AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. Contract ID Code	Page 1 Of 4
Cost-Plus-Fixed-Fee	

2. Amendment/Modification No.	3. Effective Date	4. Requisition/Purchase Req No.	5. Project No. (If applicable)
P00003	2004JUN10	SEE SCHEDULE	

6. Issued By Code W56HZV

TACOM WARREN BLDG 231
AMSTA-AQ-ABGA
JEFFREY BEAN (586)574-7860
WARREN, MICHIGAN 48397-5000
HTTP://CONTRACTING.TACOM.ARMY.MIL
EMAIL: BEANJ@TACOM.ARMY.MIL

7. Administered By (If other than Item 6) Code S1501A

DCMA INDIANAPOLIS
EMMETT J. BEAN CENTER
8899 E. 56TH ST.
INDIANAPOLIS, IN 46249-5701

SCD C **PAS** NONE **ADP PT** HQ0337

8. Name And Address Of Contractor (No., Street, City, County, State and Zip Code)

ADIABATICS INCORPORATED
3385 COMMERCE DR
COLUMBUS, IN. 47201-2201

TYPE BUSINESS: Small Disadvantaged Business Performing in U.S.

Code 9Y975 **Facility Code**

☐ **9A. Amendment Of Solicitation No.**

9B. Dated (See Item 11)

☒ **10A. Modification Of Contract/Order No.**
DAAE07-03-C-L004

10B. Dated (See Item 13)
2003JAN15

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ **The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers**
☐ **is extended,** ☐ **is not extended.**

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendments: (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. Accounting And Appropriation Data (If required)
NO CHANGE TO OBLIGATION DATA

13. THIS ITEM ONLY APPLIES TO MODIFICATIONS OF CONTRACTS/ORDERS
It Modifies The Contract/Order No. As Described In Item 14.

KIND MOD CODE: G

☐ **A. This Change Order is Issued Pursuant To: The Changes Set Forth In Item 14 Are Made In The Contract/Order No. In Item 10A.**

☐ **B. The Above Numbered Contract/Order Is Modified To Reflect The Administrative Changes (such as changes in paying office, appropriation data, etc.) Set Forth In Item 14, Pursuant To The Authority of FAR 43.103(b).**

☒ **C. This Supplemental Agreement Is Entered Into Pursuant To Authority Of:** mutual agreement of the parties

☐ **D. Other (Specify type of modification and authority)**

E. IMPORTANT: Contractor ☐ **is not,** ☒ **is required to sign this document and return _____ copies to the Issuing Office.**

14. Description Of Amendment/Modification (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

SEE SECOND PAGE FOR DESCRIPTION

Except as provided herein, all terms and conditions of the document referenced in item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. Name And Title Of Signer (Type or print)		16A. Name And Title Of Contracting Officer (Type or print)	
		DEREK MCALEER MCALEERD@TACOM.ARMY.MIL (586)574-7197	
15B. Contractor/Offeror	**15C. Date Signed**	**16B. United States Of America**	**16C. Date Signed**
_____ (Signature of person authorized to sign)		By /SIGNED/ (Signature of Contracting Officer)	2004JUN10

SECTION A - SUPPLEMENTAL INFORMATION

1. Modification P00003 is added to change the Statement of Work. This is primarily to reflect that the contractor shall validate the tribology model using both single and four cylinder engines, rather than just a single cylinder engine.

2. The following changes are made to section C:

2.1 Paragraph C.2.3 is changed to add a requirement to include a graphical user interface in the model.

2.2 Paragraph C.4 is changed, and paragraphs C.4 (a) and C.4 (b) are added, to change the validation hardware from a one cylinder engine to both one and four cylinder engines.

2.3 Paragraph C.4.3 is re-phrased so that is covers all dynamometer testing, and not just the testing of a one cylinder engine.

3. The cost increases of these changes are offset by lowered cost estimates relating to other areas of the Statement of Work. Therefore, there is no cost impact to this modification, and the total estimated cost and fixed fee remain unchanged.

*** END OF NARRATIVE A 004 ***

SECTION C - DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

C.1 Background: The purpose of this effort is for the contractor to advance the technology of automotive engine tribology modeling, and prepare and put into service an engine tribology simulation model. The model is to serve as a design tool to help engine designers produce advanced engine designs with high power-density and with reduced total costs.

The model is to address the technical issues of friction and wear of the engine's reciprocating and rotating parts, oil film thickness, boundary lubrication of upper ring-liner, coefficient of friction for various materials and coatings, temperature, stress and load.

C.2 Scope of Work: The contractor, acting as an independent contractor and not as an agent of the government, shall provide the necessary facility, material, personnel, equipment, and services to accomplish the tasks as defined in this contract. Under this action, the contractor shall validate and prepare for practical application a tribology simulation model for use as an engine tribology design tool.

C.2.1 The contractor shall research, analyze, design and assemble mathematical/empirical engine tribology equations, and transfer them into an advanced computer model for use by engine designers as a design tool.

C.2.2 The following are the main tribology parameters that the contractor shall include in the engine tribology model:

a. oil film thickness
b. wear
c. Coefficient of friction
d. friction torque
e. contact stress
f. specific friction work (plastic deformation between the contact surfaces)
g. shear stress
h. linear shear rate
i. piston speed
j. temperature of oil, ring, and liner
k. effective oil viscosity
l. engine oil blowby
m. engine oil consumption

C.2.3 The contractor shall design the engine tribology mathematical/empirical model and code with the capabilities to optimize and compute the value of each of the tribology parameters of paragraph C.2.2. The model shall include a graphical user interface (GUI).

C.3 The contractor shall analyze and optimize the values the engine tribology parameters of paragraph C.2.2. The contractor shall calculate the forces affecting the ring sliding and radial motions on the liner and in the piston groove. The forces to be computed, and which influence the friction, the oil film thickness, and the wear are: the inertia force, the normal/side force, the gas force, the friction force, the elastic piston ring force, and the hydrodynamic lifting force.

C.3.1 The contractor shall analyze, optimize, and measure the oil film thickness using a fully instrumented optical (laser induced fluorescent) engine.

C.3.2 The contractor shall analyze the piston ring motions in hydrodynamic and boundary lubrication modes, and calculate the oil film thickness, the friction and the piston ring and cylinder liner wear.

C.4 Testing and validation: The contractor shall evaluate and validate the total tribology parameters per paragraph C.2.2 using their laboratory tribometer test rig. In addition, the contractor shall further test the model on a dynamometer test rig using two engines, as follows:

C.4 (a) The model shall be validated using a contractor-supplied, oil-cooled, single cylinder Cummins AVL-AIPS engine equipped with full stroke cylinder liner electrical oil film thickness sensor and offset laser friction measurement instrumentation. The engine tests shall include full and part load operations with various lubricant types and at various engine RPMs.

C.4 (b) The model shall be validated using a four cylinder, water-cooled, turbocharged, fuel injected Volkswagen diesel engine. This engine shall be acquired by the Contractor for this program, and shall become the property of the Government.

C.4.1 The contractor shall make revisions and modifications to the mathematical empirical model and to the computer program code if the validation tests necessitate the modifications. The goal of this analytical and experimental work is to perfect the model to become an efficient viable and useful engine design tool.

C.4.2 Duration of the Tests: The contractor shall repeat the engine tests at various engine speeds and loads until the tribology models are fully verified and validated.

C.4.3 The contractor shall provide notification to the Contracting Officer's Technical Representative (COTR) to attend and witness the model development and validation on the laboratory test rig, and on the engine dynamometer tests. The contractor shall extend the notification to the COR one week prior to the starting of each test.

C.5 Reports and data:

C.5.1 The contractor shall prepare interim and final reports, as well as any drawings and other technical data in the format and scope specified in the applicable data item description (DD FORM 1664). The information shall be furnished to the Government in accordance with the requirements, quantities, and schedules set forth in the Contracts Data Requirements List. (DD FORM 1423)

C.5.1.1 Contractor Status, Progress and Management Report: The contractor shall prepare and deliver bi-monthly Contractor Status, Progress and Management Reports in accordance with CDRL Item No. A001, DI-MGMT-80227 (T). In addition to cost reporting; these reports shall identify the current activities, document any problems, the causes of these problems, determine program impact, and describe actions taken to resolve those problems.

C.5.1.2 Final Technical Report: The contractor shall prepare and deliver the Draft and Final Technical Report covering all the program activities. This report shall be prepared in accordance with CDRL Item No. A002, DI-MISC-80711. The Final Technical Report shall include all test data gathered during the performance of the contract. The draft final report shall be submitted to the Contracting Officer's Technical Representative (COTR) 20 days prior to contract end date. The COTR will review and return the draft report to the contractor in 10 days. The final report is due by the contract end date (24 months after award).

C.5.1.3 Tribology model: The contractor shall deliver the completed tribology model in accordance with CDRL Item No A0003, DI-MCCR 80700. The model shall be written in C++ and delivered on CD-ROM. It shall be delivered no later than the draft Technical Report (23 months and 10 days after contract award).

C.5.2 Presentation Materials. The contractor shall prepare and deliver presentation materials in accordance with CDRL A004, DI-ADMIN-81373. The contractor shall deliver 2 display boards. The first shall be due 16 months after contract award and the second due upon delivery of the Final Scientific and Technical Report. These presentation materials may be publicly displayed at government locations, or at professional or industry trade shows or conferences. The materials shall consist of portable 3-panel display board, approximately 72Wx30H in size.

C.5.2.1 Left panel to include: Purpose, Problem and Procedure.

C.5.2.2 Center panel to include: Title, Illustrations/Photos and/or Graphics/Charts.

C.5.2.3 Right panel to include: Results and Conclusions.

*** END OF NARRATIVE C 001 ***