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ORIGINAL: ENGLISH

STRENGTHENING OF THE ESSENTIAL OIL INDUSTRY IN KOREA

DP/DRK/88/001

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

Technical report: Support at the installation of equipment for the distillation and extraction as well as service at first operation*

Prepared for the Government of the Democratic People's Republic of Korea
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Siegfried Langner,
UNIDO Consultant

Backstopping Officer: R.O.B. Wijsekera
Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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SUMMARY

Title of the project: Strengthening of the Essential Oil Industry in Korea

Number of the project: DP/DRK/88/001/A/01/37

Number of the mission: DP/DRK/88/001/11-01

Description of Job-mission: Chemical Technologist and CTA

In accordance to the job description from June 21, 1990 the Chemical Technologist has at present "special responsibility for preparation of agreements for installation of equipment"

The special task for this activity was

- to prepare the basis for equipment installation together with the DPRK-partner and
- while the phase of home work to care the study tour of the DPRK specialist in G.D.R.

This part report No. 2 contains the main results of the fulfilment of this task and is the first continuation of reporting about the work of the Chemical Technologist and CTA. See also list of literature (1).

INTRODUCTION

This part report No. 2 serves for the partial fulfilment (because split mission) of activities 11-01, Chemical Technologist, and 11-50, Planning Adviser (Chief Technical Adviser/CTA) of the project document (see point II. G., Project inputs).

According to the recommendation No. 9 in (1) UNIDO decided to carry out the mission in following way:

First part: 1 month, November 1989, Pyongyang, see (1)

Second part: 1 month

a) 2 weeks, September 1990, G.D.R.

b) 2 weeks, November 1990, Pyongyang

Third part: 1 month, 1991 (after finishing of equipment installation), Pyongyang

The consultant has got in the UNIDO-letter from September 4, 1990 following task for the second part mission:

- to prepare the bases for equipment installation together with the DPRK-counterpart and
- while the phase of home work to care the study tour of the DPRK Specialists in G.D.R.

The DPRK-part accepted this task.

Additionally to the a. m. task some other questions related to the work of the CTA have been treated.

The specific aim of this report is

- to inform about results of the task fulfilment for the second part of mission of the Chemical Technologist as well as CTA and
- to state recommendations and conclusions for the partners working at present at this project

Time schedule of the second part of mission - see annex 2.

The National Project Director (NPD) confirmed the fulfilment of the consultant's task on the end of his work in Pyongyang.

Conclusions and recommendations

a) Bench-scale equipment and laboratory devices

Recommendation No. 1:

Contractor and subcontractor as well as DPRK-partner are recommended to fulfil the agreements contained in the "minutes of the meeting about the project...". Pyongyang, November 1990 (see annex 5)

b) Investigation of the essential oil quality from *Rosa rugosa*

Recommendation No. 2:

The DPRK-partner is recommended to realize the proposals for improvement and stabilisation of essential oil quality from *Rosa rugosa* mentioned in point II. C. of this report. It is necessary to pay the special attention to application of solvent n-hexan with the quality "perfumery grade" as well as to providing and using of the respective international standards for essential oils.

c) Activities as CTA

Recommendation No. 3:

UNIDO is recommended to fulfil the respective decisions of the Tripartite Review (TPR) meeting in November 1990 in Pyongyang mentioned in point II. E. of this report. This refers also to the joint proposal of the NPD and CTA to send the CTA in May or June 1991 for 2 weeks to Pyongyang. It would be useful if the Chemist-analyst and the CTA could travel together at this time.

I CARE OF THE STUDY TOUR FOR THE SPECIALISTS FROM DPRK IN
SEPTEMBER 1990 IN G.D.R.

A. Generals

The contractor for the bench-scale and laboratory equipment, agro-consult dresden GmbH (acd), and the subcontractor for the bench-scale equipment, Ingenieurbetrieb Anlagenbau Leipzig GmbH (IAB), as representatives of the G.D.R.-side had the official responsibility for organization of the study tour. Participants and time schedule - see annexes 1 and 2 of this report.

In this report the major activities of study tour in which the consultant participated are reported.

A detailed programme for preparation of the study tour has been elaborated by acd in cooperation with IAB as well as the consultant and agreed with the factories and enterprises to be visited (see annex 3).

The performance of this programme demanded relativ high costs for transportation and operative actions.

Especially Mr. Harry Schüller from acd and Mr. Hans-Dieter Winkler from IAB worked with engagement and intensity to prepare and carry out this study tour for what we have to thank them.

At the final meeting the DPRK-experts gave a positive evaluation of the study tour results and promised to handed over their report about the study tour to the German side.

In case of further improvement of English language knowledge of the members of P.E.O.R.C. the effect of such study tours could be increased.

B. Kick-off meeting according to the bench-scale equipment in Leipzig

The kick-off meeting took place on September 11, 1990 in Leipzig in the building of the subcontractor IAB.

After fixation of the new subcontractor for bench-scale equipment, IAB Leipzig, instead the enterprise KCA Dresden in the beginning 1990 and the contract signing between UNIDO and acd.

In June 1990 about supplying of the bench-scale and laboratory equipment (2) this meeting has been needed

- to inform the DPRK-specialists about the work situation and the technical solutions for special fields (equipment/pipes/valves, instrumentation, electrical equipment, steel frame works etc.) and
- to fix finally and obligatory the basis for the designing and projekting works of IAB.

Schedule and results of the meeting - see protocoll in annex 4.

C. Some further focal points of the study tour

1. Visit to CLG Grimma near Leipzig on September 6, 1990

CLG Grimma is a big industrial enterprise for development, designing and manufacturing of chemical plants and equipment especially heat exchangers. It has got a powerful R/D-division with a workshop for manufacturing of experimental chemical equipment for this project will be produced.

The DPRK-experts have been informed about the production programme, history, present situation and the plans of development of this factory.

They have got many details about the modern technology for production of essential oils from plant raw materials by high pressure extraction with gases in supercritical state.

A bench-scale plant (volume of extractor 1 l) was demonstrated in function.

A complete mounted technical plant (3 extractors with a volume of 10 l each) was visited.

There was a detailed information and discussion about the experiment results, for example the extraction results of hop and majoran.

A short visit to the workshop and a talk with the foreman gave an insight into the conditions and possibilities of equipment manufacturing for this project.

2. Visit to "Duft- und Aroma-Kompositionen Miltitz GmbH" near Leipzig on September 12, 1990

This enterprise is the most important producer of flavour and fragrance materials in East Germany. It was founded in the end of last century by Mr. Schimmel and became under this name well known in the world.

There was in the eighties an intensive cooperation between this factory and the "VEB Komplette Chemieanlagen Dresden" (enterprise for complete chemical plants), in which the author of this report is employed.

Some of colleagues from Miltitz such as Dr. Schmidt, Mr. Müller, Dr. Walther, Mr. Schuetze have supported the author very helpful in preparation and analysis of his UNIDO-missions.

The focal points of the visit of the DPRK-experts were:

- introduction into the factory
- looking around the laboratory especially the analytical devices for essential oils
- visiting of the technicum and technical chemical plants
- Handing over and discussion of analytical results of essential oils from *Rosa rugosa* and *Rosa damascena*

A modern gas-chromatograph Varian 3400 connected with mass spectrograph and a 16-bit-computer was in the laboratory the most interesting device (total price appr. 250.000,- DM)

This system can determine the single components of a mixture of substances such as essential oils which from the peaks at the gas-chromatogramm without any work with test substances.

A modern batch vacuum rectification plant similar to the plant to be delivered to DPRK have been shown in detail and explained.

About the analytic results of essential oils of *Rosa rugosa* and *Rosa damascena* - see point II. C. of this report.

3. Visit to the Agriculture Cooperative (German code: LPG) for plant production in the village Bruendel near Alsleben on September 14, 1990

The a. m. Agriculture Cooperative Bruendel is the most important producer of spice plants in East Germany such as majoran, caraway, celery, parsley and other.

Together with the "Institut für Getreideverarbeitung" (Institute for corn treatment) in Potsdam-Rehbruecke the Agriculture Cooperative developed and built a modern technical plant (3 distillation stills with a volume of 5 cubicmeters each) for production of essential oils from spice plants by steam distillation.

A special adapted distillation technology for every kind of plants have been developed.

The visit of the DPRK-specialists contained

- the introduction into the Agriculture Cooperative and the results of work with the distillation plant
- detailed explanation and demonstration of the distillation plant including the respective analytical laboratory

The participation of Dr. Thomann from the institute of corn treatment in Potsdam-Rehbruecke in this visit was useful.

He was responsible for scientific-technological aspects while the development of the distillation plant and technologies.

The report (3) contain further informations about this plant.

4. Visit to the factories for soap and cosmetics production of the enterprise "Florena" in Doebein and Waldheim on September 20, 1990

There were visited two modern factories for soap and skin creamers as examples of application of essential oils in the cosmetic industry.

Further informations about the study tour - see report of the DPRK-specialists (4).

II ACTIVITIES IN NOVEMBER 1990 IN PYONGYANG

A. Generals

Participants and time schedule of the single activities in Pyongyang - see annexes 1 and 2 of this report.

Dr. R.O.B. Wijesekera, Special Technical Adviser, from UNIDO/Vienna, responsible as backstopping officer for this project stayed from November 14 to 20, 1990, in Pyongyang.

He evaluated the work in this project as positive, gave advises for the further actions in this project especially

- about the further investigation and improvement of the essential oil quality of Rosa rugosa,
- for R/D-activities and extension service of P.E.O.R.C. and
- for providing of international scientific informations and samples of essential oils as well as for increasing of the international contacts of P.E.O.R.C.

He supported and advised the CTA in his work.

B. Bench-scale equipment and laboratory devises

This point was the most important aspect of the author's activities in Pyongyang for what there were carried out a lot of meetings and visits in the P.E.O.R.C.

The results of this meetings are written down in the minutes according annex 5 of this report.

C. Investigation of essential oil from Rosa rugosa

The chemical plant Miltitz/G.D.R. investigated 3 samples of essential oil from Rosa rugosa (R.r.) in September 1990 in comparison to essential oil from Rosa damascena (R.d.). Results - see annex 6.

Except the other smell and lower content in concrete of Rosa rugosa in comparison with concrete of Rosa damascena attract attention:

- the different content of main components citronellol (R.r.<R.d.), eugenol, eugenolmethylether (R.r.>R.d.),
- the rest content of n-hexan and further components from the solvent as well as
- the different composition of the essential oil samples of Rosa rugosa .

The main conclusions from this analysis are following:

- The essential oil of Rosa rugosa is according to its properties and composition an other oil as that from Rosa damascena. If the future works confirm this quality, then is it necessary to introduce the essential oil of Rosa rugosa into the international market as a new, unknown product what demands an intensive preparation of this market.
- The n-hexan produced in DPRK and used as solvent for flower extraction is according to his insufficient putity not suited for this purpose. Considering the advises of Dr. Wijesekera it is recommended for the further work:
- Determination of compositions of essential oils from Rosa rugosa modifications used for oil manufacturing as time diagramms while the whole vegetation period
- Decreasing of eugenol and eugenolmethylether content in the essential oil by chemical and for distillation methods

- Preferred application of Rosa rugosa oil for soap and shampoo production (eugenol has got septic effect)
- Using of n-hexan for flower extraction in the quality "perfumery grade"

The consequent providing and using of the standards for essential oils of International Standardization Organization (ISO), seat Geneve/Switzerland, is recommended as preparation to the planned export increasing of essential oils from DPRK.

The government of DPRK should prove the possibilities to become a member of this organization.

An example of such standard is added in annex 6

D. R/D-activities of P.E.O.R.C. 1990

P.E.O.R.C. informed that in summer an itself made technical falling film evaporator was in operation in a filial of P.E.O.R.C. near the fields with Rosa rugosa.

The main datas for this evaporator:

- Evaporation tube: diameter 100 mm
length 2.000 mm
- Heating: steam, normal pressure
- Working pressure in the product space: normal
- Performance: appr. 200 kg/h n-hexan
- Concentration of concrete
in concentrated extract: appr. 0,5 mass-%
- Charging of law product
to the top of evaporator: out barrels
standing under increased pressure from compressed air produced
by compressor.

Remark: the insufficient condenser performance causes losses of n-hexan in this plant.

In 1990 20 litres of Rosa rugosa oil absolute were produced by P.E.O.R.C. and delivered to the domestic industry. A falling film evaporator in function was demonstrated in the laboratory of P.E.O.R.C.. The main datas of this evaporator are following:

- Material: Stainless steel
- Evaporation tube: inside diameter: 20 mm
length: 1.000 mm
- Evaporator top with sight glass ball flask in a cool (!) water bath
- work pressure: atmospheric
- Heating: by hot water from thermostat,
entry temperature: appr. 90 C
- Product at the inlet:
 - Color: light yellow-green
 - appr. 5 l/h
 - Concentration of concrete in the solvent: 0,5 mass-%
- Concentrated product:
 - Color: like amber
 - Concentration: 30,0 Ma-% concrete
 - Condensat n-hexan: without color
 - Remark: very quiet stabl operation of this evaporator

The DPRK-specialists told that about 16 - 17% of the essential oil are discharged out the evaporator with vapor in form of smallest drops, about what is written in sovietic literature. From that a request results to the contractor to supply additionally a demister (see annex 5).

A laboratory glass apparatus for removal of volatile solvent components from essential oil absolue by stripping with warm or hot gases has been demonstrated and detailed explained.

The main part of the apparatus is a small packing column with heating jacket in which the liquid essential oil flowes from the top to the bottom over the packings and from large phase contact surface.

The gas enters in the bottom of the column and moves up in counter-stream to the liquid.

Losses of essential oil with leaving gas can be minimized by control of the optimal gas-flow-rate.

The smell test of the treated essential oil has shown a good purification effect. The consultant expressed the opinion that in case of using of n-hexan "perfumery grade" this additional treatment of essential oil is not needed.

E. Activities as Chief Technical Adviser (CTA)

The preparation, active participation and the fulfilment of some measures of the tripartite review (TPR) meeting between UNDP, UNIDO and the representatives of the DPRK-government on November 16, 1990 in close cooperation with the NPD stood in the middle point of CTA's activities.

Content and results of TPR meeting:

In the beginning the NPD, Mr. Choi, and CTA reported about the stage of the project work and made proposals for further necessary activities. The TPR meeting evaluated the project progress positive.

Following measures were fixed:

- About missions of international experts:

- Confirmation of Mr. Langner's mission in the end of 1991 for one man-month to participate in running-up of the bench-scale equipment
- Confirmation of Dr. Thomann's mission as chemist-analyst 1991, one man-month, Training of DPRK-specialists in operation with laboratory equipment, Telex to UNIDO. Responsible: CTA
- Confirmation of an engineer's mission from the subcontractor IAB Leipzig for supervision of erection 1991, two man-months Telex to UNIDO. Responsible: CTA

- About training (study tours/fellowships)

The money of about 13.000,- US-dollars was left after carrying out of 3 study tours/fellowships to use for:

- participation of two DPRK-experts in UNIDO-workshop for essential oils on February 1991 in Manila, UNIDO, Mr. Wijesekere, will send the nominee forms to Pyongyang
- study tour to Shanghai/P. R. of China, 2 - 3 persons, 2 weeks

- About equipment:

- Purchase of the thin layer chromatograph (TLC) for about 6.000,- US-dollar was confirmed
Telex to UNIDO. Responsible CTA
- Purchase of the office devises involved in the project (1 copier, 1 computer) on the base of "Field Purchase Order".
Responsible: CTA
- Finishing of elaboration and handing over to CTA of specifications for glass ware, reference materials etc.
(Pos. 7,8,9 of project equipment list) Responsible: NPD
- Reminder of 10 % prepayment for contractor acd by telex to UNIDO. Responsible: CTA
- Additional contract for complete prefabrication of two main process units, 40.150,- US-dollar, was confirmed
Telex to UNIDO. Responsible: CTA

- end of TPR - meeting -

The NDP and CTA elaborated on November 26, 1990, a joint proposal for project budget revision handed over on November 28, 1990 in Vienna by CTA to Dr. Wijesekera.

The NPD and CTA have got the opinion that it would be useful if the CTA could travel to Pyongyang after receiving of detail engineering from subcontractor in Pyongyang and after the beginning of the civil works in P.E.O.R.C. on May or June 1991 for two weeks and propose this travel.

Financing: budget line 11 - 50 of the project, planning adviser. The CTA prepared the telexes fixed at the TPR meeting and sent after signing by Mr. Karcher, UNDP-representative, to UNIDO.

He filled out the UNDP-forms "Field Purchase Order" for purchase of the office devises (copier, computer) contained in the project, signed and distributed according to fixed distribution list.

III. LIST OF LITERATURE

- 1 Technical report: Part one, findings and recommendations;
DP/ID/SER.A/1350; 17. May 1990;
UNIDO; Mr. Langner/R.O.B. Wijesekera

- 2 Agreement between UNIDO (called the Client) and agro-consult
dresden (called the Contractor) on Establishment of a Pilot
Plant for essential oil: 6/6/1990;
Purchase order No. 15-0-0344 M
Offer No.: acd DD 084-180/00228

- 3 Technical report: Design of the modern chemical equipment
for the production and processing of essential oils;
DP/ID/SER.A/1357; 7. June 1990
UNIDO; Mr. Langner/R.O.B. Wijesekera

- 4 Report of the DPRK-specialists about the study tour to
G.D.R. in September 1990

The management personnel of the partner,
their names and functions/jobs

1. While the study tour in Germany

See annexes 3 and 4 of this report

2. In Pyongyang/D.P.R.K. in November 1990

The management personnel of the partner in scientific-
technical activities:

Choi Dung Gwang - Director of the P.E.O.R.C., NPD

Li Myong Ho - Head of the P.E.O.R.C. laboratory

Kim Byong Chol - Deputy Director of the P.E.O.R.C.

Mr. Mun - Interpreter

The management personnel of the partner for principle tasks:

Mr. Li - Director in the General bureau for cooperation
with international organisations (GBC/O)

Ko Ju Chol - leading member in GBC/O

From UNDP-/UNIDO-side:

Mr. Karcher - Representative of UNDP in Pyongyang

Mr. Rieger - leading member in the UNDP-office in Pyongyang

Li Song Ho - National Project Officer in the UNDP-office in
Pyongyang

Mr. R.O.B.
Wijesekera - Special Technical Adviser, UNIDO, Vienna

Time schedule of the activities

1. While the study tour in September 1990 in Germany

See annex 3 of this report

2. November/December 1990

| | |
|---------------------|---|
| 11./12.11.1990 | flight Berlin - Moscow - Pyongyang |
| 13.11. - 26.11.1990 | working in Pyongyang |
| 27.11.1990 | flight Pyongyang - Moscow - Vienna |
| 28./29.11. 1990 | debriefing with UNIDO in Vienna |
| 30.11./01.12.1990 | private staying in Vienna |
| 02.12.1990 | fly-back Vienna-Berlin and going by train to Dresden |

P R O G R A M M E

=====

Day by day programme for the tour visite DP/DRK/88/001/32-02

| Day | Date | Place to be visited | Remarks |
|-----|--------|--|---------|
| Sun | 2/9/90 | Start of mission arrival of the delegation at Schönefeld. Stay/accomodation at Berlin. | |
| Mon | 3/9 | Meeting in the PDRK's Embassy at Berlin and travel to Dresden (Waldparkhotel) & Meeting | |
| Tue | 4/9 | Meeting with agro-consult dresden GmbH detailed programme and project coordination. | |
| Wed | 5/9 | Visit to Leipzig Autumn Fair, meeting with the GS IAB-Leipzig & Carl Zeiss Jena & Others | |
| Thu | 6/9 | CLG Leipzig Grimma manufacturer of the pilot-plant equipment & visit chem.plant & technicum. | |
| Fri | 7/9 | Meeting with Linde-KCA-Dresden manufacturer for chem.plant ind. & "Heckmann" Pilotplants | |
| Sat | 8/9 | Sightseeing Dresden Centre, botanical-garden | |
| Sun | 9/9 | zoological-garden, visit of castel Königstein Visit of Pillnitz, Sächsische Schweiz, Bastei | |
| Mon | 10/9 | Travel to Leipzig , meeting IAB GmbH-Leipzig visite the engineering facillities, model constr, computer-centre and check in the Hotel Leipzig. | |
| Tue | 11/9 | Kick-off-meeting at IAB-Leipzig discussion & agreement about whole details of the pilot plant essential oils to be supplied to Pyongyang 1991. | |
| Wed | 12/9 | CLG Central Laboratoy Essential Oils Miltitz Analytic/Labor/Parfumery/Aromatic-production with discussion about all laboratory equipment to be delivered to PEORG I. Qu. 1991 & other materials. | |
| Thu | 13/9 | Meeting at IAB and CLG for final discussion, preparation of the protocoll of the kick-off meeting with an interpretor and all experts. | |
| Fri | 14/9 | Visit LPG Pründel, travel to destrict Halle/Alsleben (water-steamlined destillation) | |
| Sat | 15/9 | Sightseeing at city Leipzig organized by the GS IAB-Leipzig acc. to wishes of delegation. | |
| Sun | 16/9 | Day off / Rest | |

| | | |
|-------|------|---|
| Mon | 17/9 | Final discussion with IAB-Leipzig and signing of the agreement/protocoll (english) by all parties e.g. the PDRK-delegation, the IAB-Experts and the UNIDO-Consultant S. Langner. |
| Tue | 18/9 | Visit of Research Institute IGV Potsdam/Rehbrücke Food/Cereal/Essent.Oils/Spaces/Addit. |
| Wed | 19/9 | Visit of Central Institut Food-Stuff ZFE Bergholz-Rehbrücke & visit the barock-garden |
| Thu | 20/9 | Visit of Waldheim the chemical plant with perfumery in soap-production and laboratory |
| Fri | 21/9 | Environment-protection with CLG/IAB and acid in Leipzig with video-film with references and visit of the "Agricultural Fair" AGRA" |
| ----- | | |
| Sat | 22/9 | Sightseeing-tour in and around Leipzig with programme organized by IAB-Leipzig. |
| Sun | 23/9 | Day-off / rest and preparation of check out |
| ----- | | |
| Mon | 24/9 | Visit of Chemical Plant Rudisleben or alternativ chemical/perfumery/cosmetic industry. |
| Tue | 25/9 | Travel to Dresden and check in HO-Hotel visit of the hunting castel at Moritzburg. |
| Wed | 26/9 | Visit PWH Pharmazeut. Werk Halle /BT Artern Mobile container system/field distillation. |
| Thu | 27/9 | Meeting with experts about further programme add. need of glas ware and chemic. reference materials, solvents & other instruments for ess. oils and perfumery laboratories. Final meeting with the General Manager of acid-GmbH/ Dresden. |
| Fri | 28/9 | Travel to Berlin / Meeting Fortschritt (FLM) and with the embassy of PDRK/Berlin / Departure Berlin-Pyongyang Meeting with other export companies acc. wish. |
| ----- | | |

Names of Travellers : 1. Mr. Dr. Choi Dong Gang
 2. Mr. Dr. Li Myong Ho
 3. Mr. Dr. Kim Byong Chol
 4. Mr. M. Sc. Ko Ju Chol

Telefon-Numbers of partners:

| | | | | |
|-------------------------|--------|---------|-------|-----------|
| A.) Mr. S. Langner | LKCA | Dresden | 051/ | 23210/328 |
| B.) Mr. P. Rost | acid | Dresden | 051/ | 2361055 |
| Mr. H. Schüller | acid | Dresden | 051/ | 52421 |
| C.) Mr. HD. Winkler | IAB | Leipzig | 0941/ | 79530 |
| Mr. Richter | IAB | Leipzig | 0941/ | 3931/239 |
| D.) Embassy of the PDRK | Berlin | VW | 002 | 2291252 |

Protocol

On the discussions held on September 11, 1990 related to the essential oil project UNIDO/People's Democratic Republic of Korea (Kick-off meeting carried out in the offices of the general supplier IAB Leipzig GmbH)

1. Participants

- Mr. M. sc. Ko Ju Chol Senior Officer, G.B.C.I.O.,
People's Democratic Republic of
Korea
- Mr. Dr. Li Myong Ho Deputy Director of the P.E.O.R.C.,
People's Democratic Republic of
Korea
- Mr. Dr. Kim Byong Chol Senior Officer of the P.E.O.R.C.,
People's Democratic Republic of
Korea
- Mr. Langner UNIDO consultant
- Mr. Winkler Marketing Manager, IAB Leipzig
GmbH, GDR
- Mr. Richter Senior Engineer, IAB Leipzig
GmbH, GDR
- Mr. Boehme Senior Project Designer, IAB
Leipzig GmbH, GDR
- Mrs. Mai Special Project Designer
Steel Structures
IAB Leipzig GmbH, GDR
- Mr. Eube Special Project Designer
Instrumentation
IAB Leipzig GmbH, GDR
- Mr. Wegs Special Project Designer
Electrics
IAB Leipzig GmbH, GDR
- Mrs. Kuehnl Interpreter

2. Place of Discussions

Leipzig-Markkleeberg, GDR

3. Objective of Discussions

The discussions were aimed at coordinating and fixing the fundamentals for preparing the project with respect to the essential oil pilot plant to be delivered to the research laboratory centre P.E.O.R.C., People's Democratic Republic of Korea by IAB Leipzig GmbH in accordance with the contract No. DD 084/180/0028 concluded between UNIDO and agro-consult Dresden GmbH on June 6/June 20, 1990.

4. Documents and Leaflets

4.1. The GDR side has submitted the following:

- process flow diagram HS1 vacuum falling-film evaporation
Dwg. No. 51/025 35(0)
- process flow diagram HS2 discontinuous vacuum rectification
Dwg. No. 51/025 36(0)
- arrangement/plot plan machinery room, apparatus hall
Dwg. No. 51/024 93(0)
- datasheets of all tanks and apparatuses used in HS1 vacuum falling-film evaporation and in HS2 discontinuous vacuum rectification
- leaflet including the technical parameters plus diagram of the cooling plant

4.2. Documents Delivered by the Korean Side:

- design sketch of vacuum falling-film evaporator

4.3. Documents Delivered by the GDR Side:

- datasheets of all tanks and apparatuses employed in the HS1 vacuum falling-film evaporation and HS2 discontinuous vacuum rectification
- complete list of measuring points (instrumentation) and leaflets on measuring and control devices

5. Results of Discussions

The results obtained have been compiled in the Annexes 1 to 4.

They are forming the final and binding basis for the execution of plants according to the detailed engineering project and equipment delivery.

6. Based upon the arrangements made during discussions the time schedule mentioned in Appendix F to the contract DD 084/180/0028 of June 6/June 20, 1990 will be agreed between the GDR and the People's Democratic Republic of Korea as follows:

- civil construction specification November 30, 1990 by air
- detail engineering project February 28, 1991 by air
(mechanical equipment and piping,
electrotechnical equipment, steel
structures)
- delivery of plant equipment September 30, 1991 by ship

1)

7. Scope of the Protocol

The protocol is comprised of 3 pages.
In addition, the protocol includes the following:

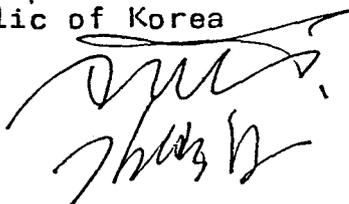
- Annex 1 Mechanical equipment & piping (1 page)
- Annex 2 Instrumentation (1 page)
- Annex 3 Electrotechnical equipment (1 page)
- Annex 4 Steel structures (1 page)
- Annex 5 Sketch (1 page)

8. The protocol has been made out in 4 copies in English of which are

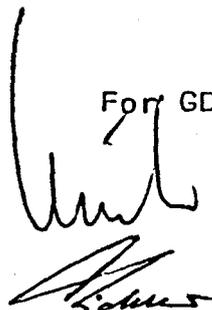
- 1 copy for the UNIDO
- 1 copy for the Korean side
- 2 copies for the GDR side

9. Signatures

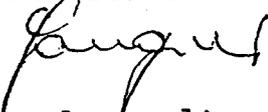
For People's Democratic
Republic of Korea



For GDR/General Supplier



UNIDO consultant



1)

The general supplier will make all his efforts to effect the delivery 1 month in advance.

Mechanical Equipment & Piping

1. The documents submitted according to it. 4.1. of the protocol have been prepared on the basis of the contract and the protocol on the discussions held in Phongjang from November 25, 1989 to December 6, 1989.
2. The Korean side has presented a sketch of the vacuum falling-film evaporator 1E1 including the following modifications as to previous arrangements (see it. 4.2. of the protocol).

- increase of the evaporator head and mounting of a demister between socket p_1 and p_2 . The demister is attached such to be demountable.
- reduction of the length of the cylindric part of the falling-film evaporator from 3,200 mm to 2,500 mm.

The GDR side will consider this modification when producing the falling-film evaporator.

However, attention should be paid to the fact that the scheduled evaporation quantity of 50 kg/h cannot be assured with the reduced length.

The modifications requested by the Korean side will be included into the datasheet 01.0010 and submitted with the documents according to it. 4.3. of the protocol.

3. The reflux divider 2D1 located at the top of the vacuum rectification column 2K1 will be replaced by an electric system with 2 solenoid valves.
4. The planned refrigerating unit comprised of 2 pcs. centrifugal pump (1P1.1/2), 2 pcs. air-cooled compressor units (1N1) and 1 pc. cold water tank 1V1 will be replaced by a compact cooling plant according to leaflet (see protocol, it. 4.1.). Piping and pump of the cold water circuit are made of nichrome steel meeting the latest technological standards. The cooling plant is provided with 1 cold water circulating pump only which is, however, able to deliver the individual quantities and the overall quantity for both pilot plants.
The compact cooling plant will be denominated 1N1.
The Korean side confirms this modification with respect to cold generation.
The refrigerating unit will be provided with air cooling.
Due to the relatively high cooling water quantities (approx. 7.5 m³/h) water cooling will not be provided for.
5. The piping are connected by welding in order to avoid possible sources of leakage.
Flanged connections are used to ensure linkage to tank and apparatus sockets.

6. Control air will not be required for the pilot plants. Due to this reason, the contract and UNIDO of June 6/June 20, 1990 does not contain the delivery of the control air generating unit. Dry air required for the adsorption stage has consequently to be made available by the Korean side.
7. The adsorption plant sketch mentioned in the protocol of December 6, 1989, Annex 2, it. 2.7. has been prepared, discussed and confirmed by the Korean side to be the basis for the delivery of the valves by the general supplier. The sketch is attached to the protocol as Annex 5. The specifications of the valves to be delivered will be submitted by the Korean side to the general supplier in November 1990.

Annex 2Instrumentation

Based upon the discussions held in Phongjang in November/December 1989 measuring and control instruments will be mainly provided with local indicators.

If this cannot be effected due to technological reasons, transmitters will be employed that are combined with indicators mounted in the supporting structure.

They have to be mounted such to ensure reading from the ground floor level.

The distribution boxes are accommodated in the supporting structures in order to minimize connecting works in the People's Democratic Republic of Korea.

Thus, instrument cabinets in the machinery and apparatus room are not needed.

Annex 3

- 30 -

Electrotechnical Equipment

The structure of the electrotechnical plant has been explained by way of the arrangement/plot plan.

The max. installed capacity for the electrotechnical plant amounts to approx. 65 kW. All consumers will be locally switched. As regards inspection glass illumination, the latter is completely switched per supporting structure.

It has been pointed out that within the Korean scope for potential equalization of the electrotechnical and technological plant earthing connections/terminals have to be provided for. Earthing and lightning protection systems as well as the the lighting plant (except inspection glass illumination) have to be provided for completely. Feeding of the distribution has to be effected, too.

Detailed data will be given within the civil construction specification.

Annex 4

- 31 -

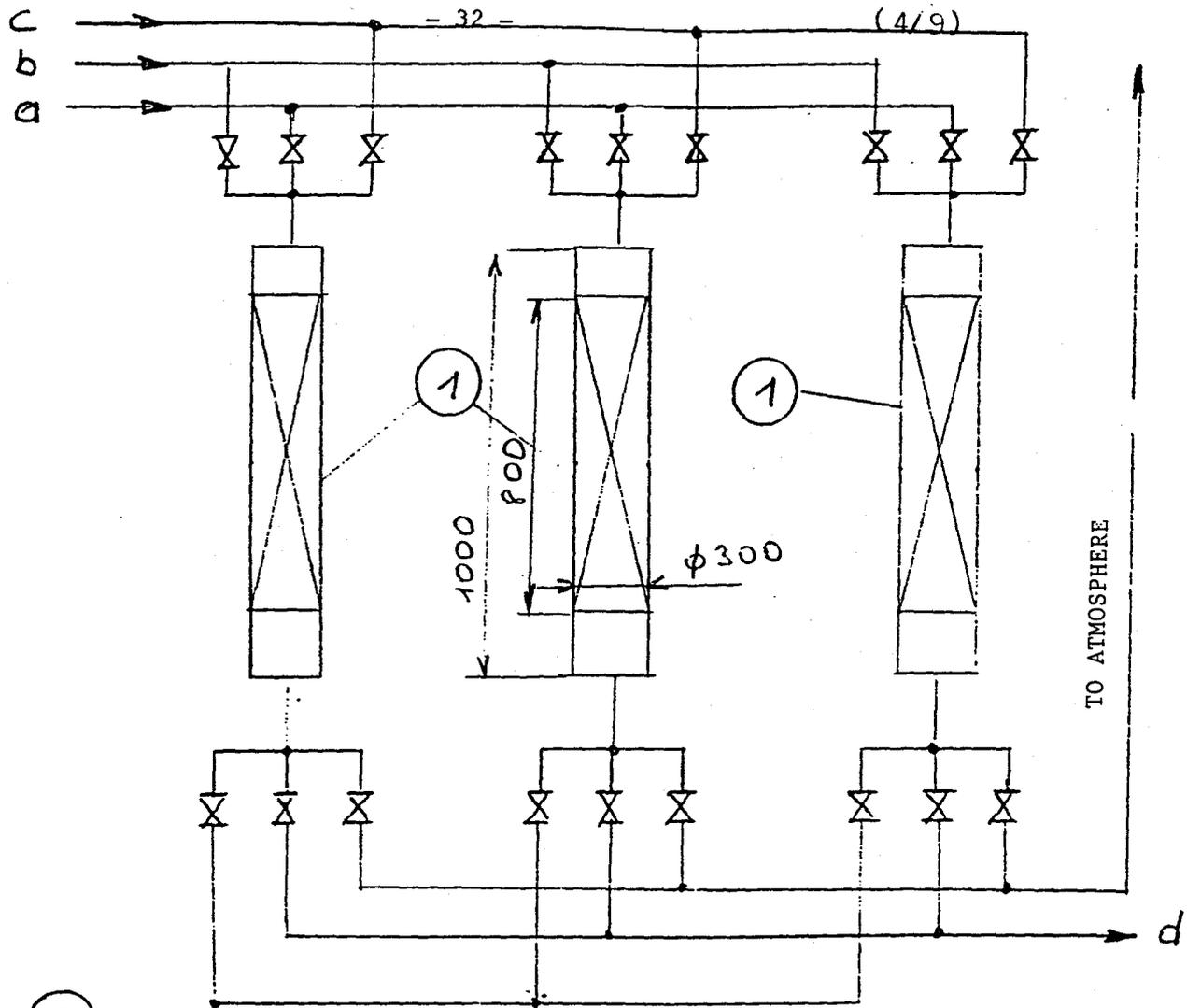
Steel Structures

The two supporting structures are dimensioned 3 m x 1.2m x 8.8 m each. The overall weight of the steel structures amounts to approx. 3 tons.

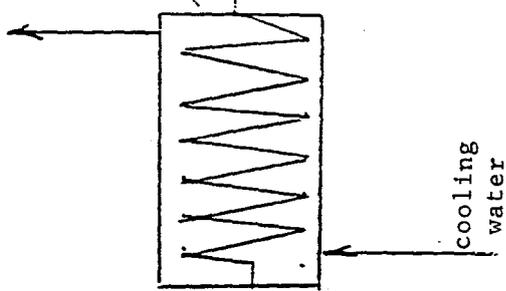
The supporting structure will be provided with diagonal braces for stabilizing purposes.

Each supporting structure is furnished with a catwalk plus ladder to give proper access to the platform which is arranged on the top girder level. The catwalk has been configured such to be continuous over the length of both supporting structures.

Another ladder is employed to ensure access to the catwalk. In order to mount the apparatuses 2-3 girder levels are available in the supporting structures on which platforms can be provided for in accordance with requirement.

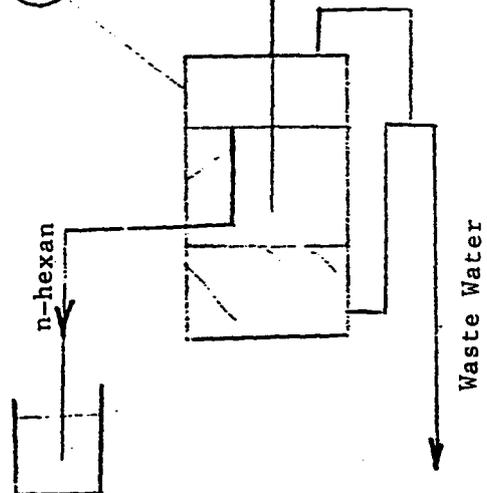


2



- 1- adsorbers
- 2- Condenser
- 3- separator
- a. vacuum pipe from pos. 1V6
- b. steam for regeneration
- c. warm air for drying
- d. to vacuum pump 1P2

3



| |
|--|
| ESSENTIAL OILS UNIDO - DPR |
| Principle flow diagram of adsorption stage |
| Drawing number made on : 1990/09/13 by: Mr. langner additional: Mr. Kim |

ANNEX 5
Pyongyang 1990-11-26
UNIDO - 1g

Minutes of the meeting on DP/DRK/88/001 - essential oils DPRK
from 90-11-13 to 90-11-26

1. Participants:
Mr. Choi National project Director
Mr. Li Head of laboratory of PEORC, DPRK
Mr. Langner Chief Technical Adviser
Mr. Mun Interpreter
2. Place of meeting: Pyongyang, DPRK
3. The major aim was the preparation of the arrangements for installation of the bench scale equipment.
4. Documents which were handed over by the CTA to the NPD in accordance with the respective request of the contractor agroconsult dresden (ACD) and the subcontractor for bench scale equipment Ingenieur betriebAnlagenbau Leipzig (JAB).

a) Bench scale equipment:

- Installation plan, drawing number 51/024393(0), date: 1990-10-30, 1 sheet, German/English.
- Specification of measurement and control devices, date: 1990-10-13, English, 4 sheets.
- Actual data sheet for 2 cold water pumps, No. of data sheet: 01.0070, Post. No. 1pl.1, 1pl.2, German, date: 90-9-17.
- Design drawings of equipment for its manufacturing, German, date: Oct. 1990, 1 sheet for every pos.

| Pos. No. | Draw No. | Pos. No. | Draw No. |
|----------|----------|----------------|----------|
| 1E1,1V3 | without | 2k1 | without |
| 1V2 | 1567578 | 2K1(still) | without |
| 1V4 | 1567553 | 2K1(column) | without |
| 1V5 | 1568240 | 2K1(reflux) | without |
| 1V5 | 1567770 | 2K1(condenser) | without |
| 1V7 | 1568056 | 2C1 | without |
| 1C1 | 1568312 | 2H1 | 1568185 |
| 1H1 | 1568177 | | " |

- Leaflet for "cooling water re-coolers" of the company ETSCHER/Kuelanlagenbau GmbH, English, 8 pages.
- b) Laboratory and analytical equipment
- Catalogues for GLC, rotary evaporator, polarimeter, refractometer, balances, TLC.
 - Offer from acd about GC-reference material October 1990.
5. Results and measures look appended No. 1,2
 6. This minutes contains 1.1 pages.
 7. This minutes is made in 4 specimens, written in English of them
 - 1 for NPD and CTA each
 - 1 for ACD and JAB each

Appendix 1: Bench scale equipment

a) General

The CTA commented the handed over documents especially the installation plan. The NPD required that the new solution for the reflux divider (2 solenoid valves) has to be without any spark formation.

b) Transportaiton of equipment

The CTA informed about the datas of the 2 containers/boxes for transport of the complete pre-fabricated process units (film evaporator, rectification column):

- sizes (max) 2 x 4 x 12 m each
- mass 6 t without packing material
- + approx. 7,5t total each.

Agreement No. 1 (A1):

The NPD declared that the DPRK side will organize and carry out the transportation of the equipment from harbour nampo to the PEORC in Pyongyang.

A2: The NPD investigates and organizes a suitable technology and transport equipment (crone etc.) for transportation of the equipment from the nearest main road to the project site in PEORC, Pyongyang.

c) Machine room and equipment hall

The CTA explained the auxiliary system No. 2 - cold generation which is cooled by air (35,000 m³/h) and the requirements to its installatin (in-and outlet of cooling air, etc).

Inside the machine room is the length from the ground floor \pm om: 3,88 - 922 = 3,66m. The girder and all necessary auxiliary equipment for erection of the plant will be provided by the DPRK side.

The design details for these two rooms will be given in the civil construction specification. The CTA informed about some of them (ventilation rate etc.).

d) Connection points (CP)

Look minutes of the meeting from 89-11-30 to 89-12-06 in Pyongyang and Technological schemes film evaporator, draw No. 0134.01-02.3(0), and batch vacuum rectification, draw No. 0134.02-02.2(0). The CP were in detail discussed and particularly corrected.

A3: The connecting points and their execution mentioned in table No. 1 of this appendix are agreed for the further designing works and the installation of the plant.

e) Various questions

- The CTA recommended on the west side of the machine room building to build a concrete pit covered with grill and connected with public waste water system. All kinds of waste water (condensae, cooling water return, waste

water from steam generator etc.) should be led in this pit. Especially the condensate must have a free outlet (high pressure). The groundfloors of the machine room and equipment hall should have a small gradient to the west side with connections to the waste water pit. In the waste water pit should be included an oil separator.

A4: The CTA will arrange that a short documentaiton for a standard oil separator will be sent to PEORC.

The NPD asked about the material for the vacuum pumps and the parameters of the lubrication oil for the pumps.

A5: The CTA will send respective information regarding:

- Specification of ball cocks for the adsorptive plant
- vacuum DN40, 6 pieces
- warm air, steam condensate: DN25 12 pieces.
Pressure: vacuu, steam p(abs) = 2 bar
Material: stainless steel
- The design drawings of some equipment were with the following results discussed:
 - NPD asked about the outlet of the rest product from the head of evaporator 1E1 to equip with valve.
 - No connection between heating jacket of evaporator 1E1 and the head of it.
 - NPD asked to prove the possibility to deliver a separate apparatus with demister instead; the demister in the head of evaporator 1E1.

| Number | Medium | Localisation | Design | Responsibility for delivery and mounting |
|--|--|---|--|--|
| 1 | 2 | 3 | 4 | 5 |
| CP1 CP2 CP3 CP4 CP5 CP6 | hecane/ wax hexane wax/he xane raw oil distil late distil late | filling station " " " | valves and tube connections by DN 25: the length of a standing barrel is 1m | by contractor, the flexible tubes will be delivered by the DPRK-side |
| CP7 CP8 | warm water supply warm water return | equipment hall, evaporation unit | 2 valves with flanges and opposite flanges DN25 | by DPRK-side |
| CP9 | refuse | equipment hall rectificatio n plant | valve with pipe, DN80; outlet in pot | by contractor |
| CP10 | cooling water supply | - " - | valve with flange and opposite flange DN 50 | by DPRK side |
| CP11 | coll water return (2 pipes) + conden sate | equipment hall wall on the west side | 3 valves with flanges and opposite flange DN 25 | by contractor |
| CP12 | steam of adsorp tion, P (abs) = 2 bar | equipment hall rectifitatio n plant | valve with flange and opp. flange, DN25 | - " - |
| CP13 | vacuum | equipment hall vessel 1V6 | flange and opposite flange, DN40 | - " - |

| | | | | |
|------|----------------|---|---|--|
| CP14 | vacuum | equipment hall between adsorption plant and vacuum pump | - " - | - " - |
| CP15 | drinking water | machine room, steam generator | valve with flange and opp. flange, DN25 | by DPRK side |
| CP16 | waste water | - " - | valve with flange and opp. flange DN 25 | by DPRK side |
| CP17 | electro-energy | machine room | | to the cell - DPRK ; cell and from the cell - contractor |

Appendix 2: laboratory and analytical equipment

According to the handed over leaflets following the questions were discussed:

- Rotary evaporator, The wanted type is : LRV2EV
- GC: all auxiliary and consumable materials (chromatogram paper, write color etc) should be delivered too.
- NPD asked about the specification and delivered quantities of this materials for later additional orders by himself.
- The DRK side provides only the gases in balloons without any valves for pressure reducing etc.
- Devices for pressure reducing, control and measurement of gas flow rate, connections should be delivered by the contractor (opinion of NPD)
- PEORC wants to connect the GC with an external computer and therefore to have the specification of the plug.
- Polarimeter:
wanted type: S
How many polarimeter tubes will be delivered
- Refractometer, balances, TLC: no questions.

Agreement No. 1 (A1): The CTA informed the contractor about a.m. points and asked him to manage the necessary activities. According to the laboratory glass ware, consumables etc (pos. No. 7,8,9 of the equipment list in the project document Annex III) PEORC handed over complete specification to the CTA. A2: UNIDO is asked on the basis of a.m. specification to order this expandable equipment (Budget Line 41-00).

Duft- und Aromakompo-
sitionen GmbH-Miltitz
(Flavour and Fragrance
Composition Limited Co.)

Miltitz 20/9/90

Reference : Investigation of products made
from "Rosa Rugosa" in PDR-Korea
=====

1. Smell evaluation of Rosa rugosa
concret and absolve products

In comparison to Rosa damascena the :

- smell differs essentially in direction of cucumber note,
- fatty like iris and
- intensity is lower than the French or Bulgarian quality.
- upper the concret there is a smell of solvent.

The samples handed over on 13.9.90 are similar in smell.

The concret has got a smell of solvent, which is not so intensive as before. However the part of solvent pollutions contained according to the gaschromatogramme (GC-Analysis) aromatics too, is still much to high (see GC - diagrammes of essential oil).

According to the defination of I F R A, the content of 10 ppm benzen can not be exceeded.

There are not any solvent traces in the French oil from the Rosa damascena.

2. Manufacturing of essential oil from concret
by steam distillation according to Brueckner

| | | |
|----------------|-------------|----------------------|
| SAMPLE I | (July 1990) | 9,2 % essential oil |
| SAMPLE II | (July 1990) | 10,9 % essential oil |
| SAMPLE III | (Sept 1990) | 14,2 % essential oil |
| Rosa damascena | (standard) | 16,2 % essential oil |

3. Comparison of selected content substances of essential oil from Rosa rugosa and Rosa damascena produced from the concret

| SUBSTANCE | R.rugosa 7/90 surface % | R.rugosa 9/90 surface % | R.damas surface % |
|--------------------|----------------------------|----------------------------|----------------------|
| Linalool | 0,38 | 0,24 | 0,50 |
| Phenylethylalcohol | 2,85 | 1,9 | 2,65 |
| Rosenoxid | 0,07 | 0,26 | 0,1 |
| Citronellol | 15,4 | 10,9 | 33,9 |
| Citral b | 0,63 | 0,39 | - |
| Phenylethylacetat | 1,38 | 0,97 | 0,24 |
| Geraniol | 14,1 | 9,9 | 13,8 |
| Citral a | 1,4 | 0,8 | 0,2 |
| Eugenol | 25,2 | 16,7 | 2,0 |
| Geranylacetat | 1,2 | 0,65 | 1,2 |
| Eugenolmethylether | 17,3 | 7,5 | 0,8 |

As the table shows there are big differences between Rosa rugosa and Rosa damasceana in content of eugenol and eugenolmethylether.

For further information in this subject, please see enclosed printing-sheet of the gaschromatogrammes.

Oil of rose (*Rosa damascena* P. Miller), Turkey

1 Scope

This International Standard specifies certain characteristics of essential oil of rose (*Rosa damascena* P. Miller), Turkey, with a view to facilitating the assessment of its quality.

It applies to oils distilled in industrial installations and not to oils of rose of the "peasant" type, which have different characteristics.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/R 210 : 1961, Essential oils - Packing.

ISO/R 211 : 1961, Essential oils - Labelling and marking containers.

ISO 212 : 1973, Essential oils - Sampling.

ISO 279 : 1981, Essential oils - Determination of relative density at 20 °C
(Reference method).

ISO 280 : 1976, Essential oils - Determination of refractive index.

ISO 592 : 1981, Essential oils - Determination of optical rotation.

ISO 1041 : 1973, Essential oils - Determination of freezing point.

ISO 1241 : 1980, Essential oils - Determination of ester value after acetylation
and evaluation of free alcohols and total alcohols content.

3 Definition

For the purposes of this International Standard, the following definition applies.

oil of rose, Turkey : The oil obtained by steam distillation of the flowers of *Rosa damascena* P. Miller, cultivated in Turkey.

4 Requirements

4.1 Appearance

Liquid, or more or less crystallized.

4.2 Colour

Light yellow.

4.3 Odour

Characteristic, rosy.

4.4 Relative density at 20/20 °C

Minimum : 0,848

Maximum : 0,862

4.5 Refractive Index at 20 °C

Minimum : 1,453 0

Maximum : 1,464 0

4.6 Optical rotation at 20 °C

Range from -5° to -2°

4.7 Freezing point

About 20 °C

4.8 Ester value

Minimum : 7,5

Maximum : 23,5

4.9 Ester value after acetylation

Minimum 204, corresponding to 71 % (m/m) alcohols expressed as citronellol

Maximum : 231, corresponding to 77 % (m/m) alcohols expressed as citronellol

4.10 Chromatographic profile

Evaluate the quantities of the following characteristic constituents of the essential oil on the chromatographic profile obtained.

The proportion of these constituents, calculated in relation to the sum of all peak areas, and assuming identical response factors, shall be as follows :

| | | | |
|---------------------|----|----|-------|
| citronellol | 34 | to | 44 % |
| nerol | 6 | to | 9 % |
| geraniol | 12 | to | 18 % |
| phenylethyl alcohol | | | < 2 % |

A typical chromatogram is given in annex A, for information only.

4.11 Flash point

102 °C (as an indication only)

5 Sampling

- 43 -

See ISO 212.

Minimum volume of final sample : 25 ml

Note -- This volume allows each of the tests specified in this International Standard to be carried out at least once.

6 Methods of test

6.1 Relative density at 20/20 °C

See ISO 279.

6.2 Refractive Index at 20 °C

See ISO 280.

6.3 Optical rotation at 20 °C

See ISO 592.

6.4 Freezing point

See ISO 10-1.

6.5 Ester value

See ISO 709.

6.6 Ester value after acetylation

See ISO 1241.

Test portion mass for the total alcohols determination, before acetylation : 2 g +/- 0,05 g
Saponification time : 2 h

Acetylation test portion volume : 5 ml of essential oil
Acetylation time : 3 h

Test portion mass, after acetylation : 2 g +/- 0,05 g
Saponification time : 2 h

6.7 Chromatographic profile

See annex A, for information only.

6.8 Flash point

To be included later.

7 Packing, labelling and marking

See ISO/R 210 and ISO/R 211.

Annex A (informative)

Typical chromatogram

Sample: oil of rose, Turkey

Column: fused silica capillary, length 25 m, internal diameter 0,3 mm

Stationary phase: polyethylene glycol 20 000

Split ratio: 10/90

Detector: flame ionization

Oven temperature:

- initial temperature: 60 °C for 10 min
- programme of temperature rise: 3 K/min
- final temperature: 200 °C for 50 min

Injection temperature: 250 °C

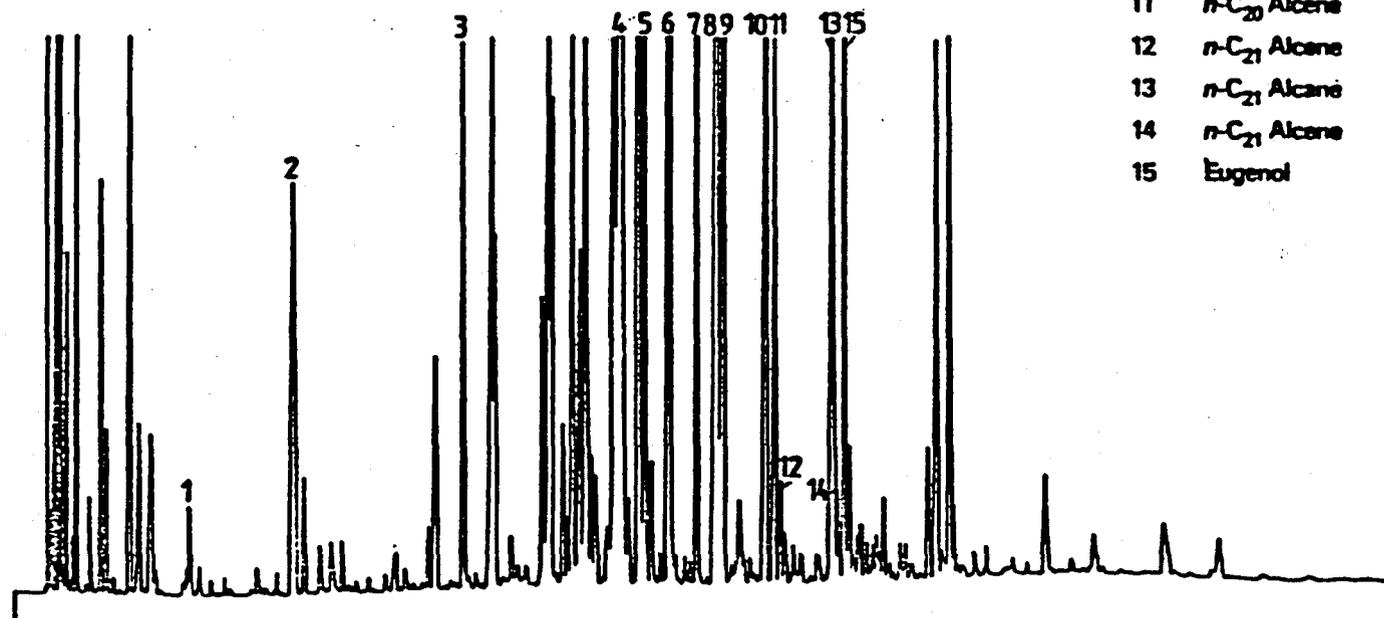
Detection temperature: 250 °C

Carrier gas: nitrogen

Volume injected: 0,3 µl

Constituents

- | | | |
|----|--|--|
| 1 | Ethanol | |
| 2 | <i>cis</i> - and <i>trans</i> - Rose oxide | |
| 3 | Linalol | |
| 4 | Citronellol | |
| 5 | Nerol | |
| 6 | Geraniol | |
| 7 | Phenylethyl alcohol | |
| 8 | <i>n</i> -C ₁₉ Alcane | |
| 9 | <i>n</i> -C ₁₉ Alcane | |
| 10 | Methyleugenol | |
| 11 | <i>n</i> -C ₂₀ Alcane | |
| 12 | <i>n</i> -C ₂₁ Alcane | |
| 13 | <i>n</i> -C ₂₁ Alcane | |
| 14 | <i>n</i> -C ₂₁ Alcane | |
| 15 | Eugenol | |



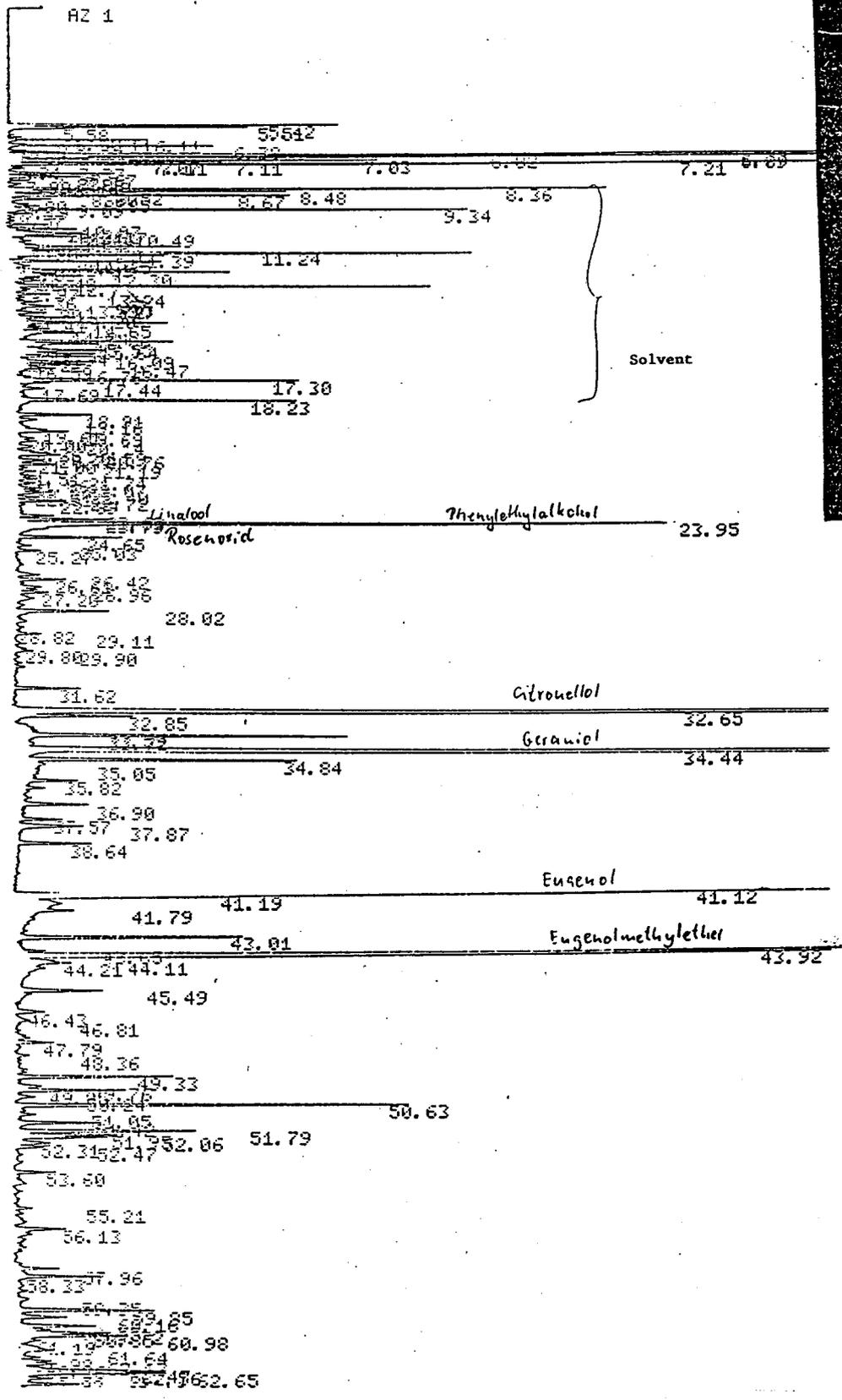
DATE " 18/9/90
 TIME " 12WLT
 TIME"12:43
 FI= 1. FE= 1. MN= 0.
 PRESS 'ENTER' TO SKIP ENTRY
 FILE NAME=" ROSA RUGOSA 17.9.90
 TIME FUNCTION VALUE
 TI= 0.1 TF=" AZ TV= 1
 TT=

METHOD NUMBER:MN=

END OF DIALOG
 CS= 0.5
 AT= 2
 PW=2
 NA=500

VARIAN INSTRUMENT GROUP 00-997140-01

CHANNEL A INJECT 13:13:11

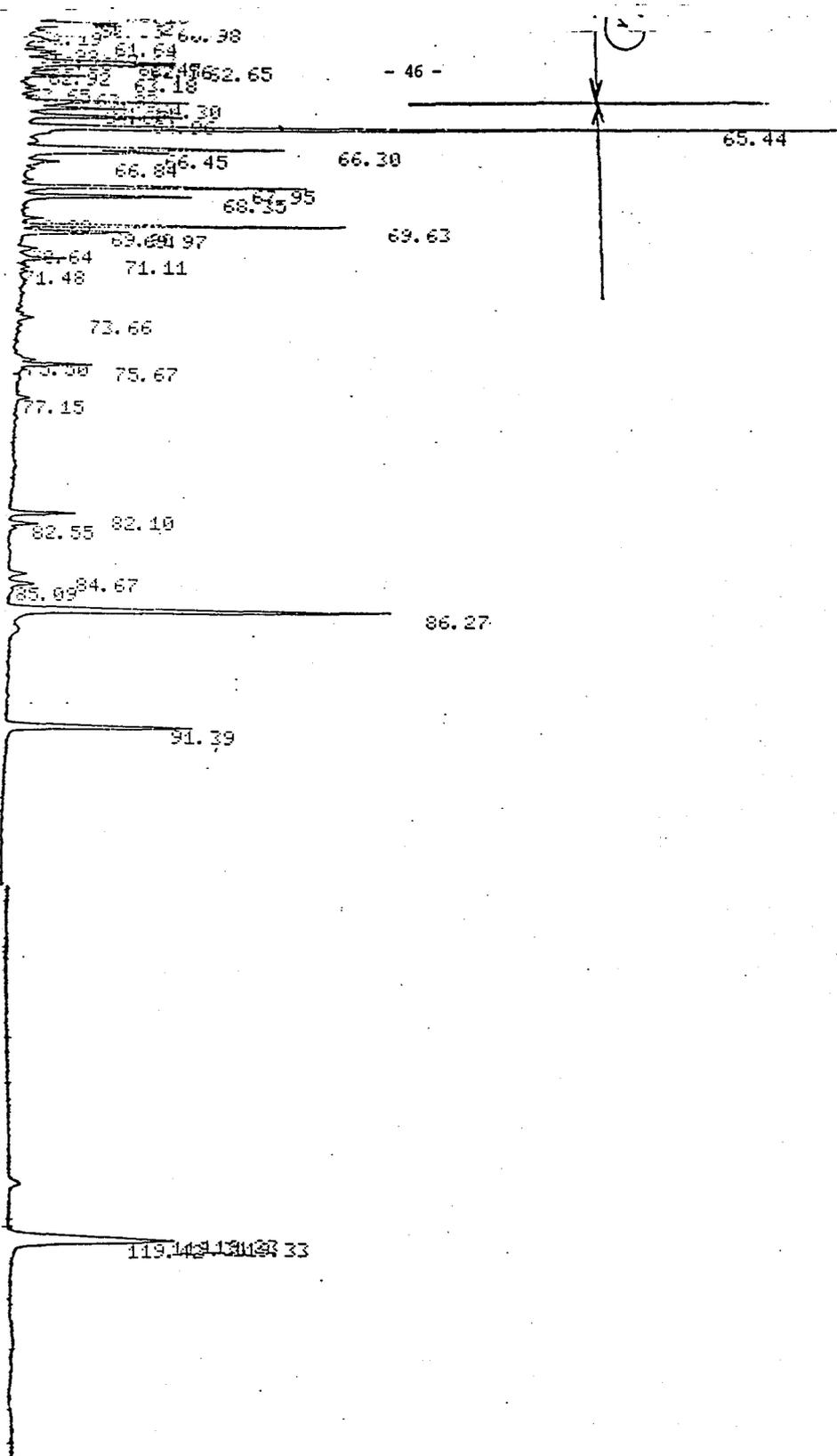


GROUP 00-997140-01

VARIAN INSTRUMENT GROUP

00-997140-01

VARIAN INSTRUMENT GROUP



ROSA RUGOSA 17.9.90 *br. App 17.9.90* KVR 13:13:11 CH= "A" PS= 1.
 2th. of aus Rosa rugosa
 FILE 1. (method) METHOD 0. RUN 1 INDEX 1

| PEAK# | AREA% | RT | AREA BC |
|-------|-------|------|----------|
| 1 | 0.513 | 5.42 | 3562 02 |
| 2 | 0.369 | 5.51 | 2562 02 |
| 3 | 0.103 | 5.58 | 716 03 |
| 4 | 0.083 | 6.11 | 575 03 |
| 5 | 0.298 | 6.38 | 2069 03 |
| 6 | 2.663 | 6.77 | 18492 02 |
| 7 | 0.747 | 6.82 | 5190 02 |
| 8 | 3.508 | 6.89 | 24358 08 |
| 9 | 0.511 | 7.03 | 3551 06 |
| 10 | 0.159 | 7.07 | 1101 06 |
| 11 | 0.137 | 7.11 | 951 06 |

VARIAN INSTRUMENT GROUP OC-997140-01

| | | | |
|----|--------|-------|-----------|
| 5 | 0.297 | 7.36 | 59 |
| 6 | 2.663 | 7.77 | 18492 02 |
| 7 | 0.747 | 6.82 | 5190 02 |
| 8 | 3.508 | 6.89 | 24358 08 |
| 9 | 0.511 | 7.03 | 3551 06 |
| 10 | 0.159 | 7.07 | 1101 06 |
| 11 | 0.137 | 7.11 | 951 06 |
| 12 | 0.128 | 7.11 | 888 06 |
| 13 | 2.178 | 7.21 | 15122 09 |
| 14 | 0.171 | 7.67 | 1189 01 |
| 15 | 0.111 | 7.82 | 768 03 |
| 16 | 1.001 | 8.36 | 6949 02 |
| 17 | 0.423 | 8.48 | 2937 02 |
| 18 | 0.157 | 8.52 | 1093 02 |
| 19 | 0.499 | 8.67 | 3465 03 |
| 20 | 0.08 | 8.85 | 558 03 |
| 21 | 0.712 | 9.34 | 4945 01 |
| 22 | 0.107 | 10.26 | 746 02 |
| 23 | 0.116 | 10.44 | 803 02 |
| 24 | 0.115 | 10.49 | 802 03 |
| 25 | 0.086 | 10.61 | 595 01 |
| 26 | 0.378 | 11.08 | 2628 02 |
| 27 | 0.158 | 11.24 | 1096 02 |
| 28 | 1.318 | 11.39 | 9155 02 |
| 29 | 0.297 | 11.51 | 2059 02 |
| 30 | 0.303 | 11.81 | 2101 02 |
| 31 | 0.773 | 12.3 | 5367 02 |
| 32 | 0.278 | 12.49 | 1930 02 |
| 33 | 0.091 | 12.73 | 635 02 |
| 34 | 0.819 | 12.97 | 5689 02 |
| 35 | 0.102 | 13.36 | 706 02 |
| 36 | 0.076 | 13.72 | 527 02 |
| 37 | 0.165 | 13.9 | 1145 02 |
| 38 | 0.111 | 14.2 | 772 02 |
| 39 | 0.175 | 14.41 | 1214 02 |
| 40 | 0.45 | 14.65 | 3127 02 |
| 41 | 0.136 | 14.94 | 944 02 |
| 42 | 0.327 | 15.06 | 2273 02 |
| 43 | 0.405 | 15.53 | 2812 02 |
| 44 | 0.267 | 15.64 | 1851 02 |
| 45 | 0.334 | 15.94 | 2316 02 |
| 46 | 0.189 | 16.09 | 1313 02 |
| 47 | 0.164 | 16.22 | 1141 02 |
| 48 | 0.244 | 16.47 | 1695 02 |
| 49 | 0.163 | 16.59 | 1131 02 |
| 50 | 0.13 | 16.76 | 904 03 |
| 51 | 0.7 | 17.3 | 4858 03 |
| 52 | 0.617 | 18.23 | 4287 01 |
| 53 | 0.21 | 18.91 | 1461 01 |
| 54 | 0.116 | 19.69 | 805 03 |
| 55 | 0.088 | 20.74 | 612 02 |
| 56 | 0.088 | 20.76 | 612 03 |
| 57 | 0.085 | 21.19 | 593 01 |
| 58 | 0.072 | 22.51 | 501 03 |
| 59 | 0.117 | 22.89 | 812 01 |
| 60 | 0.24 | 23.79 | 1664 01 |
| 61 | 1.913 | 23.95 | 13283 01 |
| 62 | 0.265 | 24.65 | 1841 01 |
| 63 | 0.136 | 26.61 | 942 01 |
| 64 | 0.091 | 26.95 | 629 01 |
| 65 | 0.273 | 28.02 | 1894 01 |
| 66 | 0.182 | 31.62 | 1264 01 |
| 67 | 10.971 | 32.65 | 76185 02 |
| 68 | 0.392 | 32.85 | 2719 03 |
| 69 | 0.143 | 33.59 | 995 02 |
| 70 | 0.97 | 33.72 | 6737 03 |
| 71 | 9.922 | 34.44 | 68899 01 |
| 72 | 0.804 | 34.84 | 5580 01 |
| 73 | 0.129 | 35.82 | 893 01 |
| 74 | 0.22 | 36.9 | 1529 01 |
| 75 | 0.116 | 37.57 | 803 01 |
| 76 | 0.26 | 37.87 | 1804 01 |
| 77 | 0.197 | 38.64 | 1370 01 |
| 78 | 16.727 | 41.12 | 116156 02 |
| 79 | 0.261 | 41.19 | 1815 03 |
| 80 | 0.653 | 43.01 | 4538 01 |
| 81 | 7.554 | 43.92 | 52458 03 |
| 82 | 0.085 | 44.11 | 590 02 |
| 83 | 0.116 | 44.21 | 808 03 |
| 84 | 0.25 | 45.49 | 1723 01 |
| 85 | 0.123 | 46.43 | 855 01 |
| 86 | 0.1 | 47.79 | 697 01 |
| 87 | 0.513 | 49.33 | 3565 01 |
| 88 | 0.111 | 49.76 | 770 02 |
| 89 | 0.357 | 49.95 | 2477 03 |
| 90 | 1.18 | 50.63 | 8193 01 |
| 91 | 0.226 | 51.42 | 1567 01 |
| 92 | 0.553 | 51.79 | 3839 02 |
| 93 | 0.286 | 51.95 | 1984 02 |
| 94 | 0.25 | 52.06 | 1734 03 |
| 95 | 0.085 | 52.31 | 592 02 |

| | | | | |
|----|--------|-------|--------|----|
| 72 | 0.804 | 34.84 | 5580 | 01 |
| 73 | 0.129 | 35.82 | 893 | 01 |
| 74 | 0.22 | 36.9 | 1529 | 01 |
| 75 | 0.116 | 37.57 | 803 | 01 |
| 76 | 0.26 | 37.87 | 1804 | 01 |
| 77 | 0.197 | 38.64 | 1370 | 01 |
| 78 | 16.727 | 41.12 | 116156 | 02 |
| 79 | 0.261 | 41.19 | 1815 | 03 |
| 80 | 0.653 | 42.01 | 4528 | 01 |
| 81 | 7.554 | 42.92 | 52458 | 03 |
| 82 | 0.085 | 44.11 | 590 | 02 |
| 83 | 0.116 | 44.21 | 808 | 03 |
| 84 | 0.25 | 45.49 | 1733 | 01 |
| 85 | 0.123 | 46.43 | 855 | 01 |
| 86 | 0.1 | 47.79 | 697 | 01 |
| 87 | 0.513 | 48.33 | 3565 | 01 |
| 88 | 0.111 | 49.76 | 770 | 02 |
| 89 | 0.357 | 49.95 | 2477 | 03 |
| 90 | 1.18 | 50.63 | 8193 | 01 |
| 91 | 0.226 | 51.42 | 1567 | 01 |
| 92 | 0.553 | 51.79 | 3839 | 02 |
| 93 | 0.286 | 51.95 | 1984 | 02 |
| 94 | 0.25 | 52.06 | 1734 | 03 |
| 95 | 0.085 | 52.31 | 592 | 02 |

VARIAN INSTRUMENT GROUP 00-997140-01

| | | | | |
|-----|-------|--------|-------|----|
| 96 | 0.077 | 52.47 | 538 | 03 |
| 97 | 0.12 | 53.6 | 833 | 01 |
| 98 | 0.183 | 56.13 | 1274 | 01 |
| 99 | 0.195 | 57.96 | 1354 | 02 |
| 100 | 0.335 | 58.33 | 2328 | 03 |
| 101 | 0.452 | 59.85 | 3141 | 01 |
| 102 | 0.138 | 60.16 | 959 | 01 |
| 103 | 0.242 | 60.55 | 1683 | 02 |
| 104 | 0.08 | 60.72 | 558 | 02 |
| 105 | 0.273 | 60.85 | 1896 | 02 |
| 106 | 0.343 | 60.98 | 2382 | 03 |
| 107 | 0.095 | 62.13 | 660 | 02 |
| 108 | 0.103 | 62.26 | 712 | 02 |
| 109 | 0.491 | 62.56 | 3410 | 02 |
| 110 | 0.5 | 62.65 | 3470 | 03 |
| 111 | 0.144 | 63.18 | 998 | 01 |
| 112 | 0.002 | 64.3 | 4180 | 02 |
| 113 | 0.342 | 64.6 | 2376 | 03 |
| 114 | 0.592 | 64.96 | 4113 | 01 |
| 115 | 2.981 | 65.44 | 20698 | 01 |
| 116 | 0.935 | 66.3 | 6492 | 02 |
| 117 | 0.58 | 66.45 | 4026 | 03 |
| 118 | 0.08 | 66.84 | 557 | 01 |
| 119 | 0.99 | 67.95 | 6875 | 01 |
| 120 | 0.508 | 68.35 | 4221 | 01 |
| 121 | 0.948 | 69.63 | 6583 | 01 |
| 122 | 0.324 | 69.9 | 2252 | 02 |
| 123 | 0.186 | 69.97 | 1294 | 03 |
| 124 | 0.241 | 75.67 | 1674 | 03 |
| 125 | 0.297 | 82.1 | 2060 | 01 |
| 126 | 0.095 | 82.55 | 658 | 01 |
| 127 | 0.102 | 84.67 | 706 | 02 |
| 128 | 0.129 | 85.09 | 897 | 03 |
| 129 | 2.305 | 86.27 | 16004 | 01 |
| 130 | 1.039 | 91.39 | 7212 | 01 |
| 131 | 0.255 | 119.23 | 1772 | 02 |
| 132 | 0.311 | 119.31 | 2150 | 02 |
| 133 | 0.49 | 119.33 | 3403 | 02 |
| 134 | 0.225 | 119.42 | 1565 | 03 |

TOTAL 100. 694435