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IPR-99-27

Äspö Hard Rock Laboratory

Prototype Repository

Hydraulic tests in pilot holes
Drill campaign 1

Bengt Gentzschein

Geosigma

December 1997

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Foreword

This technical document is one of seven reports presenting the results from the hydrogeological field characterisation work prior to boring the six deposition holes in the Prototype Repository tunnel in the Äspö Hard Rock Laboratory. The field investigations have been conducted in seven test campaigns between November 1997 and August 1999. The results from each campaign are described in a separate report and the following seven ones have been published.

Gentzschein, B. 1997: Äspö Hard Rock Laboratory. Prototype Repository. Hydraulic Tests in Pilot Holes. Drill campaign 1. SKB International Progress Report IPR 99-27, December 1997.

Gentzschein, B. 1998: Äspö Hard Rock Laboratory. Prototype Repository. Hydraulic Tests in Exploratory Holes. Drill campaign 2. SKB International Progress Report IPR 99-28, May 1998.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository. Hydraulic Tests in Exploratory Holes. Drill campaign 3a. SKB International Progress Report IPR 99-29, June 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository. Hydraulic Tests in Exploratory Holes. Drill campaign 3b. SKB International Progress Report IPR 99-30, June 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository. Hydraulic Tests in Exploratory Holes. Injection Tests. SKB International Progress Report IPR 99-31 , May 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository. Hydraulic Tests in Exploratory Holes. interference Tests A after drill campaign 3 SKB International Progress Report IPR 99-32, May 1999.

Gentzschein, B. 1999: Äspö Hard Rock Laboratory. Prototype Repository. Hydraulic Tests in Exploratory Holes. interference Tests B after drill campaign 3 SKB International Progress Report IPR 99-33, November 1999.

The reports include technical specifications and description of the equipment used, measurement procedures, results of the flow and pressure measurements, relevant test data and all the background data necessary for interpretation and evaluation of field data.

Each test produces a great number of diagrams showing responses in test sections or observation boreholes caused by pressure draw-downs. Each report comprises between 120 and 600 diagrams sorted in appendices after the describing text. Due to the great number, the diagrams are not included in the printed versions of the reports. But the reports, including the diagrams are also stored as Word documents on a CD-R. In addition each diagram is stored as a file (GIF – format). The Word-documents, converted to PDF-format, as well as the diagram-files are available at the Äspö Hard Rock Laboratory.

ABSTRACT

The Prototype Repository in the Äspö Hard Rock Laboratory aims at simulating conditions in the future Deep Repository as realistically as possible. Some of many tasks are to observe the water saturation and homogenisation of the bentonite buffer and the backfill, and their interaction with the rock as well as to compare developed codes and material models with the observations. These tasks among other things need information on the hydraulic properties of the rock. The geohydraulic characterisation of the rock around the Prototype Repository is made in three stages. Each stage is intended to contribute to more details useful for determination of the localisation of the deposition holes and the boundary and rock conditions needed for the interpretation of the experimental data. The three stages are focused on:

1. Mapping of the tunnel
2. Pilot and exploratory holes
3. Deposition holes

This International Progress Report is report number 1 out of seven in a series which presents the results from stage 2, i e hydrogeological characterisation in pilot and exploratory holes, which have been obtained during seven test campaigns between November 1997 and August 1999. More precisely the present International Progress Report presents the results from the tests in the 10 pilot holes, which are situated at the 10 potential sites for the 6 deposition holes.

These 10 pilot holes were drilled in October 1997 with a spacing of approx. 6 meters in the Prototype Repository tunnel. The flow rate was measured as well as the pressure build-up. The highest flow rate was 200 ml/min in the innermost hole. When the flow rate exceeded 10 ml/min an interference test was performed by measuring the pressure responses in the two nearest drill holes on each side of the flowing hole. Five such interference tests were performed. The flow rates were also measured in one-meter sections and interference tests were made when these flow rates exceeded 10 ml/min. Also five such interference tests were made. The pressure build-up tests in the 10 pilot holes resulted in pressures between 0 and approx. 2.6 MPa.

SAMMANFATTNING

Prototypförvaret i Äspölaboratoriet byggs för att simulera förhållandena så naturnära som möjligt i det framtida djupförvaret. Några av många uppgifter är att observera bentonitbuffertens och återfyllens vattenmättnad och homogenisering liksom den interaktion mellan materialen och berget som sker samt att jämföra utvecklade koder och materialmodeller med de gjorda observationerna. För dessa uppgifter behöver bl a bergets hydrauliska egenskaper kunna beskrivas. Denna geohydrauliska karakteriseringen av berget omkring Prototypförvaret görs i tre steg. Varje steg ska bidra med mer användbar detaljinformation om lokalisering av deponeringshål samt randvillkor och bergegenskaper som behövs för tolkning av framtida observationer. De tre stegen inriktas på:

1. Kartering av tunneln
2. Pilot-och undersökningshål
3. Deponeringshål

Denna International Progress Report utgör rapport nummer 1 av sju i en serie som presenterar resultaten från Steg 2, dvs de hydrogeologiska karakteriseringar i pilot-och undersökningshål som gjorts i sju testkampanjer mellan november 1997 och augusti 1999. Mer precist redovisar föreliggande International Progress Report resultaten från mätningar i de 10 pilothålen belägna på de 10 potentiella platserna för de 6 deponeringshålen.

Dessa 10 pilothål borrades i oktober 1997 på ett inbördes avstånd av ca 6 meter i Prototypförvarstunneln. Inflödet mättes liksom tryckets uppbyggnadsförlopp. Som mest mättes ett inflöde på 200 ml/min, i det innersta hålet. När inflödet var större än 10 ml/minut gjordes interferenstester med tryckförändringar i de närmaste två borrhålen på båda sidor. Fem sådana interferenstester genomfördes. Därefter mättes flödet i varje metersektion och interferenstester gjordes i de metersektioner där flödet var större än 10 ml/min. Också fem sådana interferenstester blev genomförda. Totaltrycksmätningarna i de 10 pilothålen visar tryck från 0 till ca 2,6 MPa.

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1. BACKGROUND

Within the scope of SKB's program for RD&D 1995, SKB has decided to carry out a project named "Prototype Repository" at the Äspö Hard Rock Laboratory. The aim of the project is to test important components in SKB's deep repository system in full scale and in a realistic environment.

The Prototype Repository is focused on testing and demonstrating the function of SKB's deep repository system. Activities aimed at contributing to development and testing of the practical engineering measures required to rationally perform the steps of a deposition sequence are also included. However, efforts in this direction are limited, since these matters are addressed in the Demonstration of Repository Technology project and to some extent in the Backfill and Plug test.

The characterisation of the test site, located in the TBM-excavated part of the Äspö HRL tunnel, will be made in three stages. Each stage is intended to contribute to more details useful for the determination of the localization of the deposition holes and also the boundary and rock conditions needed for the interpretation of the experimental data. The three stages are:

1. Mapping of the tunnel
2. Pilot and exploratory holes
3. Deposition holes

Stage 1 is completed and stage 2 has been divided into two drilling campaigns:

1. Drilling of pilot holes
2. Drilling of exploratory holes

Ten pilot holes were drilled between October 14th and October 20th 1997. They were located in the tunnel interval 3/539 m - 3/593 m. This report describes the hydraulic tests that were carried out in the pilot holes.

2. OBJECTIVES

2.1 GENERAL OBJECTIVES

The Prototype Repository should simulate a real repository in as many aspects as possible. The Prototype Repository is a demonstration of the integrated function of the repository components. Results will be compared with models and assumptions to their validity.

The major objectives for the Prototype Repository are:

- To demonstrate the integrated function of a full-scale prototype of the repository system
- To provide a full-scale reference for testing/scrutinization of models, experiments and assumptions
- To develop, test and demonstrate appropriate engineering standards and quality standards and quality assurance systems.
- To demonstrate technology for monitoring of the repository system

The objectives for the characterization program are:

- To provide a basis for determination of localization of the deposition holes
- To provide data on boundary and rock conditions to enable interpretation of experimental data

2.2 OBJECTIVES FOR HYDRAULIC TESTS - DRILL CAMPAIGN 1

The objectives of the pilot holes is to obtain data for prediction of the characteristics in the deposition holes, data for modelling and to quantify the criteria needed for validation of the suitability of the position for canister deposition. Acceptance of a canister position is based on scrutinization of characterization data such as fracturing, permeability and stability of the borehole wall.

The objectives for the hydraulic tests in the pilot holes are:

- The hydraulic tests in the pilot holes should be fairly simple in order to test a methodology that possibly can be useful as a robust engineering process in the deep repository when investigating each canister position.
- the tests shall provide hydraulic data useful for a first judgment of if the position can be used for deposition of a canister.

3. SCOPE

The ten pilot boreholes were drilled with a downward inclination of 81^{o} . The length of each borehole is 8.04 m and the nominal diameter is 76 mm. The date of drilling and the water flow observed after the drilling of each borehole are presented in Table 3.1

Prior to the hydraulic tests mechanical packers were installed in the pilot holes (see Table 3.1) and the groundwater pressure was measured. The pressure measurements were repeated during the test period.

Table 3.1 Drilling data and packer installation data for the pilot holes.

Borehole	Date of drilling	Flow rate (l/min)	Date/time of packer installation (borehole closed)	Measurement section (m)
KA3539G	971018	0.17	971103 14:54	0.70 - 8.04
KA3545G	971020	>0	971103 14:43	0.70 - 8.04
KA3551G	971017	>0	971103 14:22	0.70 - 8.04
KA3557G	971016	>0	971103 14:05	0.70 - 8.04
KA3563G	971016	>0	971103 13:53	0.70 - 8.04
KA3569G	971015-16	>0	971103 13:35	0.70 - 8.04
KA3575G	971015	0	971103 13:23	0.70 - 8.04
KA3581G	971015	0	971103 11:15	0.70 - 8.04
KA3587G	971014	0	971103 11:14	0.70 - 8.04
KA3593G	971014	0.19	971103 11:13	0.70 - 8.04

After the packer installation the ground water pressure in the boreholes stabilized during two days.

Pressure build-up tests of the entire boreholes (i.e. the interval from 0.70 m to the borehole bottom) were carried out between the 5th and 7th of November. If the water flow rate exceeded 10 ml/minute an interference test was performed by monitoring of the pressure responses in the two nearest boreholes on each side of the flowing borehole. A list of tests is shown in Table 3.2

Table 3.2 A list of hydraulic tests conducted in the entire pilot boreholes. Prototype Repository - drill campaign 1, November 1997

Borehole	Date of test	Type of test	Observation boreholes
KA3539G	971107	I	KA3545G, KA3551G
KA3545G	971107	I	KA3539G, KA3551G, KA3557G
KA3551G	971106	PBT	
KA3557G	971106	PBT	
KA3563G	971106	PBT	
KA3569G	971106	PBT	
KA3575G	971106	PBT	
KA3581G	971105	PBT	
KA3587G	971105	PBT	
KA3593G	971105	I	KA3581G, KA3587G

PBT = Pressure Build-Up Test, I = interference Test

Flow logging of the ten pilot holes was performed between November 8 and November 17. A double packer system with 1 m packer spacing was used. Six double packer sections of each borehole were measured. A seventh section covering the bottom of every hole was measured using a single packer tool.

If the flow rate of the measurement section exceeded 10 ml/min a pressure build-up test was performed.

Since the packer gable and the packer pipe extend c. 0.3 m below the 1 m sealing part of the packer the lowest double packer interval possible to measure was 5.74 m - 6.74 m. As a consequence the pilot boreholes were flow logged in the following intervals:

5.74 - 6.74 m
4.74 - 5.74 m
3.74 - 4.74 m
2.74 -3.74 m
1.74 - 2.74 m
1.00 - 2.00m
6.74 - 8.04 m

In five sections a flow rate > 10ml/min was measured and a pressure build-up test was conducted. The five sections were:

KA3539G: 5.74 - 6.74 m
KA3539G: 6.74 - 8.04 m
KA3545G: 5.74 - 6.74 m
KA3545G: 6.74 - 8.04 m
KA3593G: 4.74 - 5.74 m

4. EQUIPMENT USED

When measuring the borehole pressures and carrying out the pressure build-up tests, the boreholes were shut in by mechanically operated packers manufactured by Livinstone AB. The sealing rubber length of of the packers was 0.15 m. The length of the packer system was c. 1.5 m.

A valve arrangement, including a pressure gauge for manual reading, and a sealing BAT rubber disc mounted in a nozzle, was connected on the inner packer pipe

The pressure transducers used were Druck PTX 1400. The pressure range was 60 bar. On the transducer housing a hypodermic needle was mounted. When connecting the transducer to the valve arrangement on the packer pipe, the needle penetrated the rubber disc, enabling a hydraulic communication between the measurement section and the transducer.

Pressure data were stored using the data logger BORRE MDL ver. 2.2, manufactured by IPA-konsult AB. The software of the logger is very flexible concerning sampling intervals etc. A measurement sequence can be started either by a temporarily connected computer or by using the key pad at the front of the data logger. Pressure values are shown on the computer screen during the measurements. The key pad enables three measurement options. The option ”SLOW” initiates one hour interval measurement and ”FAST” a 5 minutes interval. The ”SEQ” option is usually used during hydraulic testing. This option has stepwise increase in measurement intervals starting with 2 seconds (if one channel is used). After 30 minutes and onwards the measurement interval is three minutes. These ”SLOW”, ”FAST” and ”SEQ” options can easily be reprogrammed from the computer.

During the interference tests up to two data loggers and five pressure transducers were used

Water flow rates higher than 1-2 ml/min were measured using graduated cylinders and a stop watch. Lower rates were achieved by letting the water flow through a vertical mounted Tecalan hose and measure the rise of the water level. With one exception a Tecalan hose with the inner diameter 4 mm was used.

The outflow level above the floor of the tests respectively is listed in Table 4-1.

Table 4-1 Outflow level above the floor. Tests in pilot holes, November 1997. Prototype Repository, drill campaigns 1

Borehole	Section (m)	Date	Test No	Test type	Outflow level above floor (m)
KA3593G	0.70-8.04	971105	1	I	1.40
KA3587G	0.70-8.04	971106	2	PBT	1.40
KA3581G	0.70-8.04	971106	3	PBT	1.40
KA3575G	0.70-8.04	971106	4	PBT	1.40
KA3569G	0.70-8.04	971106	5	PBT	1.40
KA3563G	0.70-8.04	971106	6	PBT	1.40
KA3557G	0.70-8.04	971106	7	PBT	1.40
KA3551G	0.70-8.04	971106	8	PBT	1.40
KA3545G	0.70-8.04	971107	9	I	1.40
KA3539G	0.70-8.04	971107	10	I	1.40
KA3539G	5.74-6.74	971108	11	PBT	0.85
KA3539G	6.74-8.04	971109	12	PBT	0.85
KA3545G	5.74-6.74	971109	13	PBT	0.85
KA3545G	6.74-8.04	971110	14	PBT	0.85
KA3593G	4.74-5.74	971118	15	PBT	0.85

The downhole equipment used for the flow logging and the PBT's of a feature in the pilot holes consisted of two inflatable Polyurethane packers, separated by a pipe, a pipe string and two pressure lines. The sealing length of each packer is 1.0 m and they are inflated using water pressurized by nitrogen. The pipe between the packers and a by-pass opening at the upper gable of the outer packer equalize the ground water pressure on both sides of the measurement section. One of the two pressure hoses (polyamide) is connecting the packers and the pressurizing system. The second pressure hose establishes hydraulic contact between the measurement chamber and a transducer positioned outside the borehole.

The pipe string is made of aluminum with threaded pipe joints of stainless steel. The outer/inner diameter is 33/21 mm and the length of individual pipe segments is 1 m.

The test tool and the pipe string were lowered into the borehole using a manually operated winch.

The packer inflation influences the accuracy of the flow measurements. The generated flow in a double packer section caused by the packers used in the pilot hole tests have been tested in the laboratory, cf. Lindström (1997). The results

show that after 30 minutes of inflation, the flow is c. 0.5 ml/min. and after 40 minutes the generated flow is c.0.4ml/min. Consequently, the effect of packer creep induced flow is most pronounced for low-transmissive test sections., see Figure 4.1

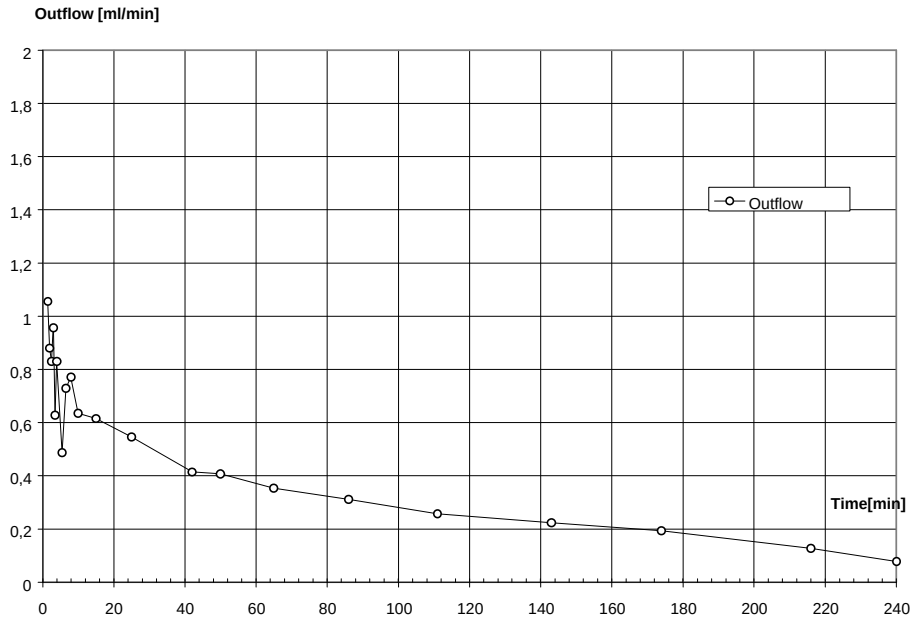

Figure 4.1 Generated flow caused by inflation of double packers PUR 72. Elapsed time from start of inflation, from Lindström 1997.

5. PERFORMANCE

5.1 PRESSURE MEASUREMENTS

The ground water pressure of the pilot holes was at one occasion measured using pressure transducer, data logger and a portable PC. The transducer was connected to the ”BAT-connection” of the boreholes respectively and the logger value, displayed on the PC-screen, was noted. The pressure was calculated using the calibration constants. Before the measurements, the borehole pressures were stabilized for about two days.

The borehole pressures were at several occasions also achieved by reading the pressure gauges mounted on the valve adapters.

5.2 PRESSURE BUILD-UP TESTS OF THE ENTIRE BOREHOLES AND INTERFERENCE TESTS.

Before the measurements, the borehole pressures were stabilized for about two days

The flow logging test cycle was perfomed as follows:

- the pressure transducers and the data loggers were connected, see chapter 4, to the flowing borehole and the two nearby boreholes on each side
- the logarithmic scanning option (”SEQ”) of the logger was initiated
- the valve of the flowing borehole was opened and the flow was measured during 60 minutes
- the logarithmic scanning option (”SEQ”) of the loggers was restarted
- the valve was closed and the pressure build-up was registered during 30 minutes.
- the data loggers were switched off.
- transfer to next borehole and reconfiguration of the monitoring equipment.

The flow rate was measured using graduated cylinders or a Tecalan hose, see chapter 4.

The data loggers were programmed to measure with the highest sample rate during the first three minutes of the flow phase and recovery phase respectively. Thereafter the sampling interval was 20 seconds. Since 2-3 transducers were connected to each data logger the lowest measurement interval was 3-4 seconds

If the flow rate exceeded 10 ml/min the test was performed as an interference test. If the flow was less, the test was evaluated as an pressure build-up test in the flowing borehole.

5.3 FLOW METER LOGGING WITH DOUBLE PACKERS

Shortly before the measurement of a pilot hole the mechanical packer was removed and the double packer section was assembled.

If the flow rate of a 1m-section was less than 10 ml/min a measurement cycle was performed as follows:

- the double packer section was lowered to the first position.
- start of the packer inflation and data logger (SEQ)
- the packers stabilized for 30 minutes
- the packer pipe was filled with water and if necessary a tecalan hose was mounted on the top of the packer pipe
- flow measurements during 5 minutes
- packer deflation
- transfer to next borehole section

The flow logging started in the bottom of the borehole (first section: 5.74-6.74 m). Thereafter the the packers were lifted 1m for the next test.

When the six double packer measurements were completed, the lower packer was removed. The bottom of the borehole was measured with a single packer in the same way as described above.

The flow rate was measured using graduated cylinders or a tecalan hose, see chapter 4.

5.4 PRESSURE BUILD-UP TEST OF A FEATURE IN PILOT BOREHOLE

If the flow rate of a 1m-section was greater than 10 ml/min a measurement cycle was performed as follows:

- the double packer section was lowered to the measurement interval.
- start of the packer inflation and data logger (SEQ)
- the packers stabilized for c. 5 minutes
- the packer pipe was filled with water
- flow measurements during 30 minutes
- the logarithmic scanning option (”SEQ”) of the loggers was restarted
- the valve was closed and the pressure build-up was registered during 15 minutes.
- packer deflation
- transfer to next borehole section

The flow rate was measured using graduated cylinders and a stop watch.

6. RESULTS

6.1 PRESSURE MEASUREMENTS

The results of the pressure measurement are listed in Table 6.1

Table 6.1 Borehole pressures (kPa) measured by pressure gauges or pressure transducer and data logger, Pilot holes for Prototype Repository - drill campaign 1

Date: Time	971104 10:20	971104 16:20	971105 10:00	971105 10:00	971106 08:41	971107 08:52	971114 08:20	971117 13:40
Borehole/ Section(m)	(press. gauge)	(press. Gauge)	(press. Gauge)	(pr.tran-sducer)	(press. Gauge)	(press. Gauge)	(press. Gauge)	(press. gauge)
KA3593G 0.70-8.04	2000	2000	2000	2219	1980	1990	2000	2000
KA3587G 0.70-8.04	1100	1300	1500	1483	1400	1600	1750	1710
KA3581G 0.70-8.04	0	0	0	46	0	0	-	0
KA3575G 0.70-8.04	0	0	0	13	0	0	-	0
KA3569G 0.70-8.04	200	300	340	234	550	520	440	490
KA3563G 0.70-8.04	0	0	0	52	0	0	0	0
KA3557G 0.70-8.04	0	0	0	2.5	0	0	230	370
KA3551G 0.70-8.04	-	350	520	450	800	400	0	0
KA3545G 0.70-8.04	-	2400	2480	2330	2540	2570	2580	2580
KA3539G 0.70-8.04	-	2300	2330	2250	2350	2380	2440	2480

At one occasion the borehole pressures were measured by pressure gauges and the transducer at the same time. As can be seen in Table 6.1 there is a small discrepancy between the two methods. The pressure values measured by the data logger/transducer system should, however, be more reliable since the system was calibrated some days before the pilot hole measurements.

6.2 PRESSURE BUILD-UP TESTS OF THE ENTIRE BOREHOLES AND INTERFERENCE TESTS.

Appendices A1 - A10 contain the diagrams for each test. The different types of diagrams are:

- Lin-Lin plots for the whole test sequence
- Lin-Log plots for the draw-down phase and the Pressure build-up
- Log-Log plots for the draw-down phase and the Pressure build-up
- Derivative plots for the recovery

The pressure build-up is plotted versus the equivalent time, dt_e, in minutes. The equivalent time is defined as:

$$dt_e = \frac{t_p \cdot dt}{t_p + dt}$$ where

t_p = time in minutes when the test section was open
dt = elapsed time after shutting the valve to the test section.

In the following details and important test data for each test are described
The abbreviations used are

- Po = Initial pressure before opening of the valve
- Pp = Pressure just before closing the valve
- Pf = Pressure at the end of the pressure build-up period

Borehole KA3539G, section 0.70 m - 8.04 m

Date:	97-11-07	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3539G
Valve opened: 971107 104200 Valve closed: 971107 114158
Total flowing time : 60 min Tot. Pr. Build-up time: 166 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3545G and KA3551G.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3539G	2264.5	5.1	2188.8
KA3545G	2087.1	2235.0	2304.6
KA3551G	354.4	374.71	430.4

Manually read pressures and flow rates of KA3539G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
10:43:30		0.138
10:46		0.135
10:50		0.133
11:02		0.131
11:12		0.130
11:21		0.130
11:32		0.129
11:40		0.128
11:42:13	1250	
11:42:28	1700	
11:42:43	1880	
11:42:58	1970	
11:43:28	2010	
11:46	2160	
12:04	2220	
12:12	2230	
14:32	2250	

Borehole KA3545G, section 0.70 m - 8.04 m

Date:	97-11-07	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3545G
Valve opened: 971107 085959 Valve closed: 971107 095959
Total flowing time : 60 min Tot. Pr. Build-up time: 30 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3539, KA3551G and KA3557G.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3545G	2328.9	2.3	1996.5
KA3539G	2264.1	2262.0	2264.3
KA3551G	320.4	340.0	353.5
KA3557G	3.9	3.2	3.9

Manually read pressures and flow rates of KA3545G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
09:01:30		0.024
09:05		0.0195
09:16:30		0.0155
09:25		0.0145
09:35		0.014
09:45		0.014
09:56		0.013
10:00:19	400	
10:00:29	440	
10:00:44	620	
10:00:59	700	
10:01:29	890	
10:03	1240	
10:06	1600	
10:26	2180	
10:30	2200	

Borehole KA3551G, section 0.70 m - 8.04 m

Date:	97-11-06	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3551G
Valve opened: 971106 182500 Valve closed: 971106 192500
Total flowing time : 60 min Tot. Pr. Build-up time: 30.35 min.

The test was performed as a pressure build-up test. Only pressure measurements in KA3551G are reported.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3551G	824.3	2.7	19.4

Manually measured flow rates of KA3551G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
18:30:30		7.8×10^{-5}
18:41:30		3.5×10^{-5}
18:49:30		3.0×10^{-5}
19:02:30		2.5×10^{-5}
19:14:30		2.2×10^{-5}

The flow rates were achieved by measuring the rise of the water level in a Tecalan hose, see chapter 4. No pressure build-up was observed on the pressure gauge.

Borehole KA3557G, section 0.70 m - 8.04 m

Date:	97-11-06	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3557G
Valve opened: 971106 160959 Valve closed: 971106 171000
Total flowing time : 60 min Tot. Pr. Build-up time: 29.9 min

The test was performed as a pressure build-up test. Only pressure measurements in KA3557G are reported.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3557G	3.9	0.69	2.1

No water flow at all from KA3557G could be observed, and no pressure build-up was observed on the pressure gauge.

Borehole KA3563G, section 0.70 m - 8.04 m

Date:	97-11-06	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3563G
Valve opened: 971106 142500 Valve closed: 971106 152500
Total flowing time : 60 min Tot. Pr. Build-up time: 29.7 min.

The test was performed as a pressure build-up test. Only pressure measurements in KA3563G are reported.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3563G	51.5	-0.2	48.5

Manually measured flow rates of KA3563G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
14:27:30		0.009
14:35		0.007
14:52		0.007
15:01		0.007
15:12		0.007
15:22		0.007
15:55	0	

No pressure build-up was observed on the pressure gauge.

Borehole KA3569G, section 0.70 m - 8.04 m

Date:	97-11-06	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3569G
Valve opened: 971106 104500 Valve closed: 971106 114500
Total flowing time : 60 min Tot. Pr. Build-up time: 130 min.

The test was performed as a pressure build-up test. Only pressure measurements in KA3569G are reported.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3569G	442.3	0.9	413

Manually measured flow rates of KA3569G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
10:55		4.8×10^{-4}
11:02		4.3×10^{-4}
11:15		4.0×10^{-4}
11:27		3.9×10^{-4}
11:41		3.8×10^{-4}
13:55	0	

The flow rates were achieved by measuring the rise of the water level in a Tecalan hose, see chapter 4. No pressure build-up was observed on the pressure gauge.

Borehole KA3575G, section 0.70 m - 8.04 m

Date:	97-11-07	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3575G
Valve opened: 971106 085959 Valve closed: 971106 100000
Total flowing time : 60 min Tot. Pr. Build-up time: 30 min.

The test was performed as a pressure build-up test. Only pressure measurements in KA3575G are reported.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3575G	21.8	1.6	2.3

Manually measured flow rates of KA3575G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
09:05		8.4×10^{-6}
09:25		5.5×10^{-6}
09:45		3.8×10^{-6}
09:54		1.4×10^{-5}
10:30	0	

The flow rates were determined by measuring the rise of the water level in a Tecalan hose, see chapter 4. No pressure build-up was observed on the pressure gauge.

Borehole KA3581G, section 0.70 m - 8.04 m

Date: 97-11-05 Field Crew: B. Gentzschein
Borehole length: 8.04 m Borehole diameter: 76 mm

Flowing borehole: KA3581G
Valve opened: 971105 160000 Valve closed: 971105 170000
Total flowing time : 60 min Tot. Pr. Build-up time: 30 min.

The test was performed as a pressure build-up test. Only pressure measurements in KA3581G are reported.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3581G	49.4	2.5	4.4

Manually measured flow rates of KA3581G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
16:05		6.3×10^{-6}
16:20		1.3×10^{-6}
16:20		1.3×10^{-6}
16:45	0	

The flow rates were determined by measuring the rise of the water level in a Tecalan hose, see chapter 4. No pressure build-up was observed on the pressure gauge.

Borehole KA3587G, section 0.70 m - 8.04 m

Date:	97-11-05	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3587G
Valve opened: 971105 140000 Valve closed: 971105 150000
Total flowing time : 60 min Tot. Pr. Build-up time: 30 min.

The test was performed as a pressure build-up test. Only pressure measurements in KA3587G are reported.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3587G	1330.9	5.0	84.7

Manually measured flow rates of KA3587G are presented in the table below.

Time	Pressure (kPa)	Flow rate (l/min)
14:22		1.0×10^{-4}
14:37		8.6×10^{-5}
14:46		7.9×10^{-5}
14:55		7.9×10^{-5}
15:30	0	

The flow rates were achieved by measuring the rise of the water level in a Tecalan hose, see chapter 4. No pressure build-up was observed on the pressure gauge.

Borehole KA3593G, section 0.70 m - 8.04 m

Date:	97-11-05	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Flowing borehole: KA3593G
Valve opened: 971105 104559 Valve closed: 971105 114600
Total flowing time : 60 min Tot. Pr. Build-up time: 123 min.

The test was performed as an interference test. Pressure responses were monitored in boreholes KA3587G and KA3581G.

Borehole	Po(kPa)	Pp(kPa)	Pf(kPa)
KA3593G	2220.7	6.4	2117.0
KA3587G	1417.1	1361	1328.6
KA3581G	44.3	45.0	49.6

Manually read pressures and flow rates of KA3593G are presented below.

Time	Pressure (kPa)	Flow rate (l/min)
10:47		0.426
10:50		0.358
11:01		0.33
11:10		0.31
11:20		0.30
11:30		0.285
11:40		0.265
11:44		0.265
11:46:30	950	
11:47	1000	
11:48	1110	
11:50	1200	
11:55	1290	
12:00	1390	
12:11	1410	
12:16	1440	
13:49	1720	

6.3 FLOW METER LOGGING WITH DOUBLE PACKERS

The result of the flow logging is presented in Table 6.2.

Table 6.2 Results of flow logging of the pilot boreholes for the Prototype Repository, drill campaign 1.

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3539G	971108	5.74-6.74	0.0825	PBT
KA3539G	971109	4.74-5.74	0.0055	
KA3539G	971109	3.74-4.74	9.5×10^{-4}	
KA3539G	971109	2.74-3.74	4.8×10^{-5}	
KA3539G	971109	1.74-2.74	4.8×10^{-5}	
KA3539G	971109	1.00-2.00	0.0013	
KA3539G	971109	6.74-8.04	0.058	PBT
KA3545G	971109	5.74-6.74	0.0095	PBT
KA3545G	97110	4.74-5.74	0.0098	
KA3545G	97110	3.74-4.74	2.6×10^{-5}	
KA3545G	97110	2.74-3.74	1.0×10^{-4}	
KA3545G	97110	1.74-2.74	2.8×10^{-5}	
KA3545G	97110	1.00-2.00	5.8×10^{-5}	
KA3545G	97110	6.74-8.04	0.010	PBT
KA3551G	971110	5.74-6.74	2.5×10^{-5}	
KA3551G	971110	4.74-5.74	3.8×10^{-5}	
KA3551G	971110	3.74-4.74	3.3×10^{-5}	
KA3551G	971110	2.74-3.74	4.5×10^{-5}	
KA3551G	971111	1.74-2.74	5.8×10^{-5}	
KA3551G	971111	1.00-2.00	6.6×10^{-5}	
KA3551G	971111	6.74-8.04	2.0×10^{-5}	

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3557G	971111	5.74-6.74	1.0×10^{-4}	
KA3557G	971111	4.74-5.74	4.8×10^{-5}	
KA3557G	971111	3.74-4.74	5.5×10^{-5}	
KA3557G	971111	2.74-3.74	2.0×10^{-5}	
KA3557G	971111	1.74-2.74	1.1×10^{-4}	
KA3557G	971111	1.00-2.00	2.3×10^{-5}	
KA3557G	971111	6.74-8.04	2.5×10^{-5}	
KA3563G	971112	5.74-6.74	1.8×10^{-5}	
KA3563G	971112	4.74-5.74	0.0045	
KA3563G	971112	3.74-4.74	0.0032	
KA3563G	971112	2.74-3.74	7.5×10^{-6}	
KA3563G	971112	1.74-2.74	0.0023	
KA3563G	971112	1.00-2.00	0.0023	
KA3563G	971112	6.74-8.04	2.3×10^{-5}	
KA3569G	**971112**	5.74-6.74	2.3×10^{-5}	
KA3569G	971112	4.74-5.74	2.3×10^{-5}	
KA3569G	971112	3.74-4.74	3.7×10^{-4}	
KA3569G	971112	2.74-3.74	1.7×10^{-4}	
KA3569G	971112	1.74-2.74	7.8×10^{-5}	
KA3569G	971112	1.00-2.00	1.9×10^{-4}	
KA3569G	971112	6.74-8.04	3.0×10^{-5}	
KA3575G	971113	5.74-6.74	1.8×10^{-4}	
KA3575G	971113	4.74-5.74	2.1×10^{-4}	
KA3575G	971113	3.74-4.74	6.6×10^{-5}	
KA3575G	971113	2.74-3.74	7.8×10^{-5}	
KA3575G	971113	1.74-2.74	1.4×10^{-4}	

Flowing Borehole	Date of Test	Section (m)	Flow rate (l/min)	Comment
KA3575G	971113	1.00-2.00	1.2×10^{-4}	
KA3575G	971113	6.74-8.04	1.3×10^{-5}	
KA3581G	971114	5.74-6.74	9.1×10^{-5}	
KA3581G	971114	4.74-5.74	1.0×10^{-4}	
KA3581G	971114	3.74-4.74	4.3×10^{-5}	
KA3581G	971114	2.74-3.74	1.6×10^{-4}	
KA3581G	971114	1.74-2.74	7.8×10^{-5}	
KA3581G	971114	1.00-2.00	2.0×10^{-5}	
KA3581G	971117	6.74-8.04	1.8×10^{-5}	
KA3587G	971117	5.74-6.74	7.3×10^{-5}	
KA3587G	971117	4.74-5.74	8.8×10^{-5}	
KA3587G	971117	3.74-4.74	9.6×10^{-5}	
KA3587G	971117	2.74-3.74	3.8×10^{-5}	
KA3587G	971117	1.74-2.74	4.0×10^{-5}	
KA3587G	971117	1.00-2.00	8.8×10^{-5}	
KA3587G	971117	6.74-8.04	7.3×10^{-5}	
KA3593G	971118	5.74-6.74	3.8×10^{-5}	
KA3593G	971118	4.74-5.74	0.204	PBT
KA3593G	971118	3.74-4.74	4.8×10^{-5}	
KA3593G	971118	2.74-3.74	3.0×10^{-5}	
KA3593G	971118	1.74-2.74	5.8×10^{-5}	
KA3593G	971118	1.00-2.00	1.3×10^{-5}	
KA3593G	971118	6.74-8.04	2.3×10^{-5}	

6.4 PRESSURE BUILD-UP TEST OF A FEATURE IN PILOT BOREHOLE

In five of the flow logged sections flow rates equal to or greater than 0.010 l/minute were measured. In these sections the measurement was extended to a pressure build-up test.

Appendicies B1 - B5 contain the diagrams for each test. The different types of diagrams are:

- Lin-Lin plots for the whole test sequence
- Lin-Log plots for the Pressure build-up
- Log-Log plots for the Pressure build-up
- Derivative plots for the recovery

In the Lin-Log and Log-Log plots a time correction has been performed, see section 6.2

In the following details and important test data for each test are described
Flowing time = time between packer inflation and valve closing

Borehole KA3539G, section 5.74 m - 6.74 m

Date:	97-11-08	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Packer inflation: 971108 181000 Valve closed: 971108 184500
Flowing time : 35 min Tot. Pr. Build-up time: 15min.

Pressure just before closing the valve (Pp, kPa): 14.9
Pressure at the end of the recovery (Pf, kPa) : 17.0

Manually measured flow rates during pressure build-up test in KA3539G, 5.74 - 6.74 m, are presented below.

Time	Flow rate (l/min)
18:16:30	0.083
18:21	0.083
18:27	0.083
18:35	0.0825
18:42	0.0825

Borehole KA3539G, section 6.74 m - 8.04 m

Date:	97-11-09	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Packer inflation: 971109 160912 Valve closed: 971109 165400
Flowing time : 44.8 min Tot. Pr. Build-up time: 16 min.

Pressure just before closing the valve (Pp, kPa): 13.1
Pressure at the end of the recovery (Pf, kPa) : 1751.6

Manually measured flow rates during pressure build-up test in KA3539G, 6.74 - 8.04 m**,** are presented below.

Time	Flow rate (l/min)
16:18	0.058
16:26	0.058
16:36	0.058
16:47	0.058
16:53	0.058

Borehole KA3545G, section 5.74 m - 6.74 m

Date:	97-11-09	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Packer inflation: 971109 182800 Valve closed: 971109 190300
Flowing time : 35 min Tot. Pr. Build-up time: 15min.

Pressure just before closing the valve (Pp, kPa): 11.7
Pressure at the end of the recovery (Pf, kPa) : 1763.1

Manually measured flow rates during pressure build-up test in KA3545G 5.74 - 6.74 m, are presented below.

Time	Flow rate (l/min)
18:39	0.010
18:47	0.0105
18:54	0.010
19:01	0.0095

Borehole KA3545G, section 6.74 m - 8.04 m

Date:	97-11-10	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Packer inflation: 971110 133330 Valve closed: 971110 140800
Flowing time : 34.5 min Tot. Pr. Build-up time: 15min.

Pressure just before closing the valve (Pp, kPa): 11.9
Pressure at the end of the recovery (Pf, kPa) : 1721.5

Manually measured flow rates during pressure build-up test in KA3545G, 6.74 - 8.04 m, are presented below.

Time	Flow rate (l/min)
13:45	0.0095
13:52	0.010
14:01	0.010
14:06	0.010

Borehole KA3593G, section 4.74 m - 5.74 m

Date:	97-11-18	Field Crew:	B. Gentzschein
Borehole length:	8.04 m	Borehole diameter:	76 mm

Packer inflation: 971118 094610 Valve closed: 971118 101556
Flowing time : 29.8 min Tot. Pr. Build-up time: 15min.

Pressure just before closing the valve (Pp, kPa): 15.4
Pressure at the end of the recovery (Pf, kPa) : 1807.0

Manually measured flow rates during pressure build-up test in KA3593G, 4.74 - 5.74 m, are presented below.

Time	Flow rate (l/min)
09:55	0.214
10:05	0.206
10:12	0.204

7. REFERENCES

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Lindström, D. 1997: True Block Scale Prototype Experiment. Packer and Prototype Dummy. Apr. 1997 , SKB TN-97-15b

Rhén, I. and Nilsson, L., 1991: Pressure build-up tests in sounding boreholes - performance and evaluation. SKB-Technical Document No. 25-91-010

APPENDICES

The following appendices are not included as hard copies in the report, but stored on CD-ROM which is available at Äspö Hard Rock Laboratory.

APPENDIX A1: Diagrams of the interference test in pilot hole KA3539G, 0.70-8.04 m , and diagrams of pressure responses in KA3545G and KA3551G

APPENDIX A2: Diagrams of the interference test in pilot hole KA3545G, 0.70-8.04 m , and diagrams of pressure responses in KA3539G, KA3551G and KA3557G

APPENDIX A3: Diagrams of the pressure build-up test in pilot hole KA3551G, 0.70-8.04 m ,

APPENDIX A4: Diagrams of the pressure build-up test in pilot hole KA3557G, 0.70-8.04 m ,

APPENDIX A5: Diagrams of the pressure build-up test in pilot hole KA3563G, 0.70-8.04 m ,

APPENDIX A6: Diagrams of the pressure build-up test in pilot hole KA3569G, 0.70-8.04 m ,

APPENDIX A7: Diagrams of the pressure build-up test in pilot hole KA3575G, 0.70-8.04 m ,

APPENDIX A8: Diagrams of the pressure build-up test in pilot hole KA3581G , 0.70-8.04 m ,

APPENDIX A9: Diagrams of the pressure build-up test in pilot hole KA3587G , 0.70-8.04 m ,

APPENDIX A10: Diagrams of the interference test in pilot hole KA3593G, 0.70-8.04 m and diagrams of pressure responses in KA3581G and KA3587G

APPENDIX B1: Diagrams of the pressure build-up test in pilot hole KA3539G, 5.74-6.74 m ,

APPENDIX B2: Diagrams of the pressure build-up test in pilot hole KA3539G, 6.74-8.04 m ,

APPENDIX B3: Diagrams of the pressure build-up test in pilot hole KA3545G, 5.74-6.74 m ,

APPENDIX B4: Diagrams of the pressure build-up test in pilot hole KA3545G, 5.74-8.04 m ,

APPENDIX B5 : Diagrams of the pressure build-up test in pilot hole KA3593G , 4.74-5.74 m ,

DATA FILES

Table C:1 A list of data files of data stored by the Borre data logger (*.BOR-files), calibration files and converted pressure data files. Hydraulic tests in pilot boreholes for the Prototype Repository, drill campaign 1, November 1997.

Flowing Borehole	Date of Test	Start – Stop Time of test	Section (m)	Test No	Observation Borehole	Pressure files ” *.HYF-files”	Pressure files ” *.BOR-files”	Calibration file
KA3539G	971107	10:41-14:28	0.70-8.04	10	KA3539G	KA3539G.HYF	KA351107.BOR	BORRE40P.CAL
KA3539G	971107	10:41-14:28	0.70-8.04	10	KA3545G	KA3539G.HYF	”	”
KA3539G	971107	10:41-14:28	0.70-8.04	10	KA3551G	KA3539G.HYF	”	”
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3545G	KA3545G.HYF	”	”
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3539G	KA3545G.HYF	”	”
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3551G	KA3545G.HYF	”	”
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3557G	KA3545G.HYF	”	”
KA3551G	971106	18:24-19.55	0.70-8.04	8	KA3551G	KA3551G.HYF	”	”
KA3557G	971106	16:07-17:40	0.70-8.04	7	KA3557G	KA3557G.HYF	”	”
KA3563G	971106	14:24-15:55	0.70-8.04	6	KA3563G	KA3563G.HYF	”	”
KA3569G	971106	10:42-13.55	0.70-8.04	5	KA3569G	KA3569G.HYF	”	”
KA3575G	971106	08.43-10:30	0.70-8.04	4	KA3575G	KA3575G.HYF	”	”
KA3581G	971106	15:57-17.30	0.70-8.04	3	KA3581G	KA3581G.HYF	”	”
KA3587G	971106	10:57-15:30	0.70-8.04	2	KA3587G	KA3587G.HYF	”	”
KA3593G	971105	10:44-13:49	0.70-8.04	1	KA3593G	KA3593G.HYF	”	”
KA3593G	971105	10:44-13:49	0.70-8.04	1	KA3581G	KA3593G.HYF	”	”
KA3593G	971105	10:44-13:49	0.70-8.04	1	KA3587G	KA3593G.HYF	”	”
KA3539G	971108	18:17-19:00	5.74-6.74	11	KA3539G1	KA3539G1.HYF	KA351118.BOR	BORRE40B.CAL
KA3539G	971109	16:09-17:10	6.4-8.04	12	KA3539G2	KA3539G2.HYF	”	”
KA3545G	971109	18:35-19:18	5.74-6.74	13	KA3545G1	KA3545G1.HYF	”	”
KA3545G	971110	13:33-14:23	6.74-8.04	14	KA3545G2	KA3545G2.HYF	”	”
KA3593G	971118	09:46-10:31	4.74-5.74	15	KA3593G1	KA3593G1.HYF	”	”

Table C:2 Data files (text files) created of data logger data, hydraulic tests in pilot boreholes for the Prototype Repository, drill campaign 1, November 1997.

Flowing Borehole	Date of Test	Start – Stop Time of test	Section (m)	Test No	Observation Borehole	Pressure files Draw-down	Pressure files Recovery	Flow rate files
KA3539G	971107	10:41-14:28	0.70-8.04	10	KA3539G	10PD3539.TXT	10PB3539.TXT	10FD3539.TXT
KA3539G	971107	10:41-14:28	0.70-8.04	10	KA3545G	10PD3545.TXT	10PB3545.TXT	
KA3539G	971107	10:41-14:28	0.70-8.04	10	KA3551G	10PD3551.TXT	10PB3551.TXT	
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3545G	09PD3545.TXT	09PB3545.TXT	09FD3545.TXT
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3539G	09PD3539.TXT	09PB3539.TXT	
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3551G	09PD3551.TXT	09PB3551.TXT	
KA3545G	971107	08:59-10:30	0.70-8.04	9	KA3557G	09PD3557.TXT	09PB3557.TXT	
KA3551G	971106	18:24-19.55	0.70-8.04	8	KA3551G	08PD3551.TXT	08PB3551.TXT	08FD3551.TXT
KA3557G	971106	16:07-17:40	0.70-8.04	7	KA3557G	07PD3557.TXT	07PB3557.TXT	07FD35571.TXT
KA3563G	971106	14:24-15:55	0.70-8.04	6	KA3563G	06PD3563.TXT	06PB3563.TXT	06FD3563.TXT
KA3569G	971106	10:42-13.55	0.70-8.04	5	KA3569G	05PD3569.TXT	05PB3569.TXT	05FD3569.TXT
KA3575G	971106	08.43-10:30	0.70-8.04	4	KA3575G	04PD3575.TXT	04PB3575.TXT	04FD3575.TXT
KA3581G	971106	15:57-17.30	0.70-8.04	3	KA3581G	03PD3581.TXT	03PB3581.TXT	03FD3581.TXT
KA3587G	971106	10:57-15:30	0.70-8.04	2	KA3587G	02PD3587.TXT	02PB3587.TXT	02FD3587.TXT
KA3593G	971105	10:44-13:49	0.70-8.04	1	KA3593G	01PD3593.TXT	01PB3593.TXT	01FD3593.TXT
KA3593G	971105	10:44-13:49	0.70-8.04	1	KA3581G	01PD3581.TXT	01PB3581.TXT	
KA3593G	971105	10:44-13:49	0.70-8.04	1	KA3587G	01PD3587.TXT	01PB3587.TXT	
KA3539G	971108	18:17-19:00	5.74-6.74	11	KA3539G1		11PB39G1.TXT	11FD39G1.TXT
KA3539G	971109	16:09-17:10	6.4-8.04	12	KA3539G2		12PB39G2.TXT	12FD39G2.TXT
KA3545G	971109	18:35-19:18	5.74-6.74	13	KA3545G1		13PB45G1.TXT	13FD45G1.TXT
KA3545G	971110	13:33-14:23	6.74-8.04	14	KA3545G2		14PB45G2.TXT	14FD45G2.TXT
KA3593G	971118	09:46-10:31	4.74-5.74	15	KA3593G1		15PB93G1.TXT	15FD93G1.TXT