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to the Southern Republics of the CIS  
and Georgia - TRACECA : Roads  
Maintenance. Project No TNREG  
9601

## Module A: Materials, Plant, Standards

### **Laboratory Assessment Report for Uzbekistan**

Date of submission  
24<sup>th</sup> November 1998





**Technical Assistance to the Southern Republics of CIS and  
Georgia – TRACECA**

**TRADE AND TRANSPORT SECTORS**

**LABORATORY ASSESMENT REPORT FOR UZBEKISTAN**

**MODULE A : MATERIALS, PLANT, STANDARDS**

**OF**

**PROJECT NO. TNREG 9601, ROADS MAINTENANCE**

**24<sup>th</sup> November 1998**

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Helsinki  
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**in association with**

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**Roughton Int.  
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Module A

**REPORT COVER PAGE**

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Project Number	:	TNREG 9601
Country	:	Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Tadjikistan, Turkmenistan and Uzbekistan

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# **TRACECA ROAD MAINTENANCE PROJECT**

## **MODULE A**

### **ASSESSMENT OF MAJOR LABORATORY REQUIREMENTS BY COUNTRY**

#### **INTRODUCTION**

During the first Phase of Module A consideration was given to the whole question of quality control in the project countries.

Although the principal conclusion reached was that quality control was primarily a matter of attitude and was closely connected to a need to completely separate the procurement and supervision side of the road construction industry from the construction side it was accepted that effective quality control must also depend on the availability of adequate testing facilities.

The Phase I Report prepared by the Consultants for presentation to the Steering Committee meeting held in Almaty in February 1998 considered the complete costs of the necessary equipment to establish hypothetical Central and District laboratories for a Roads Administration wishing to implement a full range of standard western test methods. These costs did not consider buildings which it was assumed would be for the country to supply and would be existing facilities.

The question was further developed at the Steering Committee meeting where it was suggested that the Consultants could visit interested countries and review existing laboratory facilities with a view to making recommendations for the improvement and future development of test capability.

Of the countries represented at the meeting Armenia, Azerbaijan, Kazakstan, Kyrgyzstan, Tadjikistan, Turkmenistan and Uzbekistan expressed interest in this proposal; Mongolia was not interested and Georgia was not represented. In practice events beyond the Consultant's control have made a visit to Tadjikistan impossible.

The Consultants visited the six specifically interested, accessible countries and Georgia during July and August 1998 to review and discuss existing test facilities and future requirements. A notable feature of these discussions in many countries was dismay on the recipient side that this project had no plans or money to provide any concrete benefits in the form of extra equipment and would, in effect, produce only paper. It was explained that the form of Module A and the resources available to it were geared to assessing problems and making recommendations for ways in which future projects could assist in alleviating those problems. It is intended that this report will provide a basis for such future action.

## **GENERAL OBSERVATIONS**

The quality of the existing facilities varies widely from country to country. In large part this has a historical basis in that some countries were originally equipped with extensive research and testing facilities which served a region whilst others have inherited what were, effectively, outposts of a main centre which is now located in another country.

In all countries there is a residue of FSU testing equipment, generally old but much of it still in useable condition. This equipment is located in the capital of each country and forms the present basis of what is effectively a Central Laboratory. On the basis of our discussions with the heads of laboratories and design and research institutes most countries have little additional equipment outside these centres.

Exceptions to this are Uzbekistan, Armenia and Kazakstan. Uzbekistan has invested a substantial amount in new mobile laboratory facilities which are functioning in various parts of the country. Armenia is making a steady effort to progressively set up testing facilities at all asphalt production sites and Kazakstan has inherited a number of provincial laboratories which are still functional.

With the exception of Uzbekistan, which has made a commendable effort to equip itself with new testing equipment, none of the countries has comprehensive quantities of new western test equipment although there are various small items which have been accumulated from recent technical assistance projects and Armenia has received a more substantial investment in asphalt design equipment.

## **Central Laboratories**

Each of the project countries is now a completely independent entity and obviously there is a reasonable case for saying that each should have a properly equipped Central Roads Laboratory giving it the capability to duplicate and check tests carried out elsewhere in the country by others and to carry out more sophisticated tests that may not be possible elsewhere. Such a Central Laboratory should also have the capacity for carrying out further research into specific problems of road design and construction peculiar to its parent country, although this is probably more a question of investment in personnel than additional equipment.

It is fairly clear that future major road investment in all the project countries is likely to come primarily from western oriented sources for some considerable time. It is assumed that in discussing the establishment or the reinforcement of Central Laboratory facilities this will take the form of provision of test equipment suitable for established western testing methods.

Before a serious commitment can be made to investment in Central Laboratory facilities in any country there are important questions to be answered:

- Is there currently, or in the near future, a reasonable workload for such a Central laboratory?
- Are the existing premises adequate to house it?
- Are the necessary staff available to operate it?
- Are the necessary funds available to staff and operate it?

## **Workload**

There is a general problem in trying to relate workload to laboratory requirements. In most countries there is no available local finance for significant local capital projects and workload generally must be seen in terms of internationally financed projects.

However, the normal major roads project includes within the Contract for the Works the supply and equipping of an Engineer's laboratory at the site. In those projects with which the Consultant is familiar the site laboratory specification is quite comprehensive and this equipment will become the property of the Client on completion of the project.

It is therefore difficult to justify extensive major expenditure on additional equipment on the grounds of existing workload. Where there is a significant existing workload, this is generally such that it carries its own laboratory facility with it.

This does not negate the argument that each country ought to have a functioning Central Laboratory at the core of its quality control system but it does mean that the requirements for that Central Laboratory have to be examined more carefully in light of these external circumstances.

### **Premises**

Existing premises in Armenia, Georgia, Uzbekistan and Kazakstan are basically satisfactory although in all cases there could be a case for some modest refurbishment.

Premises in Turkmenistan and Azerbaidjan are poor with dilapidated, old buildings and inadequate space. Kyrgyzstan is presently without effective laboratory premises.

If there is to be any serious attempt to set up proper Central laboratories in these last three countries any project addressing the issue will have to be prepared for a substantial outlay on premises as well as equipment.

### **Staffing**

Existing staffing is as variable as the laboratory premises and seems to run more or less in parallel. Although there are complaints regarding rundown of staffing the laboratories in Armenia, Georgia, Kazakstan and Uzbekistan seem to have sufficient staff to operate as functioning laboratories covering the basic essentials. Azerbaidjan is reduced to a handful of staff and Turkmenistan has only one laboratory technician at the Design Institute laboratory and one more at the main asphalt plant. Kyrgyzstan has no permanent laboratory staffing.

Of course, in some respects the level of staffing reflects the workload. As work for the laboratories has declined the staff have been laid off. Where we have discussed staffing there has generally been a feeling that if extra staff were needed and funds available to pay them, then suitable people would be forthcoming; either former staff who were available for work or staff being laid off from other scientific institutes who would have suitable general training and background.

There should be little or no problem in existing laboratory staff adapting to the needs of western standard tests. In general the differences between western and FSU tests are not great and much of the work is extremely similar. One area of Module A's work has been in the translation of an extensive list of AASHTO tests into Russian. With this translation as a guide, existing trained personnel should find it relatively simple to make the changes required to carry out the required tests.

### **Funding**

All the project countries are suffering from financial constraints and in some cases these seem to be exceptionally severe; it is doubtful whether any of them would wish at present

to provide any substantial amount of additional funding to pay for extra staff or improved accommodation in support of a major upgrade of Central Laboratory facilities.

Armenia, Georgia, Kazakstan and Uzbekistan already have sufficient levels of staffing that some additional modern equipment could be integrated into the present organisation and put to use.

Azerbaijan and Turkmenistan both presumably have sufficient expectations of improving finances from oil and gas revenues that laboratory improvement projects could reasonably be prepared on the prospect of adequate local contributions to guarantee satisfactory levels of operating finance for the next five years. Some form of assistance might be used to provide equipment and refurbishment of premises but probably government should contribute the actual premises comprising buildings, reasonably located and having adequate space.

If Kyrgyzstan is to set up a functioning Central laboratory it may well require more help than the others, and such a decision should be based on a realistic projection of operating funds for a minimum period. Any Central Laboratory project in Kyrgyzstan would also have to examine the question of who would operate the laboratory and under what terms.

### **District Laboratories**

Although the reinforcement of the Central laboratories can be justified to on the basis of setting up essential national infrastructure, the establishment of District laboratories must be looked at strictly on the basis of necessity.

If it is accepted that where major projects are scheduled these are going to bring in their own laboratory facilities, then the only workload that District laboratories can realistically be expected to have to carry is that of control of minor projects carried out with local funding. In all cases it seems that this is likely to be no more than asphalt and surface dressing works with, possibly, some minor concrete works involved in bridge or culvert repair.

Augmentation of the Central laboratories is likely to stretch manning and funding capacities to present limits in many cases. There can be no justification for extensive expenditure on full fledged District laboratories unless they are going to be utilised and it would appear that District laboratories, if any, are presently needed only for the control of bituminous pavement works.

One other aspect of the District laboratory discussion is that of the physical size of each country. Kazakstan is huge, Turkmenistan and Uzbekistan both very large. In these very large countries there is clearly a greater need for secondary testing facilities than in the smaller countries where a greater degree of control can be exercised from the centre and where countryside testing, although sometimes with difficulty and only on a limited scale, can be undertaken from the centre.

## National Testing Policies

As noted above this discussion is based on the supposition that any project assistance in upgrading laboratories will be directed towards the implementation of western test methods. However, the extent to which this policy can be followed depends on national legal frameworks and testing policies.

Although different countries seem to place different weight and emphasis on the domestic legal requirements, it does appear that in most cases there are legal restrictions preventing the official adoption or use of western standards and that where such standards are being applied in internationally funded projects this is generally being done without proper legal sanction.

The whole question of the adoption of new standards is more complex in most of the project countries than is understood in the west. The existing standards, inherited from the Soviet Union, still have the force of law. Indeed, in one country we were informed that the specification of certain aggregate gradings had caused problems because the suppliers within the country had refused to supply the required aggregates on the basis that it would have been illegal to produce these, non-standard, sizes.

The matter is further complicated by the fact that almost all the project countries are involved in the ongoing CIS project to modernise standards and design methods. This involvement seems to be taken with varying degrees of seriousness, but some of the project countries clearly take their commitment to this project seriously and have expressed their intention of adopting the resulting standards as they become final.

Quite apart from the need for countries to settle their preferences in respect of FSU, CIS and Western test methods, there is also an urgent need for serious consideration in respect of the use of western test methods themselves.

Western standards and the associated test procedures are not all identical to each other although in most cases there are very close similarities; indeed, in some cases the similarities are likely to lead to more confusion than the differences for those unfamiliar with the standards. In at least two of the project countries there are two internationally funded projects either in or nearing the tender stage where no control has been exercised over the international consultants responsible for the design and documentation. The result is that in one country the first project has been specified using AASHTO tests and standards and the second using DIN and in the other country the first project uses a mixture of AASHTO and BS standards and the second, again, uses DIN.

*{This lack of uniform procedure raises further, potentially even more serious, questions regarding the uniformity of the pavement design methods used to which we were unable to get precise answers and which are specifically not part of the remit of module A}*

Quite apart from the general undesirability of one country constructing various sections of highway using a variety of different standards this situation has future consequences

since the equipment to be provided under the various contracts will eventually find its way into the national inventory. Obviously a considerable part of the equipment involved will be of general use, but great care will be needed to avoid confusion if apparently similar but actually different pieces of equipment for specialised tests are all stored and used together.

There is a very clear need for each of the project countries to establish its own national specification and to stick to it. National specifications would need to be tailored to country conditions and legislation, as well as being acceptable to funding agencies and would therefore need significant policy decisions by each of the nine countries. They would also need to be available in English and the National languages.

However, until countries do establish their own national specifications, clearly stating all the tests which they require to be used there are serious obstacles to implementing any comprehensive upgrading of laboratory test facilities. Whilst laboratories could currently be upgraded with the supply of general equipment, in many cases, the supply of much specific test equipment must await firm, long term policy decisions.

Some countries have clearly made the decision to adopt western test methods as part of their national routine. Uzbekistan has already invested heavily in western equipment using its own resources, Armenia seems determined to press on with the establishment of Marshall Asphalt design and control systems as the national standard, Kyrgyzstan has stated that it intends to use western test methods throughout from now on.

On the other hand Kazakstan has stated that it proposes to stick with FSU methods and to convert to the revised CIS standards for all domestically financed works while using western standards only when required to do so for internationally funded projects. Georgia has taken a similar line.

### **Priority Areas**

The specific requirement for Module A is to concentrate on measures to improve the standard of bituminous paving. This basic priority agrees in large part with our observed order of priorities within the project countries. The primary requirement within the roads sector for some years is clearly going to be the rehabilitation of the existing network rather than the creation of new roads. The principal area of work within this rehabilitation is going to be asphalt paving. Therefore the primary need in upgrading laboratory facilities is to ensure that adequate equipment for design and control of asphalt paving works and the constituent materials is available.

The Laboratories capacity to execute design of pavements and pavement rehabilitations is correspondingly important. Where asphalt overlays are to be provided it is important that thickness be based on proper measurements of existing pavement strength and on informed estimates of future traffic in order that value for money may be achieved. An earlier TRACECA project has already commenced the installation of pavement management systems in those countries where it is considered appropriate and under this

project Module D is continuing this work. Accordingly this report does not necessarily address the question of equipping for pavement strength analysis directly although the tables of equipment in the appendices include necessary deflection beam equipment for one method of assessing pavement strength and in some cases we have suggested that consideration be given to the possibility of equipping Central laboratories to carry out this work.

Augmentation of the Laboratories abilities to carry out design and control of Earthworks and Concrete works is definitely of a lower priority and again, although the equipment tables make provision for this work it is not considered immediately essential to upgrade laboratories in this respect.

### **Equipment Sourcing**

Laboratory test equipment is expensive. As far as we have seen during visits to the project countries all recent equipment has been sourced from western Europe. Since this has mostly been brought in by western consultants for use on new projects this is not surprising.

Much of the equipment required for the control of asphalt work is actually relatively simple and can be manufactured in basically equipped light engineering workshops. However, the general reaction of officials in project countries to the suggestion that much of the necessary equipment could readily be manufactured locally has been completely negative. This negative reaction may be due, in part, to a remembrance of times past when most, if not all, test equipment came from a single manufacturer in Russia which seems to have been the only authorised manufacturer of certified test equipment.

In practical terms the AASHTO standards actually carry in them quite complete details of the equipment required and sufficient information is generally available from the standard itself to allow manufacture directly.

Obviously certain equipment needs to be procured from specialist manufacturers; sieve sets, thermometers, dial gauges, proving rings, weighing equipment, compression test equipment. However, there is a great deal of simple equipment such as the basic moulds, rammers and baseplates which can be made by any small machine shop and then somewhat more advanced items such as ovens and the simpler load frames that could be produced by many light industrial bases.

There are certainly enterprises within Kyrgyzstan, to name one country, which would be interested in commencing manufacture of this type of equipment and developing towards the manufacture of more sophisticated items.

Some attention needs to be given to these possibilities for local manufacturing; the provision of some form of regional domestic preference in future tenders for test equipment might well provide a useful stimulus. It is unfortunate that no western test equipment manufacturers found it worth their while to participate in the investor's

conference sponsored by this project since this might well have offered productive opportunities for joint venture manufacturing.

## **Basic Recommendations**

The recommendations and suggestions given in this report have deliberately been kept low key and economical. They are aimed to provide a basic minimum upgrading of each country's laboratory facilities to fulfil present and immediate future requirements. They do not attempt to provide complete, fully equipped Central Laboratory facilities nor comprehensive District Laboratories.

In the event that such a wholesale upgrading is proposed the cost will be high and in most of the project countries it is hard to see how it can be justified under current circumstances. However, the possibility of such major upgradings was considered in our Phase I Report to the steering committee and in that report we provided suggested equipment lists, with current prices, for both Central and District Laboratories. In view of their usefulness in providing an indicator of likely costs for equipment from western sources those lists are appended to this report as Appendix B.

## **UZBEKISTAN**

### **Existing Laboratory Facilities**

Uzbekistan has a substantial, functional Central laboratory in Tashkent located at the main Roads Department and Design Institute building.

Alone amongst the project countries Uzbekistan has made a substantial investment in western test equipment from its own funds and the Central laboratory is equipped to carry out a comprehensive range of western, mainly AASHTO, tests

In addition to equipping the central laboratory Uzbekistan has also invested in 5 purpose built mobile laboratories capable of carrying out basic soils, concrete and asphalt testing in the field.

These mobile laboratories are currently distributed throughout Uzbekistan controlling:

- Asphalt production - Tashkent
- Road Works – Fergana
- Airport Construction – Uchkuduk
- Road Works – Karakalpak
- Reconstruction M 37 – Bukhara

### **Current Workload**

Work in hand comprises airport and road works financed from domestic resources and there is a programme of further works planned.

It is expected that future major work in the roads sector, both domestically and internationally funded, will comprise rehabilitation, resurfacing and maintenance projects (with some new construction) which will be primarily asphalt work rather than earthworks or structural work

### **Additional Equipment: The Central Laboratory**

This laboratory is well equipped and staffed and there does not seem to be any specific requirement for urgent improvements.

Uzbekistan currently uses locally produced bitumen and reports that there are no problems with bitumen quality. During Phase I of this project samples of bitumen from Fergana refinery were taken and tested and found to be of good quality.

Nonetheless, there do exist within the region clear problems with bitumen quality and in our report on bitumen specifications we have recommended the use of additional tests to ensure that bitumen supplied for road use is indeed of the acceptable quality and performance.

Although Uzbekistan does not, at present appear to have problems in this regard we believe that it would desirable to reinforce the Laboratory's capacity in the bitumen testing area to carry out the additional tests we have recommended in the Bitumen specification report. These tests are, in any case, highly desirable additions to the Central Laboratory's capacity to research and control bitumen quality. The use of these tests and the application of the suggested revised bitumen specification would become particularly important if, due to an increase in the annual volume of bituminous work, Uzbekistan were to become an importer of bitumen.

Accordingly we recommend that the Central Laboratory equipment should be augmented as soon as possible by the provision of equipment to carry out:

- Rolling Thin Film Oven Test (RTOFT AASHTO T 240)
- Fraas Breaking Point Test (IP 80)
- Dynamic Viscosity Test by Rotary Viscometer (Brookfield or similar with temperature control unit)

The RTOFT is designed to test bitumen for its resistance to deterioration of properties during the mixing and laying phase. The oven test itself, causes premature oxidation of bitumen under conditions roughly comparable to the mixing and laying and the degraded bitumen is then subject to repeats of the various standard tests to assess to what extent its properties have deteriorated

The Fraas test is designed to check the low temperature properties of bitumen and is desirable for use in Uzbekistan only in those limited areas where extreme winter temperatures can be found. Bitumens with high Fraas temperatures can lead to shrinkage cracking of asphalt in very cold weather.

The viscosity test equipment allows for the rapid and accurate checking of bitumen viscosity at various temperatures. We believe that this type of equipment used to check viscosity at 60 DegC is the most convenient way for roads laboratories to control wax in bitumen.

In addition to equipment to improve Central Laboratory bitumen control consideration should also be given to improving the laboratory's capacity in respect of pavement strength analysis. This aspect of the laboratory work is already receiving considerable attention under module D of the present project which deals with the completion of the installation of the Pavement Management system commenced under an earlier project. However, Appendix A includes details of a suggested list of equipment for conducting basic "manual" deflection beam analysis of pavements together with the associated pavement construction checking and subgrade strength tests. Depending on the conclusions of Module D it may well be desirable for the Central Laboratory's pavement analysis capacity to be upgraded by the acquisition of this basic test equipment.

### **Additional Equipment: Field and Mobile Laboratories**

In addition to improving the Central laboratory's capacity to check and control bitumen quality it is desirable that the existing mobile laboratories also be upgraded.

There are obviously severe limits to the volume of equipment which can be packed into a mobile laboratory where space is at a premium. Accordingly we suggest only that these units be equipped with the additional viscosity testing equipment.

The RTFT is a relatively lengthy and complex procedure and needs the associated subsequent tests to be carried out as well and is therefore not suitable for the mobile units. The Fraas test is only appropriate for very limited areas of Uzbekistan and can be considered an abnormal test to be conducted at the Central laboratory on those occasions when it is appropriate, or for which the equipment can be seconded from the Central Laboratory to the relevant Mobile if required.

The Laboratory Director has indicated that he would actually like his overall field capacity to be increased by the provision of 8 more Mobile Laboratories. Whilst basically sympathetic to this request we feel that this is such a major increase in overall testing capacity and such a costly one that it must be left to be assessed as a part of some other project.

However, we also believe that the use of mobile laboratories to control the output of generally static facilities such as asphalt production units is actually a misuse of valuable resources.

In our view, where asphalt plants are producing significant tonnages of asphalt they should be able to carry out tests for:

- i. Aggregate gradation
- ii. Bitumen content and grading of the mixed material
- iii. Marshall testing: Density, Voids analysis, Stability and Flow

Major asphalt production units should each have a site laboratory capable of conducting this testing rather than relying on the use of mobile facilities.

To upgrade the existing site laboratories to this standard and to replace existing FSU style equipment each will require:

- Bitumen extraction apparatus
- Balance (1.5 kilogram accurate .05 gram)
- Manual Marshall Compaction Hammer with three sets moulds
- Vernier Calipers
- Water bath for 6 Marshall specimens 60 degC +/- .5 degC
- Marshall Test Frame complete with Proving Ring, Dial Gauges, Test Head

- High Volume Consumables: Filters for the centrifuge extractor; Solvent, filter papers for making Marshall specimens.
- Oven large enough to hold a 5 kilogram asphalt sample and maintain temperatures up to 160 degC with an accuracy of +/- 2 degC

The above list is an absolute minimum. Additional items which should be allowed include replacement fine gauge sieves (No. 200 or 75 micron sieves have to be considered as medium term consumables and the other fine gauge sieves cannot be expected to retain their accuracy for very long under constant usage) and miscellaneous containers and trays.

As far as possible test specimens should always be prepared with samples taken directly from the plant to the laboratory. The oven is required for keeping the balance of the sample warm whilst the first specimens are being compacted. Reheating of cooled samples should be avoided as far as possible.

There are a variety of equipment types available for the routine testing of asphalt mixes for bitumen content. On grounds of cost, simplicity and reliability for use in out of the way locations we recommend the manually operated centrifugal bowl type as the preferred way of approaching this test. If operated outdoors with commonsense precautions, this equipment can be used in safety with commercial petrol as the solvent which is both economical and avoids any problems over solvent supply.

It is assumed that mix design will continue to be undertaken at the Central Laboratory on the basis of samples of aggregates and bitumen submitted by the production centres. If mix design were to be required at any of the Asphalt Plants then additional equipment would be needed.

### **Equipment for Bitumen Testing in the Field**

In addition to the Asphalt testing equipment listed above it may well be considered desirable to equip production plant laboratories with bitumen testing equipment. If this were the case it would presumably be in recognition of the fact that problems of bitumen quality were being encountered, either with imported bitumen or, possibly, with some sources of locally produced bitumen.

Again we would not recommend that production plant laboratories should be equipped to carry out RTFT or Fraas testing but if they were to be required to keep a reasonable control on the quality of bitumen deliveries they should be equipped to carry out tests for:

- Penetration
- Viscosity (Brookfield type equipment)
- Softening Point
- Flash Point (less important)

### **Costs; Laboratory Equipment**

Based on recent costs taken from a competitive quotation by a European supplier for a major laboratory refurbishment and re-equipping project elsewhere the approximate costs of giving effect to these recommendations are:

<i>Central Lab; Bitumen Test Equipment</i>		<i>US\$ 16 700</i>
<i>Central Lab; Pavement strength testing</i>		<i>US\$ 57 044</i>
<i>Mobile Labs; Viscosity Test Equipment per lab</i>	<i>US\$ 9 000</i>	
<i>For 5 Labs</i>		<i>US\$ 45 000</i>
<i>Asphalt Plant; Upgrade for asphalt control per lab</i>	<i>US\$ 21 074</i>	
<i>Say 5 Labs</i>		<i>US\$ 105 370</i>
<i>Asphalt Plant; Bitumen Test Equipment</i>	<i>US\$ 18 635</i>	
<i>Say 5 labs</i>		<i>US\$ 93 175</i>
<i>Total</i>		<i>US\$ 317 289</i>
<i>Add shipping etc 20%</i>		<i>US\$ 63 458</i>
<b><i>Grand Total</i></b>		<b><i>US\$ 380 747</i></b>

### **Surface Dressing Testing & Control Equipment**

No recommendations are made regarding the acquisition of test equipment for surface dressing work. The Central Laboratory is already equipped to carry out testing on aggregates and bitumens to approve them for this work. Testing during construction is a matter of checking and controlling rates of spread using basic weighing equipment and sample containers.



**APPENDIX A**  
**SUGGESTED BITUMEN TEST EQUIPMENT FOR CENTRAL LABORATORY**  
**UZBEKISTAN**

DESCRIPTION	QUANTITY	UNIT PRICE US \$	TOTAL PRICE US \$
Brookefield Viscometer with Thermosel	1	9000.00	9000.00
Rolling Thin Film Oven	1	5000.00	5000.00
Frass Breaking Point Tester prEN12593	1	2700.00	2700.00
<b>Total: Additional Bitumen Test Equipment Central Lab.</b>			<b>16700.00</b>

**SUGGESTED OPTIONAL EQUIPMENT FOR CENTRAL LABORATORY**  
**UZBEKISTAN**

DESCRIPTION	QUANTITY	UNIT PRICE US \$	TOTAL PRICE US \$
<b>Optional Deflection Testing Equipment</b>			
Benkelman Beam	2	2075.00	4150.00
Vertical Dial Gauge 1 in. range x 0.002 in. div.	2	260.00	520.00
Beam Vertical Dial Gauge	2	270.00	540.00
Measuring Wheel	1	300.00	300.00
Steel Tape 30 m	1	62.00	62.00
<b>Total; Deflection testing Equipment</b>			<b>5572.00</b>
<b>Optional DCP Test Equipment</b>			
Dynamic Cone Penetrometer (DCP) 8kg TRL/South African Design	2	2660.00	5320.00
Spare upper shafts	2	130.00	260.00
Spare 60 degree cones	20	85.00	1700.00
Spare standard lower shafts	10	135.00	1350.00
Spare Anvils	1	67.00	67.00
<b>Total DCP Test Equipment</b>			<b>8697.00</b>
<b>Optional Roughness Measuring Equipment</b>			
TRL Bump Integrator Unit	3	1510.00	4530.00
Spare Wire For Bump integrator	3	24.00	72.00
Spare Opto Sensor and PCB For Bump Integrator	3	120.00	360.00
Installation Kit for Bump Integrator	3	164.00	492.00
"Merlin" for Calibrating Bump Integrator	1	1760.00	1760.00
Counter for Bump Integrator	3	770.00	2310.00
Distance Oedometer/Timer	3	705.00	2115.00
<b>Total; Roughness Measuring Equipment</b>			<b>11639.00</b>
<b>Optional In Situ Density Equipment</b>			
Sand Pouring Cylinder 200mm	4	490.00	1960.00
Calibrating Container	4	210.00	840.00
Metal Tray for 200mm Sand Cone	4	34.00	136.00
Field and Laboratory Balance 10kg to 1.0 gm	4	815.00	3260.00
Wooden Carrying Case for above balances	4	230.00	920.00
Portable Elec. Top-loading Balance 610 gm to 0.1 gm	1	1270.00	1270.00
Speedy Moisture Tester	4	1720.00	6880.00
Calcium Carbide Powder (400g)	25	14.00	350.00
Speedy Calibration Kit	1	1520.00	1520.00
Nuclear Moisture/Density Gauge MC3	1	14000.00	14000.00
<b>Total; In Situ Density Equipment</b>			<b>31136.00</b>

Grand Total Optional Testing Equipment

57044.00

fieldlab

**Appendix A**  
**RECOMMENDED BASIC EQUIPMENT**  
**for Asphalt Production Plant laboratory**  
**UZBEKISTAN**

Description	No	Unit cost US\$	Amount US\$
8 inch/200mm dia Sieve Set 0.075 - 75mm	1	1900.00	1900.00
Flakiness Gauge	2	57.00	114.00
Bitumen extraction apparatus Manual Centrifuge	1	1500.00	1500.00
Top Pan Balance, 5000g x 0.1g 220-240v 50hz 1ph	1	1110.00	1110.00
Asphalt Compaction Mould (comprising body,base plate and filling/extraction collar)	10	78.00	780.00
Compaction pedestal and mould holder (ASTM D1559)	1	760.00	760.00
Wooden Asphalt Compaction Block (ASTM)	1	506.00	506.00
Specimen Mould Holder (ASTM)	1	225.00	225.00
Compaction Hammer	1	325.00	325.00
Sample Extruder	1	354.00	354.00
Marshall Test 25-E, 25kN cap. w/ digital display Load and flow transducers included.	1	7910.00	7910.00
Spares Kit for above	1	260.00	260.00
Breaking Head (Marshall)	2	520.00	1040.00
Vernier Calipers	1	30.00	30.00
Water Bath (40 to 70 deg C +/- 0.5 deg C)	1	1500.00	1500.00
High Volume Consumables (incl Thermometers)	Set	1000.00	1000.00
Small Fan Circulated Oven 300 deg C	1	1760.00	1760.00
<b>Total Production Plant Basic Asphalt Lab</b>	<b>each plant</b>		<b>21074.00</b>

**Additional Production Plant Lab Equipment for Bitumen tests**

Description	No	Unit cost US\$	Amount US\$
Standard Bitumin Penetrometer	1	800.00	800.00
Automatic Controller (Bit.Pen)	1	530.00	530.00
Penetration Needle	6	175.00	1050.00
Water Bath (21 to 56 deg C +/- 0.1 deg C)	1	2910.00	2910.00
Penetration Tin	15	1.00	15.00
ASTM Ring and Ball Apparatus	1	580.00	580.00
Cleveland Flash Cup Apparatus	1	3750.00	3750.00
Brookefield Viscometer with Thermosel	1	9000.00	9000.00
<b>Total production Plant Bitumen Test Equipment</b>	<b>each plant</b>		<b>18635.00</b>



**APPENDIX B  
RECOMMENDED BASIC EQUIPMENT FOR CENTRAL LABORATORY**

DESCRIPTION	QUANTITY	UNIT PRICE US \$	TOTAL PRICE US \$
<b>Laboratory Equipment For Foundations Soil Testing</b>			
425 L Drying Oven (Fan Convection) 40 - 200 deg C	1	4200.00	4200.00
Dial Thermometer (0 - 300 deg c)	1	75.00	75.00
Melting Pot (2l 40 - 95 deg c approx )	1	530.00	530.00
Hand operated soil lathe	1	300.00	300.00
Wire Saw	1	25.00	25.00
Trimming Knife	1	6.00	6.00
Liquid Limit Penetrometer	3	700.00	2100.00
Linear Shrinkage mould 140 mm long	5	50.00	250.00
Vernier Calipers (150 mm -0.1mm)	1	8.00	8.00
Soil Hydrometer ASTM D 422	2	25.00	50.00
Constant temperature bath	1	3000.00	3000.00
Top Pan Electric Balance 600/1200/3100 by 0.01/0.02/0.05g	1	2700.00	2700.00
High speed stirrer	1	700.00	700.00
8 inch/200mm dia Sieve Set 0.075 - 75mm	1	1900.00	1900.00
Sieve Shaker	1	2700.00	2700.00
Miscellaneous (Glassware stopwatches etc)	1	2500.00	2500.00
One- dimensional consolidation BS1377	3	2600.00	7800.00
8 Channel data Acquisition Unit	1	5900.00	5900.00
Pentium P120 PC 16MB Ram 1.2 GD Hard Disk plus Lazer printe,UPS and software	1	4000.00	4000.00
Soil Permeability (Constant Head) Apparatus	1	700.00	700.00
Triaxial Apparatus Electronic (Complete)	1	14000.00	14000.00
Sample Extruder	1	800.00	800.00
Direct Shear Test 60mm square Electronic (Complete)	1	11000.00	11000.00
Miscellaneous Sample Trays and tins etc	1	800.00	800.00
<b>SubTotal - Lab Equip for Foundations</b>	<b>66,044.00</b>		
<b><i>In situ</i> Test Equipment and Site Investigation Equipment for Foundation Soils</b>			
Hand Vane Tester 19 and 33mm vanes 0-120 kPa	2	1800.00	3600.00
300mm extension rod for Vane Tester	2	130.00	260.00
1 metre Extension Rod for Vane Tester	1	140.00	140.00
Prospecting Kit (Hand Auger and Sampling)	2	1600.00	3200.00
Water Level Indicator	1	300.00	300.00
Cable Percussion Boring Rig - 18 hp engine , 2 ton winch (Dando 2000 or equivalent)	1	21000.00	21000.00
Tools and sampling equipment	1	56000.00	56000.00
<b>Sub Total - SI Equip. for Foundations</b>	<b>84,500.00</b>		

<b>General Laboratory Equipment For Testing Construction Materials (Aggregates and Concrete)</b>			
Automatic Soil Compactor	2	6000.00	12000.00
ASTM compaction rammer	5	120.00	600.00
Spatula 100mm blade	12	11.00	132.00
CBR Load Frame 50kN	1	5200.00	5200.00
CBR 28 kN load measuring ring	1	630.00	630.00
CBR Penetration piston	1	70.00	70.00
CBR Penetration/swell dial gauges	4	120.00	480.00
CBR Bracket and adaptor	1	43.00	43.00
CBR mould body (ASTM)	20	60.00	1200.00
CBR extension collar	20	47.00	940.00
CBR perf. baseplate	20	62.00	1240.00
CBR spacing disc	20	77.00	1540.00
CBR Filter screen	20	4.00	80.00
CBR 5 lb split surcharge weight	40	39.00	1560.00
CBR Swell plate	2	68.00	136.00
CBR Swell tripod	2	63.00	126.00
Straight edge	2	20.00	40.00
Stabilised Soil Cylinder Mould (UCS) 150 by 150mm	10	100.00	1000.00
8 in/200 mm dia Sieve Set 0.075 mm to 75mm Plus nessary Spare Sieves	2	2200.00	4400.00
12 in/300mm dia Sieve Set 2.00 mm	1	2000.00	2000.00
Sieve Brush	3	10.00	30.00
Seive Shaker	2	3000.00	6000.00
Wet Sieve Attachment	1	570.00	570.00
Sand Equivalent Apparatus	1	570.00	570.00
5 Ltr Syphon Assembly with connection for 5mm id	1	57.00	57.00
Sand Equivalent Shaker	1	1910.00	1910.00
Pyknometer 1kg capacity	3	16.00	48.00
Slump Cone	2	58.00	116.00
Tamping Rod	2	15.00	30.00
Steel Ruler	2	20.00	40.00
Base Plate	2	33.00	66.00
Slump Cone Funnel	2	88.00	176.00
Vibro Consistometer	1	1900.00	1900.00
Flow Table Apparatus	1	785.00	785.00
200 mm Cube Mould	15	375.00	5625.00
150 mm Cube Mould	5	86.00	430.00
Cylinder Mould 150 mm diameter	3	211.00	633.00
Vibrating Table (2 Cube Moulds)	1	1700.00	1700.00
Accelerated Curing Tank	1	4950.00	4950.00
Temperature Chart Recorder	1	930.00	930.00
Diamond Blade for Masonary Saw 355mm dia	1	550.00	550.00
Diamond Blade for Masonary Saw 475mm	1	820.00	820.00
Concrete Test Hammer (Schmit Type)	1	780.00	780.00
Micro Covermeter	1	2250.00	2250.00
Le Chatlier Flask	2	110.00	220.00
Le Chatelier Water Bath	1	925.00	925.00
Le Chatelier Water Mould	10	45.00	450.00
Extensibility of Mould Apparatus	1	98.00	98.00
Flakiness Gauge	2	57.00	114.00
Flakiness Sieves (Set)	1	600.00	600.00
2000 kN Concrete Compression Machine with Digital Control and Flexure Frames	1	27000.00	27000.00
AIV Apparatus	1	1800.00	1800.00

ACV Apparatus	1	700.00	700.00
Los Angeles Abrasion Machine	1	5065.00	5065.00
Set of 12 Abrasive Charges (LA Machine)	1	260.00	260.00
Polished Stone Value Apparatus BS 812(Complete)	1	11000.00	11000.00
Friction Tester	1	2000.00	2000.00
Buoyance Balance 6kg by 0.1 g	1	4700.00	4700.00
Electronic Exensometer (Steel Testing)	1	670.00	670.00
Stress- strain Recorder for Extensometer	1	840.00	840.00
722 litre Drying Oven (Fan Convect.) 40-200 deg C	1	6900.00	6900.00
425 litre Drying Oven (Fan Convect.) 40-200 deg C	2	4200.00	8400.00
Весы с чашкой, 5000g x 0.1g 220-240v 50hz 1ph	1	1110.00	1110.00
Platform Scale 50 kg by 20g (mechanical)	1	1160.00	1160.00
<b>Sub Total - Lab Equip for Materials Testing</b>		<b>138,395.00</b>	
<b>Asphalt and Bitumen Testing Equipment</b>			
Polyranging Top Pan Elec Balance 600/1200/3100 by 0.01/0.02/0.05 g	2	2710.00	5420.00
Bench mounted Mixer (5 litre)	1	3600.00	3600.00
Isomantle Electric Heater (use with mixer)	1	1460.00	1460.00
Small Fan Circulated Oven 300 deg C	1	1760.00	1760.00
NCAT Asphalt Content Tester c/w printer.	1	17650.00	17650.00
Flexible stainless steel exhaust tubing expandable to 4 meters length	1	45.00	45.00
Basket System comprising of: 2 basket assmby, extension assemblies, face mask,heat resistant gloves,heat sink plate and calibration plate.	1	1800.00	1800.00
Automatic Marshall Asphalt Compaction Apparatus	1	4900.00	4900.00
Asphalt Compaction Mould (comprising body,base plate and filling/extraction collar)	15	78.00	1170.00
Compaction pedestal and mould holder (ASTM D1559)	1	760.00	760.00
Wooden Asphalt Compaction Block (ASTM)	1	506.00	506.00
Specimen Mould Holder (ASTM)	1	225.00	225.00
Compaction Hammer	1	325.00	325.00
Sample Extruder	1	354.00	354.00
Marshall Test 25-E, 25kN cap. w/ digital display Load and flow transducers included.	1	7910.00	7910.00
Spares Kit for above	1	260.00	260.00
Breaking Head (Marshall)	2	520.00	1040.00
X/Yt Chart Recorder	1	3360.00	3360.00
Fibre Tipped Pen for above (red)	10	66.00	660.00
Fibre Tipped Pen for above (black)	30	66.00	1980.00
Bitumen Pycnometer 25ml Hubbard-Carmick type	5	75.00	375.00
Cleveland Flash Cup Apparatus	1	3750.00	3750.00
LP Gas refill (pack of 6)	3	60.00	180.00
Thermometer (-6 to +400 deg C)	2	51.00	102.00
Thermometer(155 to 175 deg C)	1	45.00	45.00
Thermometer (-2 to + 80 deg C)	1	45.00	45.00
Thermometer (30 to 200 deg C)	1	49.00	49.00
Thermometer (-1 to +175 deg C)	1	45.00	45.00
Thermometer (0 to 44 deg C)	1	34.00	34.00
Rolling Thin Film Oven	1	5000.00	5000.00
Loss on heating/thin Film Oven	1	3900.00	3900.00
Metal Container 55mm by 35mm deep	5	1.00	5.00
Aluminium Test Pan (thin film test)	3	20.00	60.00
ASTM Ring and Ball Apparatus	3	580.00	1740.00
Magnetic Stirrer (Ring & Ball Test)	2	740.00	1480.00

Standard Bitumin Penetrometer	3	800.00	2400.00
Automatic Controller (Bit.Pen)	1	530.00	530.00
Penetration Needle	6	175.00	1050.00
Water Bath (21 to 56 deg C +/- 0.1 deg C)	1	2910.00	2910.00
Penetration Tin	15	1.00	15.00
Standard Tar Viscometer	1	2920.00	2920.00
Measuring Cylinder (for Viscometer)	1	8.00	8.00
Viscosity Tubes (Viscosity 60 and 135 deg C)	1	6000.00	6000.00
Viscosity bath (Kinematic Viscosity 135 deg C)	1	5000.00	5000.00
Frass Breaking Point Tester prEN12593	1	2700.00	2700.00
Ductilometer	1	7055.00	7055.00
Ductilometer Briquette Mould	6	250.00	1500.00
Ductilometer Mould Base Plate	6	70.00	420.00
Miscellaneous Items (Protective Clothes, etc)	1	3000.00	3000.00
Fume Cabinets (with extractor fan)	1	2000.00	2000.00
<b>Sub Total - Bitumen &amp; Asphalt Lab</b>		<b>109,503.00</b>	
<b><i>In Situ</i> Test Equipment for Road Pavements</b>			
Universal pavement core drill with petrol motor	2	5800.00	11600.00
Core Barrel 100mm dia	6	350.00	2100.00
Expander Coupling for 100mm Barrel	2	220.00	440.00
Core Barrel 150 mm dia	3	550.00	1650.00
Expander coupling for 150mm Barrel	2	260.00	520.00
Sand Pouring Cylinder 200mm	6	490.00	2940.00
Calibrating Container	6	210.00	1260.00
Metal Tray for 200mm Sand Cone	6	34.00	204.00
Field and Laboratory Balance 10kg to 1.0 gm	6	815.00	4890.00
Wooden Carrying Case for above balances	6	230.00	1380.00
Portable Elec. Top-loading Balance 610 gm to 0.1 gm	1	1270.00	1270.00
Speedy Moisture Tester	5	1720.00	8600.00
Calcium Carbide Powder (400g)	25	14.00	350.00
Speedy Calibration Kit	1	1520.00	1520.00
Nuclear Moisture/Density Gauge MC3	3	14000.00	42000.00
Dynamic Cone Penetrometer (DCP) 8kg TRL/South African Design	5	2660.00	13300.00
Spare upper shafts	5	130.00	650.00
Spare 60 degree cones	40	85.00	3400.00
Spare standard lower shafts	6	135.00	810.00
Spare Anvils	2	67.00	134.00
Travelling Beam Device	2	3210.00	6420.00
Autographic Recorder Unit (for above)	2	2645.00	5290.00
Spares Kit for above	2	570.00	1140.00
MOT Straight Edge	3	530.00	1590.00
Metric wedge for use with straight edge	4	50.00	200.00
Texture Depth (Sand Patch) Apparatus	3	280.00	840.00
Friction Tester	2	8175.00	16350.00
Benkelman Beam	4	2075.00	8300.00
Vertical Dial Gauge 1 in. range x 0.002 in. div.	4	260.00	1040.00
Beam Vertical Dial Gauge	4	270.00	1080.00
Digital Thermometer and Bitumen Probe	4	190.00	760.00
Heavy Duty Asphalt Probe, 250mm long, max 600C	1	83.00	83.00
Plate Bearing Test Datum Bar Assembly	1	390.00	390.00
500 kN Hydraulic Jack	1	1930.00	1930.00
Dial Gauge, 50mm travel x 0.02mm div. comp w/clamp	4	330.00	1320.00
Hand Operated Pressure System for 500 kN Jack	1	1320.00	1320.00
150mm dia Bearing Plate	1	68.00	68.00

300mm dia Bearing Plate	1	233.00	233.00
610mm dia Bearing Plate	1	460.00	460.00
Measuring Wheel	2	300.00	600.00
Steel Tape 30 m	2	62.00	124.00
TRL Bump Integrator Unit	3	1510.00	4530.00
Spare Wire For Bump Integrator	3	24.00	72.00
Spare Opto Sensor and PCB For Bump Integrator	3	120.00	360.00
Installation Kit for Bump Integrator	3	164.00	492.00
"Merlin" for Calibrating Bump Integrator	1	1760.00	1760.00
Counter for Bump Integrator	1	770.00	770.00
Distance Oedometer/Timer	3	705.00	2115.00
<b>Sub Total - Field Test Equip for Road Pavments</b>		<b>158,655.00</b>	
<b>Calibration Equipment</b>			
Vernier Calipers 0 to 300 mm by 0.02 mm	1	320.00	320.00
Vernier Depth Calipers 0 to 200 mm	1	260.00	260.00
Micrometer 0-25 mm	1	90.00	90.00
Micrometer 25-50 mm	1	125.00	125.00
Setting Gauge 50 mm	1	200.00	200.00
Stop watch 0.2 sec	1	160.00	160.00
Engineers' Straight Edge 600 mm	1	350.00	350.00
Slip Gauge Set	1	1425.00	1425.00
Engineer's Steel Rule 1000 mm	2	43.00	86.00
Boxed Calibration Weights 1000g - 1mg	1	4910.00	4910.00
1kg calibration Weight	2	155.00	310.00
2 kg calibration Weight	2	250.00	500.00
5 kg calibration Weight	2	390.00	780.00
10 kg calibration Weight	2	750.00	1500.00
<b>Sub Total - Calibration Equipment</b>		<b>11,016.00</b>	
<b>Laboratory Equipment for Chemistry Testing</b>			
Mecanical End-over- end Shaker	1	1050.00	1050.00
Lab Digital pH Meter	2	1350.00	2700.00
Bottle Roller	1	1180.00	1180.00
Spatula etc	1	300.00	300.00
Chemicals	1	1000.00	1000.00
Sample Containers and Trays	1	400.00	400.00
Glassware	1	4000.00	4000.00
Miscellaneous items	1	3000.00	3000.00
<b>Sub Total - Lab Equip for Chemistry Testing</b>		<b>13,630.00</b>	
<b>GRAND TOTAL - BASIC EQUIPMENT FOR CENTRAL LABORATORY</b>			<b>582,000.00</b>
(Excluding shipping, installation and training)			

**APPENDIX B**  
**RECOMMENDED BASIC EQUIPMENT FOR DISTRICT LABORATORY**

DESCRIPTION	QUANTITY	UNIT PRICE US \$	TOTAL PRICE US \$
<b>Laboratory Equipment For Foundations Soil Testing</b>			
425 L Drying Oven (Fan Convection) 40 - 200 deg C	1	4200.00	4200.00
Dial Thermometer (0 - 300 deg c)	1	75.00	75.00
Liquid Limit Penetrometer	3	700.00	2100.00
Linear Shrinkage mould 140 mm long	3	50.00	150.00
Vernier Calipers (150 mm -0.1mm)	1	8.00	8.00
Top Pan Electric Balance 600/1200/3100 by 0.01/0.02/0.05g	1	2700.00	2700.00
8 inch/200mm dia Sieve Set 0.075 - 75mm	1	1900.00	1900.00
Miscellaneous (Glassware stopwatches etc)	1	2500.00	2500.00
Miscellaneous Sample Trays and tins etc	1	800.00	800.00
<b>SubTotal - Lab Equip for Foundations</b>	<b>14,433.00</b>		
<b>In situ Test Equipment and Site Investigation Equipment for Foundation Soils</b>			
Hand Vane Tester 19 and 33mm vanes 0-120 kPa	1	1800.00	1800.00
300mm extension rod for Vane Tester	2	130.00	260.00
1 metre Extension Rod for Vane Tester	1	140.00	140.00
Prospecting Kit (Hand Auger and Sampling)	1	1600.00	1600.00
Water Level Indicator	1	300.00	300.00
<b>Sub Total - SI Equip. for Foundations</b>	<b>4,100.00</b>		
<b>General Laboratory Equipment For Testing Construction Materials (Aggregates and Concrete)</b>			
Automatic Soil Compactor	1	6000.00	6000.00
ASTM compaction rammer	2	120.00	240.00
Spatula 100mm blade	4	11.00	44.00
CBR Load Frame 50kN	1	5200.00	5200.00
CBR 28 kN load measuring ring	1	630.00	630.00
CBR Penetration piston	1	70.00	70.00
CBR Penetration/swell dial gauges	4	120.00	480.00
CBR Bracket and adaptor	1	43.00	43.00
CBR mould body (ASTM)	15	60.00	900.00
CBR extension collar	15	47.00	705.00
CBR perf. baseplate	15	62.00	930.00
CBR spacing disc	15	77.00	1155.00
CBR Filter screen	15	4.00	60.00
CBR 5 lb split surcharge weight	30	39.00	1170.00
CBR Swell plate	2	68.00	136.00
CBR Swell tripod	2	63.00	126.00
Straight edge	2	20.00	40.00
Stabilised Soil Cylinder Mould (UCS) 150 by 150mm	3	100.00	300.00
8 in/200 mm dia Sieve Set 0.075 mm to 75mm Plus nessary Spare Sieves	1	2200.00	2200.00
12 in/300mm dia Sieve Set 2.00 mm	1	2000.00	2000.00
Sieve Brush	3	10.00	30.00
Seive Shaker	1	3000.00	3000.00
Wet Sieve Attachment	1	570.00	570.00
Sand Equivalent Apparatus	1	570.00	570.00
5 Ltr Syphon Assembly with connection for 5mm id	1	57.00	57.00

Sand Equivalent Shaker	1	1910.00	1910.00
Pyknometer 1kg capacity	3	16.00	48.00
Slump Cone	2	58.00	116.00
Tamping Rod	2	15.00	30.00
Steel Ruler	2	20.00	40.00
Base Plate	2	33.00	66.00
Slump Cone Funnel	2	88.00	176.00
200 mm Cube Mould	10	375.00	3750.00
150 mm Cube Mould	5	86.00	430.00
Cylinder Mould 150 mm diameter	3	211.00	633.00
Vibrating Table (2 Cube Moulds)	1	1700.00	1700.00
Accelerated Curing Tank	1	4950.00	4950.00
Temperature Chart Recorder	1	930.00	930.00
Concrete Test Hammer (Schmit Type)	1	780.00	780.00
Micro Covermeter	1	2250.00	2250.00
Flakiness Gauge	2	57.00	114.00
Flakiness Sieves (Set)	1	600.00	600.00
2000 kN Concrete Compression Machine with Digital Control and Flexure Frames	1	23000.00	23000.00
AIV Apparatus	1	1800.00	1800.00
ACV Apparatus	1	700.00	700.00
Friction Tester	1	2000.00	2000.00
Buoyance Balance 6kg by 0.1 g	1	4700.00	4700.00
425 litre Drying Oven (Fan Convect.) 40-200 deg C	2	4200.00	8400.00
Top Pan Balance, 5000g x 0.1g 220-240v 50hz 1ph	1	1110.00	1110.00
Platform Scale 50 kg by 20g (mechanical)	1	1160.00	1160.00
<b>Sub Total - Lab Equip for Materials Testing</b>	<b>88,049.00</b>		
<b>Asphalt and Bitumen Testing Equipment</b>			
Polyranging Top Pan Elec Balance 600/1200/3100 by 0.01/0.02/0.05 g	2	2710.00	5420.00
Bench mounted Mixer (5 litre)	1	3600.00	3600.00
Isomantle Electric Heater (use with mixer)	1	1460.00	1460.00
Small Fan Circulated Oven 300 deg C	1	1760.00	1760.00
NCAT Asphalt Content Tester c/w printer.	1	17650.00	17650.00
Flexible stainless steel exhaust tubing expandable to 4 meters length	1	45.00	45.00
Basket System comprising of: 2 basket assmby, extension assemblies, face mask,heat resistant gloves,heat sink plate and calibration plate.	1	1800.00	1800.00
Automatic Marshall Asphalt Compaction Apparatus	1	4900.00	4900.00
Asphalt Compaction Mould (comprising body,base plate and filling/extraction collar)	10	78.00	780.00
Compaction pedestal and mould holder (ASTM D1559)	1	760.00	760.00
Wooden Asphalt Compaction Block (ASTM)	1	506.00	506.00
Specimen Mould Holder (ASTM)	1	225.00	225.00
Compaction Hammer	1	325.00	325.00
Sample Extruder	1	354.00	354.00
Marshall Test 25-E, 25kN cap. w/ digital display Load and flow transducers included.	1	7910.00	7910.00
Spares Kit for above	1	260.00	260.00
Breaking Head (Marshall)	2	520.00	1040.00
X/Yt Chart Recorder	1	3360.00	3360.00
Fibre Tipped Pen for above (red)	10	66.00	660.00
Fibre Tipped Pen for above (black)	30	66.00	1980.00
Bitumen Pyknometer 25ml Hubbard-Carmick type	5	75.00	375.00
Thermometer (-6 to +400 deg C)	2	51.00	102.00

Thermometer(155 to 175 deg C)	1	45.00	45.00
Thermometer (-2 to + 80 deg C)	1	45.00	45.00
Thermometer (30 to 200 deg C)	1	49.00	49.00
Thermometer (-1 to +175 deg C)	1	45.00	45.00
Thermometer (0 to 44 deg C)	1	34.00	34.00
ASTM Ring and Ball Apparatus	2	580.00	1160.00
Magnetic Stirrer (Ring & Ball Test)	2	740.00	1480.00
Standard Bitumin Penetrometer	1	800.00	800.00
Automatic Controller (Bit.Pen)	1	530.00	530.00
Penetration Needle	6	175.00	1050.00
Water Bath (21 to 56 deg C +/- 0.1 deg C)	1	2910.00	2910.00
Penetration Tin	15	1.00	15.00
Miscellaneous Items (Protective Clothes, etc)	1	3000.00	3000.00
<b>Sub Total - Bitumen &amp; Asphalt Lab</b>		<b>66,435.00</b>	
<i>In Situ</i> Test Equipment for Road Pavements			
Universal pavement core drill with petrol motor	1	5800.00	5800.00
Core Barrel 100mm dia	3	350.00	1050.00
Expander Coupling for 100mm Barrel	1	220.00	220.00
Core Barrel 150 mm dia	2	550.00	1100.00
Expander coupling for 150mm Barrel	1	260.00	260.00
Sand Pouring Cylinder 200mm (Density Test)	2	490.00	980.00
Calibrating Container	2	210.00	420.00
Metal Tray for 200mm Sand Cone	2	34.00	68.00
Field and Laboratory Balance 10kg to 1.0 gm	2	815.00	1630.00
Wooden Carrying Case for above balances	2	230.00	460.00
Portable Elec. Top-loading Balance 610 gm to 0.1 gm	1	1270.00	1270.00
Speedy Moisture Tester	3	1720.00	5160.00
Calcium Carbide Powder (400g)	10	14.00	140.00
Speedy Calibration Kit	1	1520.00	1520.00
Nuclear Moisture/Density Gauge MC3	2	14000.00	28000.00
Dynamic Cone Penetrometer (DCP) 8kg TRL/South African Design	2	2660.00	5320.00
Spare upper shafts	3	130.00	390.00
Spare 60 degree cones	20	85.00	1700.00
Spare standard lower shafts	3	135.00	405.00
Spare Anvils	2	67.00	134.00
Travelling Beam Device	1	3210.00	3210.00
Autographic Recorder Unit (for above)	1	2645.00	2645.00
Spares Kit for above	1	570.00	570.00
MOT Straight Edge	1	530.00	530.00
Metric wedge for use with straight edge	2	50.00	100.00
Texture Depth (Sand Patch) Apparatus	1	280.00	280.00
Friction Tester	1	8175.00	8175.00
Benkelman Beam	2	2075.00	4150.00
Vertical Dial Gauge 1 in. range x 0.002 in. div.	2	260.00	520.00
Beam Vertical Dial Gauge	2	270.00	540.00
Digital Thermometer and Bitumen Probe	2	190.00	380.00
Heavy Duty Asphalt Probe, 250mm long, max 600C	1	83.00	83.00
Measuring Wheel	1	300.00	300.00
Steel Tape 30 m	2	62.00	124.00
TRL Bump Integrator Unit	1	1510.00	1510.00
Spare Wire For Bump Integrator	1	24.00	24.00
Spare Opto Sensor and PCB For Bump Integrator	1	120.00	120.00
Installation Kit for Bump Integrator	1	164.00	164.00
"Merlin" for Calibrating Bump Integrator	1	1760.00	1760.00
Counter for Bump Integrator	1	770.00	770.00

Distance Oedometer/Timer	2	705.00	1410.00
<b>Sub Total - Field Test Equip for Road Pavements</b>		<b>83,392.00</b>	
<b>Calibration Equipment</b>			
Vernier Calipers 0 to 300 mm by 0.02 mm	1	320.00	320.00
Vernier Depth Calipers 0 to 200 mm	1	260.00	260.00
Micrometer 0-25 mm	1	90.00	90.00
Micrometer 25-50 mm	1	125.00	125.00
Setting Gauge 50 mm	1	200.00	200.00
Stop watch 0.2 sec	1	160.00	160.00
Engineers' Straight Edge 600 mm	1	350.00	350.00
Slip Gauge Set	1	1425.00	1425.00
Engineer's Steel Rule 1000 mm	1	43.00	43.00
Boxed Calibration Weights 1000g - 1mg	1	4910.00	4910.00
1kg calibration Weight	1	155.00	155.00
5 kg calibration Weight	1	390.00	390.00
10 kg calibration Weight	1	750.00	750.00
<b>Sub Total - Calibration Equipment</b>		<b>9,178.00</b>	
<b>Laboratory Equipment for Chemistry Testing</b>			
Mecanical End-over- end Shaker	1	1050.00	1050.00
Lab Digital pH Meter	2	1350.00	2700.00
Bottle Roller	1	1180.00	1180.00
Spatula etc	1	300.00	300.00
Chemicals	1	1000.00	1000.00
Sample Containers and Trays	1	400.00	400.00
Glassware	1	1500.00	1500.00
Miscellaneous items	1	1500.00	1500.00
<b>Sub Total - Lab Equip for Chemistry Testing</b>		<b>9,630.00</b>	
<b>GRAND TOTAL - BASIC EQUIPMENT FOR DISTRICT LABORATORY</b>			<b>275,000.00</b>
(Excluding shipping, installation and training)			





