

## Statement of Work for Charnwood Dynamics

Rev. 1:	2 May 2001	
Rev. 2:	24 May 2001	
Rev. 3:	31 May 2001	
Rev. 4:	1 June 2001	
Rev. 5:	8 June 2001	
Rev. 6:	7 January 2002	Addition of Hub requirements
<u>Rev. 7:</u>	<u>3 April 2002</u>	<u>Shake requirements reduced; remove Webcam; 12VDC input</u>

MIT intends to purchase one Charnwood Dynamics CODA optical immediately and 4 more trackers (and associated sets of optical markers) in the next fiscal year. Although the units we are purchasing are based upon the design of a standard COTS model mpx2001, certain modifications must be implemented for use on the International Space Station. These modifications, and certain unique procedural requirements, are listed below; the engineering design effort as well as the procurement of unique parts (e.g.: PC boards to MIL-SPEC requirements) are to be costed separately as a non-recurring engineering effort.

Design modifications for compatibility with Space Station usage:

1. Input voltage shall be ~~6VDC~~12VDC +/- 10%.
2. Signal and power will be on a single MIL-C-38999 connector.
3. Complex printed circuit boards shall be fabricated to MIL-P-55110 or equivalent by a qualified vendor.
4. Parts and materials proposed for use shall be submitted to MIT for assessment of compatibility with ISS requirements for flammability, offgassing, and fungus resistance.
5. Electronic parts shall be of the highest quality level commonly available.
6. PC assemblies shall be conformally coated using CYTEC Conap 1155 or equivalent.
7. EMC design shall be sufficient for CE certification with conformance to ISS requirements as a goal.
8. Mechanical design shall assure that that the unit will pass a 6Grms random vibration for 60 seconds in each axis.
9. Thermal design shall assure that no individual electrical component on the PC boards exceeds a case temperature of 55C in a 25C ground laboratory environment.
10. An integral protective cover will be provided to protect the camera windows.
- ~~11. A 640x480 pixel resolution, color Webcam will be integrated into the chassis (We assume the USB signal will be routed through the MIL-C-38999 connector.)~~

In addition to the above optical trackers, MIT intends to purchase several signal processing hubs (at least two of which will meet the requirements of the Flight Program as specified below). These hubs are required in our ISS application to

- a) Analyze the marker information received from both optical bars and select the best (i.e. most accurate) set on a sample-by-sample basis;
- b) Provide a modified format data stream to the Intersense inertial sensor system (so that we will be compatible with existing Intersense COTS software); and

c) Provide a TCP/IP compatible high-speed data stream containing camera data. What is required from Charnwood is an embedded computing platform on which we can install application software which will accomplish the above tasks.

#### Procedures unique to a Flight Program

11. In order to assure that the Flight items meet materials, cleanliness, and outgassing requirements, some Charnwood-internal manufacturing procedures will need to be generated. (These would assure, for instance, that cleaning solvents used in the course of manufacture do not introduce contaminants that would later cause difficulties with outgassing tests.) MIT will assist Charnwood in reviewing its existing procedures and writing such new procedures as may be required.
12. An acceptance test procedure shall be written by Charnwood, with concurrence by MIT required, which demonstrates that the flight items meet all performance requirements in a laboratory environment (aka the Long Form Test). The Long Form Test typically includes such tests as power supply voltage margining, optical path transmission margins, etc., and will also include those science measurements proposed by Co-I Joe McIntyre. A reduced set of tests (aka the Short Form Test) shall be conducted during thermal testing, between vibration axis, etc. In the following descriptions, a Qualification Test is run only on the first deliverable flight item; all other flight items are only subjected to Acceptance testing.

The following are standard Quality requirements that will appear in our purchase order for flight units.

13. MIT shall at all times upon reasonable notice to Charnwood, be allowed access to Charnwood's facility for the purpose of inspection, progress evaluation witnessing of fabrication, tests, packaging, etc. Such inspections will be made in a manner which will not disrupt or delay the work in progress. Charnwood agrees to provide for the reasonable comfort, safety and convenience of any MIT visitor.
14. Charnwood is to furnish an as-built materials list. The list is to contain the following information as applicable: part number/drawing number, nomenclature, material code, material specification, material/manufacturer, process spec., weight, thickness, estimated surface area. This information shall be supplied electronically using a template supplied by MIT, or as negotiated with MIT. Contact Matt Smith 1.617.252.1736 .
15. All non-metallic materials shall be evaluated for fungus resistance. MIT will work with Charnwood in conducting this evaluation.
16. The supplier shall furnish a Certificate of Compliance with the parts or material procured under this purchase order.
17. MIT source inspection is required. Please notify MIT Product Assurance 2 weeks prior to delivery. Contact Matt Smith 1.617.252.1736 .

The following verification requirements will apply to each flight item.

18. An ambient pressure thermal test will be run which subjects the flight item to excursions between -10 and 50C. (Qual: 7 and one-half cycles; Acceptance: 1 and one-half cycles.) These tests are typically run in a dry nitrogen atmosphere to avoid condensation. At temperatures outside a defined operating range -- +10 to +30C, for example -- the test procedure might call for the flight item to be in an unpowered state.

- ~~20.~~19. A workmanship screen vibration test shall be performed on each flight item. The excitation is random, ~~6.1G~~4.4G rms for a duration of 60 seconds in each of three axes. The units are unpowered during vibration. (A qualification unit must pass a 6.1G rms/60 s test.)
20. Each flight item is required to operate for a minimum of 96 hours at its maximum operating temperature -- a meager attempt to reduce infant mortality.
21. Satisfactory science performance is to be judged per MIT/CSNR document 85-20001.03 .
22. The first delivered flight item shall be tested to demonstrate compliance with CE EMC requirements. Testing to Space Station requirements will be handled by MIT after acceptance and delivery.
23. Flammability and offgassing tests will be conducted by MIT after acceptance and delivery.

MIT will provided the following items for use in flight fabrication

24. MIL-C-38999 Connectors
25. Hi-Rel EEE Parts when and where available as direct substitutions for commercial items.