometry	Q1 2024	3 months
Report on Pre-CDR aerothermal analysis support of rocket geometry	Q2 2024	6 months
Report on TPS testing development plan	Post RS PDR	3 months
Coupon test report (Qty. 5 Mechanical tests)	Post RS PDR	3 months
Coupon test report (Qty. 5 Thermal tests)	Post RS PDR	3 months
Report on aerothermal IV&V for CDR	Q2 2024	6 months
TPS radiant heat test report (Qty. 2 Test articles)	Post RS PDR	3 months
TPS arc jet test report (Qty. 4 Test articles)	Q3-Q4 2024	3 months
DPLR report	Q2 2024	3 months

#### ARTICLE 4. FINANCIAL OBLIGATIONS

A. Partner agrees to reimburse NASA an estimated cost of \$601,424 for NASA to carry out its responsibilities under this Annex.

Estimated costs for the effort are shown in the table below:

<u>Responsibility #</u>	<u>Cost Category</u>	<u>Estimated Cost</u>
1A, 1B, 1C	TPS Design, manufacturing, and integration support	\$79,498
1D, 1E	TPS material response analysis support	\$106,544
1F, 1G, 1H	Pre-CDR Aerothermal Analysis Support of simple geometry	\$15,000
1F, 1G, 1H	Pre-CDR Aerothermal Analysis of rocket geometry	\$37,191
1I	CDR Aerothermal Analysis Support	\$30,000
2A, 2Bi	TPS Testing Support	\$32,865
2Bii	TPS Testing Support (Radiant Heater)	\$92,000
2Biii	TPS Arc-Jet Test Support	\$208,326

Each payment shall be marked with Ames Research Center, SAA2-403760-1.

B. NASA will not provide services or incur costs beyond the current funding. Although NASA has made a good faith effort to accurately estimate its costs, it is understood that NASA provides no assurance that the proposed effort under this Annex will be accomplished for the estimated amount. Should the effort cost more than the estimate, Partner will be advised by NASA as soon as possible. Partner shall pay all costs incurred and have the option of canceling the remaining

effort, or providing additional funding in order to continue the proposed effort under the revised estimate. Should this Annex be terminated, or the effort completed at a cost less than the agreed-to estimated cost, NASA shall account for any unspent funds within one year after completion of all effort under this Annex, and promptly thereafter, at Partner's option return any unspent funds to Partner or apply any such unspent funds to other activities under the Umbrella Agreement. Return of unspent funds will be processed via Electronic Funds Transfer (EFT) in accordance with 31 C.F.R. Part 208 and, upon request by NASA, Partner agrees to complete the Automated Clearing House (ACH) Vendor/Miscellaneous Payment Enrollment Form (SF 3881).

#### ARTICLE 5. LIABILITY

For the responsibilities and activities conducted under this Annex, and any claims arising thereunder, the following sentence shall be added to the end of Paragraph C, Article 8 (titled "Liability") of the Umbrella Agreement: Prior to issuing such direction, NASA will consider input from Partner and other factors such as the extent to which damage was attributable to the activity and the respective responsibilities of each Party as described in the Agreement.

#### ARTICLE 6. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

- A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of two years. .
- B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.
  - 1. Background Data: The Disclosing Party's Background Data, if any, will be identified in a separate technical document.
  - 2. Third Party Proprietary Data: The Disclosing Party's Third Party Proprietary Data, if any, will be identified in a separate technical document.
  - 3. Controlled Government Data: The Disclosing Party's Controlled Government Data, if any, will be identified in a separate technical document.
  - 4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement: FIAT

#### ARTICLE 7. TERM OF ANNEX

This Annex becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or three years from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

#### ARTICLE 8. RIGHT TO TERMINATE

Either Party may unilaterally terminate this Annex by providing thirty (30) calendar days written notice to the other Party.

**ARTICLE 9. POINTS OF CONTACT**

The following personnel are designated as the Points of Contact between the Parties in the performance of this Annex.

**Management Points of Contact**

NASA Ames Research Center  
Nahri Ahn  
Agreement Manager  
Moffett Field, CA 94035  
Phone: 650-604-1179  
nahri.i.ahn@nasa.gov

Relativity Space, Inc.  
Ryan Kraft  
Senior Director, Integrated Performance  
2400 E. Wardlow Rd.  
Long Beach, CA 90807  
Phone: 310-912-0250  
[rkraft@relativityspace.com](mailto:rkraft@relativityspace.com)

**Technical Points of Contact**

NASA Ames Research Center  
Keith Peterson  
Lead PICA-D and PICA Sustainability Projects  
Moffett Field, CA 94035  
Phone: (512) 650-0885  
keith.h.peterson@nasa.gov

Relativity Space, Inc.  
Jean-Loup Bourguignon  
Senior Aerothermal Engineer  
2400 E. Wardlow Rd.  
Long Beach, CA 90807  
Phone: 626-787-3916  
[jbouguignon@relativityspace.com](mailto:jbouguignon@relativityspace.com)

**ARTICLE 10. MODIFICATIONS**

Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

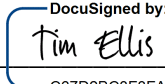
**ARTICLE 11. SIGNATORY AUTHORITY**

The signatories to this Annex covenant and warrant that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

**NATIONAL AERONAUTICS AND  
SPACE ADMINISTRATION  
AMES RESEARCH CENTER**

**RELATIVITY SPACE, INC.**

BY: \_\_\_\_\_

BY:  \_\_\_\_\_  
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Dr. Rupak Biswas  
Director of Exploration Technology

Tim Ellis  
Relativity Space  
Chief Executive Officer

DATE: \_\_\_\_\_

DATE: 8/1/2023 \_\_\_\_\_