

## **FEMTOSECOND LASER FOR FLEET VELOCITY MEASUREMENTS REQUIREMENTS AND SPECIFICATIONS**

### **I. INTRODUCTION**

FLEET (femtosecond laser electronic excitation tagging) is a laser based measurement technique where a femtosecond laser is focused down to a spot which illuminates a line in a gaseous flow. The laser excites N<sub>2</sub> and fluorescence occurs. The fluorescence is imaged by a camera and the velocity of the flow is determined from subsequent images obtained as the flow moves. NASA needs to make such measurements along many parallel lines in the flow to learn about the spatial variation in gaseous flow properties.

### **II. CLIN 1**

The contractor shall supply a one box solution Femtosecond laser. This one box solution shall be enclosed with sides and a top for laser safety with all contained lasers mounted to a single optical table for stability in accordance with the following specifications.

#### **A. SPECIFICATIONS**

<b>#</b>	<b>Parameter</b>	<b>Specification</b>	<b>Comments</b>
1	Laser Energy	>3.5 mJ/pulse	This need for multiple measurements drives the requirement on pulse energy
2	Laser Wavelength	780-820 nanometers	
3	Pulse Duration	<100 femtoseconds	The need for multiple measurements affects the short pulse duration requirement
4	Repetition Rate	>1 kilohertz	A high repetition rate is required for two reasons: first, to acquire large quantities of data (which can be averaged to reduce uncertainties) and second, to time-resolve some flows, allowing a movie-like sequence of flow velocities to be obtained
5	Beam Quality	(TEM <sub>00</sub> ): M <sub>2</sub> <1.3	
6	Operating Environment	≥ +/-5 degrees C	
7	Stability	<0.5% rms over 8 hours	
8	Transform Limit	<1.5 x transform limit	
9	Contrast Ratio	>1000:1 pre-pulse > 100:1 post-pulse	
10	Beam Diameter	9-10 millimeters	
11	Polarization	Linear	
12	Laser Size	length ≤ 1.3m width ≤ 0.8m height ≤ 0.3 m	These size specifications are limited by the size restrictions of the laboratories and facilities as described below

The following additional information is provided to further clarify the laser operating requirements summarized in the parameter table above.

1. The laser will be installed on a mobile cart by the Government and brought to several wind tunnel facilities which have significant vibrations and also which have uncontrolled temperature environments. The size of the mobile cart is restricted by narrow doorways leading to some of the laboratories and facilities and also by the small space located next to facilities where the cart will be placed. The laser will undergo significant vibration during transport. These needs drive both the thermal stability requirement and the need for a shock-resistant design (evidence of vibration testing will be required).

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2. The laser will also be used for CARS spectroscopy, which requires the broad bandwidth that accompanies <100 fs pulses.

### **B. Evidence of vibrational testing of components and/or full system**

The delivered system shall be vibration tested to 0.5 g or greater while maintaining the all power specifications after completion of the test. The time duration of the vibration testing shall be  $\geq 10$  minutes. The direction of the vibration testing is not specified.

### **C. Warranty**

The manufacturer shall provide a minimum 1 year warranty.

### **D. Deliverables & Schedule**

1. Delivery of Equipment – The equipment delivery shall be within 12 weeks of contract award to include a one box solution containing all lasers, all mounted to a single optical table for stability.
2. The contractor shall submit documentation evidence of successful vibrational testing of the unit being delivered as described in this requirements document.
3. The equipment shall be shipped F.O.B. Destination to NASA Langley Research Center, Hampton Virginia.
4. User's Manuals and Supporting Documentation
5. The contractor shall provide training at LaRC for up to 3 NASA Langley personnel on the delivered laser. The training shall be a minimum of eight (8) hours.

### **III. CLIN 2 – (OPTION 1) ADDITIONAL 1-YEAR EXTENDED WARRANTY**

The contractor shall provide an extended maintenance/warranty of one (1) year beyond the warranty period included with the base system. This shall cover all parts and labor, excluding standard consumables. This shall also include a yearly preventative maintenance (PM) service performed on-site at Langley Research Center, including annual checks of alignment, cleaning, and installation of software upgrades.

### **IV. CLIN 3 – (OPTION 2) ADDITIONAL 2-YEAR EXTENDED WARRANTY**

The contractor shall provide an extended maintenance/warranty of two (2) years beyond the warranty period included with the base system. This shall cover all parts and labor, excluding standard consumables. This shall also include a yearly preventative maintenance (PM) service performed on-site at Langley Research Center, including annual checks of alignment, cleaning, and installation of software upgrades.

### **V. CLIN 4 – (OPTION 3) ADDITIONAL 3-YEAR EXTENDED WARRANTY**

The contractor shall provide an extended maintenance/warranty of three (3) years beyond the warranty period included with the base system. This shall cover all parts and labor, excluding standard consumables. This shall also include a yearly preventative maintenance (PM) service performed on-site at Langley Research Center, including annual checks of alignment, cleaning, and installation of software upgrades.