

**RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:**
**Bid Receiving Public Works and Government
Services Canada/Réception des soumissions
Travaux publics et Services gouvernementaux
Canada**
**800 Burrard Street, Room 219
800, rue Burrard, pièce 219
Vancouver, BC V6Z 0B9
Bid Fax: (604) 775-7526**

**REQUEST FOR PROPOSAL
DEMANDE DE PROPOSITION**

**Proposal To: Public Works and Government
Services Canada**

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services, and construction listed herein and on any attached sheets at the price(s) set out therefor.

**Proposition aux: Travaux Publics et Services
Gouvernementaux Canada**

Nous offrons par la présente de vendre à Sa Majesté la Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici sur toute feuille ci-annexée, au(x) prix indiqué(s).

Comments - Commentaires

Title - Sujet Macro Scratch Tester	
Solicitation No. - N° de l'invitation 31019-136479/B	Date 2014-10-20
Client Reference No. - N° de référence du client 31019-136479	
GETS Reference No. - N° de référence de SEAG PW-\$VAN-532-7348	
File No. - N° de dossier VAN-3-36207 (532)	CCC No./N° CCC - FMS No./N° VME
Solicitation Closes - L'invitation prend fin at - à 02:00 PM on - le 2014-12-01	Time Zone Fuseau horaire Pacific Daylight Saving Time PDT
F.O.B. - F.A.B. Plant-Usine: <input type="checkbox"/> Destination: <input checked="" type="checkbox"/> Other-Autre: <input type="checkbox"/>	
Address Enquiries to: - Adresser toutes questions à: Takasaki, Alan H.	Buyer Id - Id de l'acheteur van532
Telephone No. - N° de téléphone (604) 775-7605 ()	FAX No. - N° de FAX (604) 775-7526
Destination - of Goods, Services, and Construction: Destination - des biens, services et construction: NATIONAL RESEARCH COUNCIL CANADA 4250 WESBROOK MALL VANCOUVER British Columbia V6T1W5 Canada	

Instructions: See Herein

Instructions: Voir aux présentes

Vendor/Firm Name and Address

**Raison sociale et adresse du
fournisseur/de l'entrepreneur**

Issuing Office - Bureau de distribution

Public Works and Government Services Canada - Pacific
Region
219 - 800 Burrard Street
800, rue Burrard, pièce 219
Vancouver, BC V6Z 0B9

Delivery Required - Livraison exigée See Herein	Delivery Offered - Livraison proposée
Vendor/Firm Name and Address Raison sociale et adresse du fournisseur/de l'entrepreneur	
Telephone No. - N° de téléphone Facsimile No. - N° de télécopieur	
Name and title of person authorized to sign on behalf of Vendor/Firm (type or print) Nom et titre de la personne autorisée à signer au nom du fournisseur/ de l'entrepreneur (taper ou écrire en caractères d'imprimerie)	
Signature	Date

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PART 1 - GENERAL INFORMATION

1. Security Requirement

There is no security requirement associated with this bid solicitation.

2. Requirement

The requirement is detailed under Article 2 of the resulting contract clauses.

3. Debriefings

Bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days of receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

4. Trade Agreements

"The requirement is subject to the provisions of the North American Free Trade Agreement (NAFTA), and the Agreement on Internal Trade (AIT)."

PART 2 - BIDDER INSTRUCTIONS

1. Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the *Standard Acquisition Clauses and Conditions Manual* (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The 2003 (2014-03-01) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

Subsection 5.4 of 2003, Standard Instructions - Goods or Services - Competitive Requirements, is amended as follows:

Delete: sixty (60) days
Insert: ninety (90) days

2. Submission of Bids

Bids must be submitted only to Public Works and Government Services Canada (PWGSC) Bid Receiving Unit by the date, time and place indicated on page 1 of the bid solicitation.

3. Enquiries - Bid Solicitation

All enquiries must be submitted in writing to the Contracting Authority no later than fifteen (15) calendar days before the bid closing date. Enquiries received after that time may not be answered.

Bidders should reference as accurately as possible the numbered item of the bid solicitation to which the enquiry relates. Care should be taken by bidders to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a proprietary nature must be clearly marked "proprietary" at each relevant item. Items identified as "proprietary" will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the questions or may request that the Bidder do so, so that the proprietary nature of the question is eliminated, and the enquiry can be answered with copies to all bidders. Enquiries not submitted in a form that can be distributed to all bidders may not be answered by Canada.

5. Applicable Laws

Any resulting contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in British Columbia.

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the bidders.

PART 3 - BID PREPARATION INSTRUCTIONS

1. Bid Preparation Instructions

Canada requests that bidders provide their bid in separately bound sections as follows:

- Section I: Technical Bid (2 hard copies)
- Section II: Financial Bid (1 hard copy)
- Section III: Certifications (1 hard copy)

Prices must appear in the financial bid only. No prices must be indicated in any other section of the bid.

Canada requests that bidders follow the format instructions described below in the preparation of their bid:

- (a) use 8.5 x 11 inch (216 mm x 279 mm) paper;
- (b) use a numbering system that corresponds to the bid solicitation.

In April 2006, Canada issued a policy directing federal departments and agencies to take the necessary steps to incorporate environmental considerations into the procurement process

Policy on Green Procurement

(<http://www.tpsgc-pwgsc.gc.ca/ecologisation-greening/achats-procurement/politique-policy-eng.html>). To assist Canada in reaching its objectives, bidders should:

- 1) use 8.5 x 11 inch (216 mm x 279 mm) paper containing fibre certified as originating from a sustainably-managed forest and containing minimum 30% recycled content; and
- 2) use an environmentally-preferable format including black and white printing instead of colour printing, printing double sided/duplex, using staples or clips instead of cerlox, duotangs or binders.

Section I: Technical Bid

In their technical bid, bidders must demonstrate their understanding of the requirements contained in the bid solicitation and explain how they will meet these requirements.

The technical bid must address clearly and in sufficient depth the points that are subject to the evaluation criteria against which the bid will be evaluated. Simply repeating the statement contained in the bid solicitation is not sufficient. In order to facilitate the evaluation of the bid, Canada requests that bidders address and present topics in the order of the evaluation criteria under the same headings. To avoid duplication, bidders may refer to different sections of their bids by identifying the specific paragraph and page number where the subject topic has already been addressed.

The technical bid consists of the following:

- a. **Bid Submission Form:** Bidders are requested to include the Bid Submission Form with their bids. It provides a common form in which bidders can provide information required for evaluation and contract award, such as a contact name, the Bidder's Procurement Business Number, etc. Using the form to provide this information is not mandatory, but it is recommended. If Canada determines that the information required by the Bid Submission Form is incomplete or requires correction, Canada will provide the Bidder with an opportunity to do so.
- b. **Substantiation of Technical Compliance:** The technical bid must substantiate the compliance of the Bidder and its proposed solution with the specific articles of Annex A (Requirement) identified in the Substantiation of Technical Compliance Form, which is the requested format for providing the substantiation. The Substantiation of Technical Compliance Form is not required to address any parts of this bid solicitation not referenced in the form. The substantiation must not simply be a repetition of the requirement(s), but must explain and demonstrate how the Bidder will meet the requirements and carry out the required Work. Simply stating that the Bidder or its proposed solution or product complies is not sufficient.

Where Canada determines that the substantiation is not complete, the Bidder will be declared non-responsive and disqualified. The substantiation may refer to additional documentation submitted with the bid - this information can be referenced in the "Reference" column of the Substantiation of Technical Compliance Form, where bidders are requested to indicate where in the bid the reference material can be found, including the title of the document, and the page and paragraph numbers; where the reference is not

sufficiently precise, Canada may request that the Bidder direct Canada to the appropriate location in the documentation.

Section II: Financial Bid

Bidders must submit their financial bid in accordance with Annex B, Basis of Payment. The total amount of Applicable Taxes must be shown separately. Unless otherwise indicated, bidders must include a single, firm, all-inclusive price quoted in Canadian dollars in each cell requiring an entry in the pricing tables.

Blank Prices: Bidders are requested to insert "\$0.00" for any item for which it does not intend to charge or for items that are already included in other prices set out in the tables. If the Bidder leaves any price blank, Canada will treat the price as "\$0.00" for evaluation purposes and may request that the Bidder confirm that the price is, in fact, \$0.00. No bidder will be permitted to add or change a price as part of this confirmation. Any bidder who does not confirm that the price for a blank item is \$0.00 will be declared non-responsive.

1.1 Exchange Rate Fluctuation

C3011T (2010-01-11), Exchange Rate Fluctuation

Section III: Certifications

Bidders must submit the certifications required under Part 5.

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

1. Evaluation Procedures

- a) Bids will be assessed in accordance with the entire requirement of the bid solicitation including the technical and financial evaluation criteria.
- b) An evaluation team composed of representatives of Canada will evaluate the bids.

1.1 Technical Evaluation

1.1.1 Mandatory Technical Criteria

Each bid will be reviewed to determine whether it meets the mandatory requirements of the bid solicitation. Any element of the bid solicitation identified with the words "must" or "mandatory" is a mandatory requirement. Bids that do not comply with each and every mandatory requirement will be declared non-responsive and be disqualified.

The mandatory technical requirements are described in Annex A

1.2 Financial Evaluation

SACC Manual Clause A0220T (2013-04-25), Evaluation of Price

2. Basis of Selection - Mandatory Technical Criteria

A bid must comply with the requirements of the bid solicitation and meet all mandatory technical evaluation criteria to be declared responsive. The responsive bid with the lowest evaluated price will be recommended for award of a contract.

PART 5 - CERTIFICATIONS

Bidders must provide the required certifications and documentation to be awarded a contract.

The certifications provided by bidders to Canada are subject to verification by Canada at all times. Canada will declare a bid non-responsive, or will declare a contractor in default, if any certification made by the Bidder is found to be untrue whether during the bid evaluation period or during the contract period.

The Contracting Authority will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply with this request will also render the bid non-responsive or will constitute a default under the Contract.

1. Certifications Required Precedent to Contract Award

1.1 Integrity Provisions - Associated Information

By submitting a bid, the Bidder certifies that the Bidder and its Affiliates are in compliance with the provisions as stated in Section 01 Integrity Provisions - Bid of Standard Instructions 2003. The associated information required within the Integrity Provisions will assist Canada in confirming that the certifications are true.

1.2 Federal Contractors Program for Employment Equity - Bid Certification

By submitting a bid, the Bidder certifies that the Bidder, and any of the Bidder's members if the Bidder is a Joint Venture, is not named on the Federal Contractors Program (FCP) for employment equity "FCP Limited Eligibility to Bid" list (http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml) available from Human Resources and Skills Development Canada (HRSDC) - Labour's website.

Canada will have the right to declare a bid non-responsive if the Bidder, or any member of the Bidder if the Bidder is a Joint Venture, appears on the "FCP Limited Eligibility to Bid" list at the time of contract award.

PART 6 - RESULTING CONTRACT CLAUSES

1. Security Requirement

There is no security requirement applicable to this Contract.

2. Requirement

The Contractor must provide the supply and delivery, installation and training, of a Macro Scratch Tester System, Make and Model _____ in accordance with the Requirement at Annex "A".

3. Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the Standard Acquisition Clauses and Conditions Manual (<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual>) issued by Public Works and Government Services Canada.

3.1 General Conditions

2010A (2014-03-01), General Conditions - Goods (Medium Complexity), apply to and form part of the Contract.

4. Term of Contract

4.1 Delivery

4.1.1 Hardware and software:

All the deliverables must be received on or before March 31, 2015 (or _____. (if earlier)).

4.1.2 Installation:

The Contractor must make the complete delivery within _____ days/weeks from the date of the receipt of the Hardware and Software.

4.1.3 Training:

The Contractor must make the complete delivery within _____ days/weeks from the date of acceptance of the Installation.

4.2 SACC Manual clause D0018C (2007-11-30) Delivery and Unloading

5. Authorities

5.1 Contracting Authority

The Contracting Authority for the Contract is:

Name: Alan Takasaki
 Title: Supply Specialist
 Public Works and Government Services Canada
 Acquisitions Branch Vancouver
 Address: 219 - 800 Burrard Street, Vancouver, BC

Telephone: (604) 775-7605 Facsimile: (604)775-7526

E-mail address: al.takasaki@pwgsc.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

5.2 Technical Authority (to be completed at Contract award)

The Project Authority for the Contract is:

Name: _____
 Title: _____
 Organization: _____
 Address: _____
 Telephone : _____ Facsimile: _____
 E-mail address: _____

The Technical Authority named above is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all matters concerning the technical content of the Work under the Contract. Technical matters may be discussed with the Technical Authority, however the Technical Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.

5.3 Contractor's Representative

Name: _____

Title: _____

Organization: _____

Address: _____

Telephone : ____ _ Facsimile: ____ _

E-mail address: _____

6. Payment

6.1 Basis of Payment

In consideration of the Contractor satisfactorily completing all of its obligations under the Contract, the Contractor will be paid a firm unit price as specified in Annex B for a cost of \$ _____ (*insert the amount at contract award*). Customs duties are included and Applicable Taxes are extra.

Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work, unless they have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

6.2 Limitation of Price

SACC *Manual* clause C6000C (2011-05-16) Limitation of Price

6.3 Single Payment

SACC *Manual* clause H1000C (2008-5-12) Single Payment or

SACC *Manual* clause H1001C (2008-5-12) Multiple Payments

7. Invoicing Instructions

1. The Contractor must submit invoices in accordance with the section entitled "Invoice Submission" of the general conditions. Invoices cannot be submitted until all work identified in the invoice is completed.
2. Invoices must be distributed as follows:
 - a. The original and one (1) copy must be forwarded to the address shown on page 1 of the Contract for certification and payment.

8. Certifications

8.1 Compliance

Compliance with the certifications and related documentation provided by the Contractor in its bid is a condition of the Contract and subject to verification by Canada during the term of the Contract. If the Contractor does not comply with any certification, provide the related documentation or if it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

9. Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in _____.

10. Priority of Documents

If there is a discrepancy between the wording of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

- (a) the Articles of Agreement;
- (b) the general conditions 2010A (2014-03-01) - Goods (Medium Complexity);
- (c) Annex A, Requirement;
- (d) Annex B, Basis of Payment;
- (f) the Contractor's bid dated _____ (*insert date of bid*) (*If the bid was clarified or amended, insert at the time of contract award: “, as clarified on _____” or “, as amended on _____” and insert date(s) of clarification(s) or amendment(s)*)

11. SACC Manual Clauses

B7500C (2006-06-16) Excess Goods

12. Warranty

12.1 Warranty - Contractor responsible for all costs

Section 09 entitled Warranty of general conditions 2010A is amended by deleting subsection 2 in its entirety and replacing it with the following:

2. The Contractor must pay the transportation cost associated with returning the Work or any part of the Work to the Contractor's plant for replacement, repair or making good. The Contractor must also pay the transportation cost associated with forwarding the replacement or returning the Work or part of the Work when rectified to the delivery point specified in the Contract or to another location as directed by Canada. If, in the opinion of Canada, it is not expedient to remove the Work from its location, the Contractor must carry out any necessary repair or making good of the Work at that location. In such cases, the Contractor will be responsible for all Costs (including travel and living expenses) incurred in so doing, Canada will not reimburse these Costs.

All other provisions of the warranty section remain in effect.

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Client Ref. No. - N° de réf. du client

31019-136479

File No. - N° du dossier

VAN-3-36207

CCC No./N° CCC - FMS No/ N° VME

ANNEX "A"
REQUIREMENT

(Annex A is attached at the end of this RFP)

ANNEX "B" BASIS OF PAYMENT

1 Pricing for the Macro Scratch Tester System:

Pricing must be an all inclusive firm lot ceiling price for all costs for hardware, shipping and unloading, duties and applicable taxes for a Macro Scratch Tester System complete with all equipment and miscellaneous items required to meet all the mandatory specifications in Annex A.

2 Pricing for Installation and Training:

Pricing must be an all inclusive firm lot ceiling price for all costs for, labour, on-site training, travel and living expenses.

Any other costs not identified herein but are required to complete this requirement must be included in the Firm Lot Ceiling Prices.

Table B.1

Item #	Description	Qty	U of I	Firm Lot Ceiling Price
1	Macro Scratch Tester System; Make and Model _____	1	lot	\$

Provide pricing if not already included in Item #1

2	Installation	1	lot	\$
3	Training	1	lot	\$
Total B.1				\$

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FORMS**FORM A - Bid Submission Form**

BID SUBMISSION FORM		
Bidder's full legal name		
Authorized Representative of Bidder for evaluation purposes (e.g., clarifications)	Name	
	Title	
	Address	
	Telephone #	
	Fax #	
	Email	
Bidder's Procurement Business Number (PBN) [see the Standard Instructions 2003]		
Jurisdiction of Contract: Province in Canada the bidder wishes to be the legal jurisdiction applicable to any resulting contract (if other than as specified in solicitation)		
<p>On behalf of the Bidder, by signing below, I confirm that I have read the entire bid solicitation including the documents incorporated by reference into the bid solicitation and I certify that:</p> <ol style="list-style-type: none"> 1. The Bidder considers itself and its products able to meet all the mandatory requirements described in the bid solicitation; 2. This bid is valid for the period requested in the bid solicitation; 3. All the information provided in the bid is complete, true and accurate; and 4. If the Bidder is awarded a contract, it will accept all the terms and conditions set out in the resulting contract clauses included in the bid solicitation. 		
Signature of Authorized Representative of Bidder		

FORM B - Substantiation of Technical Compliance Form

	Article of Annex A - Requirement that requires substantiation by the Bidder	Bidder Substantiation	Reference to additional Substantiation Materials included in Bid
2	The Macro Scratch Tester System must include but not necessarily limited to, the following hardware, miscellaneous accessories and software:		
a)	Scratch head assembly;		
b)	Motorised sample manipulation (X and Y tables);		
c)	Penetration depth measurement;		
d)	Optical imaging system;		
e)	Friction measurement module;		
f)	Acoustic emission detector;		
g)	Indenters of different materials and different geometries;		
h)	Computer workstation with electronics rack;		
i)	Complete operating and data analysis software package; and		
j)	Industrial joystick controller		
3	Mandatory Requirements		
3.1	The Macro Scratch Tester must include and meet or exceed the following mandatory functionalities and specifications:		
a)	Normal load: 1-200 N;		
b)	Normal load resolution: < 10 mN;		
c)	Friction (tangential) force measurement range: up to 200 N;		
d)	Friction (tangential) force resolution: < 10 mN;		
e)	Scratch speed: up to > 100 mm/min.;		
f)	Indenter penetration depth measurement: up to 4 mm ;		
g)	Indenter penetration depth measurement resolution: < 30 nm;		
h)	Motorized X translation table: > 60 mm;		
i)	Motorized Y translation table: > 60 mm;		

	Article of Annex A - Requirement that requires substantiation by the Bidder	Bidder Substantiation	Reference to additional Substantiation Materials included in Bid
j)	Table resolution: < 0.5 um;		
k)	Acoustic emission detection;		
l)	Optical objectives for magnification of 200x and 800x;		
m)	Visual matrix mapping mode		
n)	110 V 50/60 Hz		
3.2 The data analysis software package must have the following:			
a)	Complete control of scratch length, scratch speed and loading rate		
b)	Loading modes: constant, progressive and incremental		
c)	Scratch modes: single pass, multiple passes and parallel passes		
d)	Has pre-scan and post-scan modes to determine the surface profiles of the sample before, during and after a scratch		
e)	Wear modes: uni-directional and bi-directional		
f)	Full visual mapping with video software		
4 Installation requirements			
	The Contractor must provide equipment installation and on-site operator training.		
5 Warranty			
	The equipment must include a 1 year on-site warranty inclusive of all parts and labour and all travel and living expenses		

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NOTE TO BIDDERS: Please use ONE of the two mailing labels below and affix it securely to the outside of the envelope or package containing your bid submitted by mail or courier. For bids submitted by facsimile (Bid receiving fax (604) 775-7526), use this sheet as the cover sheet. Always ensure your company name, return address, open bidding solicitation number and closing date appear legibly on the outside of your bid submission.

AVIS AUX FOURNISSEURS: Pour le retour par la poste ou par messenger, veuillez utiliser UNE des étiquettes d'envoi ci-dessous et apposez-la à l'extérieur de votre enveloppe ou du colis contenant votre offre. Pour les offres soumises par télécopieur (n° du télécopieur pour la réception des offres: (604) 775-7526), utilisez cette page comme bordereau de télécopie. Assurez-vous que le nom de votre compagnie, l'adresse de retour, le numéro de l'invitation ouverte à soumissionner et la date de clôture soient lisibles à l'extérieur de votre offre.

**Bid Receiving
Public Works & Government Services Canada
2nd FLOOR - 800 BURNARD STREET
VANCOUVER BC V6Z 0B9**

Solicitation No. : 31019-136479/B

**Solicitation Closes at : 2:00 PM PT
on : December 01, 2014**

**Réception des soumissions
Travaux publics et services gouvernementaux Canada
800 rue Burrard, 2e étage
Vancouver (C.-B) V6Z 0B9**

N° de l'invitation : 31019-136479/B

**La réception des soumissions prend fin le : decembre 01, 2014
à : 14:00 PT**

Annex A Requirement Macro Scratch Tester

1. Application and Purpose of the Macro Scratch Tester

Scratch testing is used for Research, Development, and Quality Control of bulk materials and coatings. The knowledge obtained from the scratch testing will be useful to understand material-process-property relations and as a supporting tool for Failure Analysis of engineering components.

Scratch testing will be used to

- a) Obtain mechanical properties of surface material, such as scratch hardness;
- b) Understand failure modes of surface material, coating or coating-substrate interface;
- c) Estimate practical adhesion strength of coating to underlying substrate; and
- d) Perform wear tests.

2. The Macro Scratch Tester System must include but not necessarily limited to, the following hardware, miscellaneous accessories and software:

- a) Scratch head assembly;
- b) Motorised sample manipulation (X and Y tables);
- c) Penetration depth measurement;
- d) Optical imaging system;
- e) Friction measurement module;
- f) Acoustic emission detector;
- g) Indenters of different materials and different geometries;
- h) Computer workstation with electronics rack;
- i) Complete operating and data analysis software package; and
- j) Industrial joystick controller

3. Mandatory Requirements:

3.1 The Macro Scratch Tester must include and meet or exceed the following mandatory functionalities and specifications:

- a) Normal load: 1-200 N;
- b) Normal load resolution: < 10 mN;
- c) Friction (tangential) force measurement range: up to 200 N;
- d) Friction (tangential) force resolution: < 10 mN;
- e) Scratch speed: up to > 100 mm/min.;
- f) Indenter penetration depth measurement: up to 4 mm ;
- g) Indenter penetration depth measurement resolution: < 30 nm;

- h) Motorized X translation table: > 60 mm;
- i) Motorized Y translation table: > 60 mm;
- j) Table resolution: < 0.5 um;
- k) Acoustic emission detection;
- l) Optical objectives for magnification of 200x and 800x;
- m) Visual matrix mapping mode
- n) 110 V 50/60 Hz

3.2 The data analysis software package must have the following:

- a) Complete control of scratch length, scratch speed and loading rate
- b) Loading modes: constant, progressive and incremental
- c) Scratch modes: single pass, multiple passes and parallel passes
- d) Has pre-scan and post-scan modes to determine the surface profiles of the sample before, during and after a scratch
- e) Wear modes: uni-directional and bi-directional
- f) Full visual mapping with video software

4. Installation requirements

The Contractor must provide equipment installation and on-site operator training.

5. Warranty

The equipment must include a 1 year on-site warranty inclusive of all parts and labour and all travel and living expenses