Rec 10/1/2020

16

MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See http://www.mtsu.edu/sga/cleanenergy.shtml for funding guidelines. Save completed form and email to cee@mtsu.edu or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request: Ngee Sing Chong	
Department/Office: Chemistry	Phone # (Office):615-898-5487
MTSU Box # : PO Box 68	Phone # (Cell) :615-556-5509
E-mail: nchong@mtsu.edu	Submittal Date: October 1, 2020

2. Project Categories (Select One)			
Select the category that best describes the project.			
	Energy Conservation/Efficiency	X	Sustainable Design
	Alternative Fuels		Other
	Renewable Energy		

3. Project Information
a. Please provide a brief descriptive title for the project. **b.** The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. **Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.** c. List the source of project cost estimates. d. Provide a brief explanation in response to question regarding previous funding .
3a. Project Title: Plastic Recycling Priorities: Quantifying Different Types of Microplastic Particles Found in Surface Waters
3b. Project Cost Estimate: The requested project funding of $6,636 will be used for the purchase of items for assisting with the Raman spectrometric analysis of microplastic particles (please see requested items in red font in the Horiba quote). The sum of individual items are: $197+$289 + $2580 + $3570 =$6,636.
3c. Source of Estimate: The price quotes from the vendor, Horiba Scientific, for the requested items are consulted. They are attached to the end of this proposal.
3d. If previous funding from this source was awarded, explain how this request differs? My last Clean Energy project funding is for the purchase of a headspace analyzer for analyzing pollutants from the Middle Point landfill so that Rutherford County Commission and its residents can have objective scientific data to choose a sound waste disposal option. This request deals with the issue of water

contaminated by microplastic particles. These particles are widespread in surface waters (i.e. rivers, oceans, and lakes) and are showing up in both tap and bottled waters.

4. Project Description

(Completed in as much detail as possible.)

a. The scope of the work to be accomplished is a detailed description of project activities.
b. The benefit statement describes the advantages of the project as relates to the selected project category.
c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
e. Provide specific information on anticipated student involvement or benefit.
f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

4a. Scope: Work to be accomplished

The identification and quantification of microplastic particles will be carried out using confocal Raman microscopy, scanning electron microscopy (SEM) and energy-dispersive X-ray analysis (EDX). A common set of about 30 polymer standards including the ubiquitous high density polyethylene (HDPE), polypropylene (PP), polyvinyl chloride (PVC), polyethylene terephthalate (PET), and polystyrene (PS) will be used to produce standard spectra that are used to identify the microplastic particles in water samples. These standard spectra will be used to create a database to aid in the identification of microplastic particles found in the Stones River water samples in Murfreesboro. The size distribution of the particles in the range of 0.1 micron to 100 microns will be determined by both SEM/EDX and Raman microscopy. An accessory for calibrating the Raman spectrometer is needed to facilitate the Raman analysis.

For microplastic particles that are more complex, the technique of pyrolysis gas chromatography-mass spectrometry will be used. The filters containing the microplastic particles will be placed inside the pyrolyzer that can achieve a temperature of 350-700 degree Celsius to fragment the polymeric material for a more detailed analysis of their molecular structure with the help of mass fragmentation software.

The water samples will be filtered using quartz and silver membrane filters in order to retain the microplastic particles on the surfaces of these filters. The

dried filters will be placed on the microscope sample stage and analyzed using Raman and SEM/EDX techniques. The EDX and Raman spectra are used to identify the composition of the microplastic particles and the images are digitally processed with the Image J software to allow the counting and determination of the distribution of microplastic particles according to size, shape, and composition. The microplastic particle data will be compared to published data for samples obtained at other locations to assess the severity of microplastic pollution in Murfreesboro, TN. The data will be disseminated via MTSU Scholars Week presentation and/or a regional scientific conference like Tennessee Academy of Science Meeting and Southeast Regional American Chemical Society Meeting.

4b. Scope: Benefit Statement

The benefits of this project include the dissemination of microplastic pollution data with the public, scientific community, and regulatory agencies such as Environmental Protection Agency, Tennessee Health Department, and Tennessee Department of Environment and Conservation. The public awareness of microplastic pollution will spur the public to be more diligent in the recycling of plastic products and to be more prudent in the disposal of plastic items and not to throw them into rivers, lakes, or sea.

Regulatory agencies will need the microplastic pollution data to set guidelines or policies to safeguard water quality. The distribution of different types of microplastic particles will help us determine what kind of plastic products are most susceptible to degradation into microplastic particles of sub-micron sizes. It will help scientists evaluate the priorities for recycling different types of plastics.

This project also allows MTSU students to be trained in the application of laboratory and instrumental methods to carry out research in microplastic pollution. The skills gained by students will be helpful to their future employment in the chemical industry or testing laboratories.

4. Project Description (continued)

4c. Location of Project (Building, etc.):

The project will be conducted in the Molecular Spectroscopy Laboratory in SCI 3093, Gas Chromatography Laboratory in SCI 3101 and the Sample Preparation Laboratory in SCI 3070. The water samples from Stones River will be collected at different locations in Murfreesboro.

4d. Participants and Roles

Project Leader: Dr. Ngee Sing Chong (Planning and implementing the project and directing students in the analysis of air and water samples)

Instrument Support Specialist: Mr. Jessie Weatherly (In charge of the maintenance and repair of instruments throughout the project)

Student Researchers: Mr. George Worden, undergraduate student majoring in Chemistry; other students will participate via CHEM 3880 CHEM 6640 research courses.

4e. Student participation and/or student benefit

This project provides experiential learning opportunities for students in designing the sampling plan for collecting water samples. They will learn useful laboratory techniques such as Raman microscopy, SEM/EDX, and pyrolysis gas chromatography-mass spectrometry.

4f. Future Operating and/or Maintenance Requirements

The project will continue to operate with the support of Chemistry Department at MTSU. The cost of consumables needed for Raman, SEM/EDX analysis will be covered by the departmental operating expenses for student research projects.

4g. Additional Comments or Information Pertinent to the Proposed Project

This project is made possible through the recent National Science Foundation (NSF) award of funding to Dr. Chong for the purchase of a confocal Raman microscope installed this past summer. The price of the instrument purchased with the NSF award is $267,774. The price quotes for accessories from Horiba Scientific are shown at the end of this proposal. These are needed for the characterization of Raman microplastic particles.

Besides providing opportunities to conduct research through CHEM 3880, this project seeks to provide objective scientific data related to the environmental impact of microplastic pollution. It will also highlight MTSU's capability for investigating potential risks of human exposure to microplastic particles. The ultimate goal is to utilize the scientific data for the protection of environment and human health.

5. Project Performance Information

Provide information if applicable.

a. Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
b. Provide information on estimated annual energy cost savings in monetary terms.
c. Provide information on any annual operating or other cost savings in monetary terms. Be specific.
d. Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

Not Applicable

5b. Annual Energy COST Savings ($)

Not Applicable

5c. Annual Operating or Other Cost Savings. Specify. ($)

Not Applicable

5d.Matching or Supplementary Funding (Identify and Explain)

Dr. Chong typically has about $1200-$3000 research expenditures that are covered by the Chemistry and indirect cost recovered from his externally funded research. Chemistry Department also provide research supplies for both undergraduate and graduate students involved in Dr. Chong's research projects via formal research coursework and thesis-based research.

LabRAM HR Evolution Raman Microscope

Budgetary quotation subject to office approval

To:	Date: 10/1/2020
Company:	
Phone: Dr. Sing Chong Middle Tennessee State University +1-(615) 898-5487 Email: nchong@mtsu.edu	Quote Number: JRG201001-Accessories-MTSU-Chong-V1

Item	Reference	Description	Amount
		Stage Inserts and Filter Holders	
1	**G-Ins-S**	Glass insert plate, 116 x 116 x 3 mm For 75 x 50 mm stage	$57
2	**G-Ins-L**	Glass insert plate, 160 x 116 x 3 mm For 130 x 80 mm stage	$57
3	**Ins-Fil-S**	Stage insert for one filter holder, 116 x 116 x 7 mm For 75 x 50 mm stage	$197
4	**Ins-Fil-L**	Stage insert for one filter holder, 160 x 116 x 7 mm For 130 x 80 mm stage	$197
5	**Fil-hol-25**	Filter holder, 25 mm diameter, closed version, screw cap	$275
6	**Fil-hol-47**	Filter holder, 47 mm diameter, closed version, bayonet cap	$289
		Polarized Raman Kits	
7	**KIT-POL-VIS**	A set of visible half wave plate for 90° rotation of the incoming laser polarization and a Vis analyzer to analyze the Raman signal for the range [400-700nm] and holders	$2,990
8	**KIT-POL-NIR**	A set of NIR half wave plate for 90° rotation of the incoming laser polarization and a NIR analyzer to analyze the Raman signal, for the range [700-1100nm] and holders	$5,760
		Automation and Calibration	

9	**UP-MOT-POLKIT-HR**	**MOT-POLKIT-HR Motorized laser and Raman polarization kit for LabRAM HR Evolution** Includes: - Motorization for 1/2 wave plate module on laser path - Motorization for Polarization analyzer module on Raman path - Controller and software plugin in LabSpec 6 The 2 motorized polarization modules are inserted manually, and do not require any alignment. MOT-POLKIT-HR option has to be used in addition to the common polarization options The motorization of the polarization on Raman path is not compatible with ULF option	$6,630
10	**Sample-Ref**	**Internal sample reference for intensity and spectral correction.** The sample has to be defined by the user based on the application. Includes 2 holders for the 80/20 beamsplitter and the neutral window, and one 10x10mm cuvette for liquid sample.	$5,920
		The Neon lamp can be used also as a sample for spectral reference; the intensity of the Neon lines can be adjusted. Delivered with 2 sets of optics: one for UV (250-450nm), one for Visible (400-700nm). Only compatible with open space microscope Not compatible with Laser trapping accessory "LAS-TRAP-300"	
	Microscope Accessories		
11	**SP-RCO**	**Standard PRO - Patented Raman calibration Objective,** offers simple and reliable focus-free calibration - uniquely enables the reference sample to remain in position under the microscope during system calibration. Includes replaceable polystyrene reference material which is calibrated against a NIST traceable standard. Certificate and documents included (material validation for 12 months) Note: usable with laser from 440 to 800nm	$2,580
12	**SP-RCO-REF**	Replacement reference material in mount for SP-RCO. Includes certificate for 12 months validation	$1,070
	Raman Probes		
13	**SUPERHEAD-532**	**Fiber optic Raman probe for non contact remote measurements equipped with:** - Focusing and collecting lens - F = 40 mm - 2 FC connectors for multimode fibers - Set of Edge and interference filters for 532 nm laser excitation, allowing measurements from 150 cm^{-1} - Set of 2 optical fibers with metallic shielding (F = 100 µm / L = 10 m) and FC connectors. Other fibers available on request	$10,510
14	**SUPERHEAD-785**	**Fiber optic Raman probe for non contact remote measurements equipped with:** - Focusing and collecting lens - F = 40 mm - 2 FC connectors for multimode fibers - Set of Edge and interference filters for 785 nm laser excitation, allowing measurements from 150 cm^{-1} - Set of 2 optical fibers with metallic shielding (F = 100 µm / L = 10 m) and FC connectors. Other fibers available on request	$10,510

	Additional Software Modules and Licenses		
15	**LS6-MultiPoints**	**MultiPoints** - Allows automatic acquisition of Raman spectra at multiple positions. Each position can be set in X, Y and Z. This app is only available for systems equipped with a motorized XY (mandatory) and Z (optional) sample stage.	$2,000
16	**LS6-MVA+**	**MVAPlus Multivariate Analysis module** - integrated chemometrics tool based on statistical analyzes algorithms for reference spectra calculation. It includes decomposition algorithms (PCA, MCR) and clustering algorithms (HCA, K-means). This module is able to analyze large datasets, up to 4,000,000 points mapping. A comparator tool is also offered to compare the reference spectra and the induced scores distributions produced by the different algorithms. **x1 (one) general (academic/industrial) license.**	$2,600
17	**LS6-MW**	**MultiWell high throughput screening module.** **x1 (one) license includes:** - Plate holder for standard 96 well plates to be mounted on the 130mm x 85mm stage. - Plate configuration for any size/shape plate, with easy to use plate setup Wizard - Plate alignment allowing correction for plate shift, rotation and tilt (requires suitable reference markers on the plate) - Acquisition modes for single spectrum, average of 9 spectra and average of 25 spectra in each well. User can define individual wells to be included/excluded from a measurement.	$3,570
		- Full data processing/analysis functions via standard LabSpec 6 modules, including multivariate analysis (optional LS6-MVA module). Notes: Requires a suitable motorized XY stage for use. The 130mm x 85mm stage must be used to work with standard 96 well plates. This module includes the mechanical adaptation to mount a standard 96 well plate onto the 130mm x 85mm stage. A motorized Z stage and ultra-long working distance objective are recommended for optimized use. Does not include well plates.	
18	**LS6-SiStress**	**Embedded automated stress analysis** of microcrystalline Silicon and enhanced analysis reports	$2,500
19	**LS6-DLC**	**Automated DLC Coating Analysis.** Embedded automated D:G analysis and enhanced analysis reports.	$2,500
		Total:	**$60,212**
		Packing and Handling(1% of total):	**$602**
		Shipping (1% of total):	**$602**
		Grand Total:	**$61,416**

Notes

1. System warranty does not apply to computers, vacuum pump, or lasers (if any). These parts are covered by the warranty of the manufacturers of these items.
2. Full computer specification is available upon request. It is highly recommended that the computer be purchased with the instrument to allow us to pre-load and test hardware and software before delivery. If the computer is not purchased with the instrument the customer will need to ship a computer of the recommended specification to HORIBA Scientific. HORIBA is not responsible if this computer does not work with the instrument.
3. Please state clearly on your order if your company or institute is tax exempt and supply a valid copy of your tax exemption certificate. A delay in sending a valid tax exempt certificate can prevent proper processing of your order and may delay delivery.

4. This offer is subject to the novel coronavirus (COVID-19) pandemic being recognized as a force majeure event under any sales or purchase contract between HORIBA and buyer, and shall excuse HORIBA's performance or inability or failure to perform, if performance is prevented, hindered or delayed, whether directly or indirectly, by means of any COVID-19 related event or causes beyond its reasonable control, whether such cause existed or was foreseeable at the date of contract or not. Any stated dates and periods for completion of the services stated are approximate only.
5. This is a budgetary quote and subject to home office approval. HORIBA will not accept an order based on a budgetary quote. An official quotation will be issued upon request.

Quote valid 30 days Delivery: 120-150 days ARO
Terms: FOB Piscataway, NJ 50% on order, 50% on shipment - Net 30 days on approved credit **Packing, Handling and Freight charges will be billed at 2% of total order.**

Warranty: All parts and labor, 1 year after delivery and installation; consumables excluded.
A full copy of the HORIBA Scientific Terms and Conditions are attached with this quotation.

Your Sales Representative
Joshua Grandquist
Raman Division HORIBA
Scientific - HORIBA Instruments
Inc.

HORIBA INSTRUMENTS INCORPORATED
GENERAL TERMS AND CONDITIONS OF SALE

1. Scope: ALL SALES OF HORIBA INSTRUMENTS INCORPORATED ("SELLER") ARE, AND SHALL BE GOVERNED BY AND SUBJECT TO, THESE
GENERAL TERMS AND CONDITIONS OF SALE. SELLER REJECTS ALL ADDITIONAL, CONTRARY OR DIFFERENT TERMS AND CONDITIONS
PROPOSED BY BUYER, AND NO ADDITIONAL, CONTRARY OR DIFFERENT TERMS AND CONDITIONS SHALL BE BINDING ON SELLER, UNLESS
(A) SUCH TERMS AND CONDITOINS ARE IN WRITING SPECIFICALLY ATTACHED HERETO AND INCORPORATED HEREIN BY SELLER, OR (B)
OTHERWISE SPECIFICALLY ACCEPTED AND AGREED TO BY AN OFFICER OF SELLER IN WRITING. SELLER'S FINAL QUOTATION AND/OR ORDER ACKNOWLEDGEMENT, SALES AGREEMENT SIGNED BY BOTH PARTIES, TOGETHER WITH THESE GENERAL TERMS AND CONDITIONS SALE SHALL CONSTITUTE THE ENTIRE AGREEMENT BETWEEN THE PARTIES AS TO THE SUBJECT MATTER HEREOF (THIS "AGREEMENT"). BUYER'S ORDER TO PURCHASE/PERFORM, OR SELLER'S PERFORMANCE, OR BUYER'S FAILURE TO TIMELY OBJECT IN WRITING SHALL CONSTITUTE ACCEPTANCE HEREOF.

2. **Terms of Payment: All payment terms are on approved credit** (Seller reserves the right to change the payment terms, require payment of the purchase price in advance, make shipments C.O.D. or to revoke any credit extended to the Buyer if the Buyer fails to make any timely payment or if in the Seller's opinion there is a material change in the Buyer's financial condition). Unless otherwise stated in writing, payment shall be made in full in U.S. Dollars within thirty (30) days from the date of the invoice. Seller may add a monthly service charge equal to the lesser of one and one-half percent (1-1/2%) or the maximum rate allowable under applicable law to balances extending beyond thirty (30) days. Seller shall have no liability or obligation for delivery, installation, and/or to render support services, as applicable, if Buyer's account is delinquent or exceeds its approved credit limit. If Seller employs any legal process to recover any amounts due and payable by Buyer, Buyer shall pay all of Sellers' costs of collection and reasonable attorney's fees. If

shipment is deferred at Buyer's request or fault, payment shall nevertheless be due after notice to Buyer that the products are ready for shipment. Shipments held are at Buyer's sole risk and account, including payment of all reasonable storage and interest charges by Buyer within seven (7) days.

3. **Quotations and Prices:** Unless otherwise stated in writing, each quotation (not including budgetary quotations or estimates) shall expire thirty (30) days after its date. The prices set forth on quotation are based upon the manufacture of the quantity and type ordered and are subject to revision when interruptions, engineering changes or changes in quantity are caused or requested by the Buyer or when events which are beyond the control of the Seller occur. The amount of increase as computed by Seller shall be binding on the Buyer except for clerical and mathematical errors. Unless otherwise stated in writing all prices quoted shall be exclusive of taxes, insurance, custom fees, transportation, duties and other charges related thereto.

4. **Taxes and Charges:** Any tax or related charge including, without limitation VAT, sales tax or use tax, imposed by any federal, state, or other governmental authority on the sale of Seller's products or services, and export and other tariffs, duties and customs, shall be paid by Buyer in addition to the purchase price. Notwithstanding anything to the contrary herein, if no sales tax is charged by Seller and the item is subject to sales tax in Buyer's state, it is Buyer's responsibility to, and Buyer shall, pay such tax or reimburse Seller for any such tax paid by Seller.

5. **Specifications:** Weights and dimensions set forth in sales literature are illustrative only and not guaranteed unless specifically certified in writing by an officer of Seller. Seller may, without affecting the obligations under this Agreement, make normal and customary variations in specifications.

6. **Shipment, Delivery, Title and Risk of Loss.** Unless otherwise indicated on face of order acknowledgement by Seller, delivery terms shall be F.O.B. (Seller's Factory) or Ex Works (place of shipment). All delivery and handling charges shall be paid by Buyer and Buyer shall be responsible for risk of loss and providing insurance once the products are turned over to the carrier. The scheduled shipping or delivery date is a best estimate of the time the order will be shipped, and Seller will use commercially reasonable efforts to effect shipment on or before the date indicated, but Seller assumes no liability for loss, damage or consequential damages due to delays. Delays in delivery shall not be grounds for cancellation of order or reduction of purchase price. Title to such products shall remain with Seller, and shall not pass to Buyer until the price specified has been paid in full. Buyer agrees to execute within three (3) days of a request by Seller any documents required by Seller to perfect Seller's title to the products. If special domestic or export packing is specified, involving greater expense, a charge will be made to cover such extra expense. All shipments shall be insured, unless specific request was made by Buyer to the contrary, and this insurance expense shall be paid by Buyer. All claims for breakage and damage should be made to the carrier. Seller assumes no responsibility for delay, breakage, or damage after having made delivery in good order to the carrier. Shipments shall be made in the manner and by the carrier requested by Buyer but where questions arise concerning stability of carriers for handling specific products the decision of Seller must be accepted.

7. **Inspection at Seller's Factory:** Orders are accepted based on inspection and acceptance at Seller's plant. Upon request, Seller will furnish an inspection report to Buyer.

8. **Cancellation.** An order once placed with and accepted by Seller, Buyer may not terminate, suspend performance, reschedule or cancel ("cancel") without Seller's prior written consent. In cases where Seller agrees to such a cancellation, Buyer agrees to compensate Seller for any loss or damage resulting from such action, including but not limited to cost of material and labor incurred on products cancelled and services performed, and in the event of substantial delay, Seller reserves the right to renegotiate the price to include rising costs or materials and labor, as applicable. A minimum cancellation fee of twenty-five percent (25%) of the purchase price will be due unless otherwise agreed by Seller in writing. Buyer will be responsible to pay the full selling price, restocking fee or cancellation fee, whichever is appropriate, of Special or Custom products purchased by Seller to fulfill the delivery of products ordered under this Agreement.

9. **Limited Warranty; Limitation of Liability.** Unless Seller provides for a special warranty (covering designated products) in writing attached hereto, Seller only warrants that for a period of one (1) year from the

date of delivery to Buyer of the products and components manufactured by Seller, will be free of manufacturing defect in material and workmanship under normal use and service.

Notwithstanding the above, a warranty period of only ninety (90) days shall apply to data processing equipment included as part of a system, and as to any services provided by Seller. Seller makes no warranty with respect to components which, by their nature, are normally required to be replaced periodically consistent with normal use or maintenance, or as listed elsewhere in the applicable quotation.

The above warranties do not cover components manufactured by others and which are separately warranted by the manufacturer. Seller shall cooperate with Buyer in obtaining the benefits of the warranties by manufacturers of such items but assumes no obligation with respect thereto. The foregoing warranties shall cover all parts and labor necessary to make repair for the first ninety days after delivery, and thereafter parts. The provisions of this warranty shall not apply to any product (a) which has been subject to misuse, negligence, adverse environmental conditions or accident in installation or operation, (b) not operated in accordance with the printed instructions in the operation manual or good engineering and/or optical and/or electrical practice, or (c) which shall have been repaired, or altered, or serviced other than by persons authorized or approved by Seller in writing to perform such work. Time, materials, and expenses shall be billed to Buyer at the rates then in effect for any repairs or replacements not covered by the above warranties. Seller's entire liability and obligation, and Buyer's exclusive remedy, with respect to any breach by Seller of the foregoing warranties is limited to, at Seller's sole option, (a) repair or replacement at Seller's factory of the products purchased, or any component thereof, which Seller has determined to be defective after inspection at Seller's factory or (b) the return and refund of purchase price paid; provided that prompt notice of any defect is given within the applicable warranty period and timely return of the defective products or components. All defective items replaced pursuant to the above warranty become the property of Seller. Costs of shipping both defective items and replacements, therefore, shall be the responsibility of, and paid by, Buyer. The warranty applies only to original Buyer and may not be assigned or extended to any of Buyer's customers or other users of the products, unless specified in writing by Seller. **THE ABOVE WARRANTIES ARE GIVEN EXPRESSLY IN LIEU OF ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE. SELLER'S PERFORMANCE THEREOF SHALL CONSTITUTE FULFILLMENT OF ALL LIABILITIES OF SELLER WHETHER BASED ON CONTRACT, NEGLIGENCE OR OTHERWISE WITH RESPECT TO OR ARISING OUT OF SELLER'S PRODUCTS. SELLER SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, PUNITIVE, CONSEQUENTIAL OR SIMILAR DAMAGES, EVEN IF SUCH DAMAGES ARE REASONABLY FORESEEABLE. SELLER'S LIABILTY FOR ANY LOSS OR DAMAGES UNDER THIS AGREEMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID BY BUYER FOR THE PARTICULAR PRODUCT OR SERVICE.**

10. **Remedies:** If Buyer fails to pay the amounts payable hereunder as they become due or wrongfully rejects the products or services or any part thereof, then Seller shall have the right to recover, in addition to the purchase price of the said products and services and all other amounts payable in connection therewith, all costs incurred by Seller in recovering moneys due. In addition to the foregoing and all other remedies that Seller may have hereunder or by law, Seller without notice (a) may bill and declare due and payable all amounts payable with respect to products under this or any other agreement or contract between Seller and Buyer and/or (b) may suspend shipment hereunder and under any other agreement or contract between Seller and Buyer until such default, breach or rejection is cured and/or (c) may cancel any undelivered portion of this and/or any other agreement or contract between Seller and Buyer in whole or in part (provided that Buyer shall remain liable for all products delivered and for damages) and/or (d) may offset any liabilities owed to Buyer as part of this or any other agreement or contract between Seller and Buyer.

11. **Ability of Seller to Perform:** Seller has the option to reject, or cancel an order with no penalty if for any reason it becomes impractical or impossible to manufacture the ordered products. Seller shall not be liable

for delay in performance or inability to perform occasioned by any unforeseen conditions or circumstances beyond Seller's reasonable control, including, but not limited to, strike, embargo, government regulation, Letter of Credit delays, fire, flood, explosion, act of God, war, terrorist act or inability to obtain materials, transportation or services. If performance by Seller is delayed by such reason, Seller shall notify Buyer, and the time for performance by Seller shall be extended for the period of such delay.

12. **Patent Indemnity:** If any item in Seller's products sold hereunder when used for its normal purposes is charged with an infringement of a U.S. patent issued on or before the date of this Agreement and if Buyer has given prompt written notice of this charge, Seller's entire responsibility for such charge, shall be at its option (a) to obtain for Buyer the right to use such item, free of charge, or (b) to substitute for such item another equally suitable item, or (c) at Seller's expense to institute or defend any suit or legal proceeding which may arise as a result of such charge and in any such suit or legal proceeding shall satisfy any award for such infringement. Seller's obligations hereunder are subject to the conditions that the charged infringement did not arise from the combination of the items with other equipment or devices not furnished by Seller, or from modification of the product, or from the use of the product in the performance of any patented process.

13. **Copying or Replication:** Products sold are for Buyer's individual use and may not be copied or replicated. Buyer shall be liable for all damages incurred by Seller as a result of such conduct.

14. **Safety Obligations:** Only qualified, trained individuals should handle products and Buyer shall use safe operating procedures in the use of all products supplied by Seller, including without limitation Material Safety Data Sheets supplied with any product, and the use of all safety devices and guards when operating equipment, and Buyer shall maintain the same in proper working order. Buyer agrees to indemnify and hold Seller harmless from any liability or obligation incurred by Seller arising out of Buyer's failure to observe the obligations contained in this Section 14.

15. **Export Control:** Buyer represents that it will act, in compliance with all applicable export control laws and regulations, and will not knowingly export or re-export the products, software (including any information related thereto) furnished under this Agreement, directly or indirectly, unless it fully complies with all regulations of the U.S. and other applicable export laws.

16. **Governing Law:** This Agreement and the rights and obligations of the parties hereunder shall in all respects be construed and governed by the laws of the State of California without regard to its conflict of law provisions. Each party hereby agrees and irrevocably submits to the non-exclusive jurisdiction and venue of the state or federal courts in Orange County in the State of California as to any suit, action or proceeding arising out of or relating to this Agreement, and each also hereby irrevocably waives any assertion that it is not personally subject to jurisdiction of any such court.

17. **Entire Agreement:** Except for any confidentiality agreement between the parties, this Agreement contains the final and entire agreement between Seller and Buyer relating to the subject sale and no understanding representations, agreements, amendments, modifications, alterations or additions shall be effective by a writing signed by a duly authorized officer of Seller and Buyer.