P-04-60

# Oskarshamn site investigation

# Drill hole: KSH02

## Extensometer measurement of the coefficient of thermal expansion of rock

Urban Åkesson
Swedish National Testing and Research Institute

March 2004

**Svensk Kärnbränslehantering AB**
Swedish Nuclear Fuel
and Waste Management Co
Box 5864
SE-102 40 Stockholm Sweden
Tel 08-459 84 00
+46 8 459 84 00
Fax 08-661 57 19
+46 8 661 57 19

ISSN 1651-4416
SKB P-04-60

# Oskarshamn site investigation

# Drill hole: KSH02

## Extensometer measurement of the coefficient of thermal expansion of rock

Urban Åkesson
Swedish National Testing and Research Institute

March 2004

*Keywords:* Rock mechanics, Coefficient of thermal expansion, Temperature change, Density, Porosity.

# Abstract

The coefficient of thermal expansion and the wet density has been determined on six specimens from drill hole KSH02. The specimens were sampled on one level in the drill hole at a depth of approximately 300 m. The investigated rock type is mapped as a fine-grained dioritoid. The coefficient of thermal expansion has been determined between the temperature interval 20–80°C. The results indicated that the thermal expansion was almost linear and the coefficient of thermal expansion range between 6.5 and 9.9 x $10^{-6}$ mm/mm°C.

# Contents

# 1 Introduction

This document reports the data collected by Simpevarp, which is one of the activities performed as part of the site investigation at Oskarshamn. The work was carried out in accordance with activity plan AP PS 400-03-090 (SKB internal controlling document).

The principle of the measurements is to determine the coefficient of thermal expansion at different temperatures.

The cores are sampled from borehole KSH02 in the Simpevarp area (Figure 1-1). It was sampled 19 September 2003 by Thomas Janson, Tyréns AB and Urban Åkesson, The Swedish National Testing and Research Institute (SP). Specimens were taken from one level in the rock core at a depth of approximately 300 m. The rock cores were transported by SP from Simpevarp and arrived to SP 20 September 2003. The testing was performed during January and March 2004.


***Figure 1-1****. Map of Oskarshamn site.*

# 2 Objective and scope

The purpose is to determine the linear coefficient of thermal expansion for rock cores in water-saturated condition between +20–80°C.

These parameters will be included in rock mechanical model for the Simpevarp area, performed by SKB. The specimens and the results will be presented in tables, diagrams and spreadsheets.

# 3 Equipment

Following equipment has been used for the analyses:

- Extensometer (DEMEC inv no 102266) for measurements of the thermal expansion. Calibration of the instrument was done before the measurements on every new temperature (see Appendix 2). The uncertainty of the extensometer is $\pm$ 3.97 x $10^{-6}$ mm/mm (strain) which for these samples equals an uncertainty of a single measurement of the coefficient of thermal expansion of $\pm$ 0.2 x $10^{-6}$ mm/mm°C for a temperature difference of 20°C.
- Reference bar in invar steel for calibrate the extensometer.
- Heating chamber (inv no 102284) with an accuracy of $\pm$ 0.7°C at 80°C for heating up the specimens.
- A covered plastic box filled with water for keeping the specimens water saturated.

# 4 Execution

Determination of the coefficient of thermal expansion was made in accordance with SKB's method description SKB MD 191.002-version 1.9 (SKB internal controlling document). The department of Building Technology and Mechanics (BM) at SP performed the test.

## 4.1 Description of the samples

From the Simpevarp area was specimens sampled on one level in drill hole KSH02. The drill hole starts at a depth of 100 m, and the sampled level was at approximately depth of 300 m. Six specimens, with a length of 250 mm and a diameter of 50 mm were sampled. The sampled rock type is a fine-grained dioritoid. Detailed geological description of the rock type is given in SKB's BOREMAP of KSH02. Table 4-1 show the rock type and identification marks of the specimens.

**Table 4-1. Rock type and identification marks (Rock-type classification according to Boremap).**

| Rock type | Identification | Sampling depth, according to the marks on the drill-core boxes (Sec up) |
|---|---|---|
| Fine-grained dioritoid | KSH02-90L-1 | 312.17 |
| Fine-grained dioritoid | KSH02-90L-2 | 314.33 |
| Fine-grained dioritoid | KSH02-90L-3 | 323.45 |
| Fine-grained dioritoid | KSH02-90L-4 | 324.78 |
| Fine-grained dioritoid | KSH02-90L-5 | 326.32 |
| Fine-grained dioritoid | KSH02-90L-6 | 326.85 |

## 4.2 Testing

The execution procedure followed the prescription in SKB MD 191.002-version 1.9 and SKB MD 160.002-version 1.9. (SKB internal controlling document) and the following steps were performed:

| Item | Activity |
|---|---|
| 1 | The specimens were cut according to the marks on the rock cores. |
| 2 | Two measuring points with a distance of 200 mm were glued on the specimens. |
| 3 | The specimens were water saturated for seven days. |
| 4 | The wet density was determined (see Appendix 3). |
| 5 | The coefficient of thermal expansion was determined. The thermal expansion was measured at 20, 40, 60 and 80°C. On each temperature level was three to five measurements done with 24 h intervals in order to know that the expansion was completed for each temperature level (see Appendix 2). The coefficient of thermal expansion was determined between 20–80°C. |
| 6 | The specimens were photographed in JPEG-format. |

# 5 Results

The main results of the site investigation of KSH02 could be found in the database SICADA FN161.

## 5.1 Description of the specimens and presentation of the results

The temperature of water for water saturation was 21.2°C and the density of the water was 998 kg/m$^3$. The coefficient of thermal expansion was determined between +20–80°C.

**KSH02-90L-1 (312.17)**

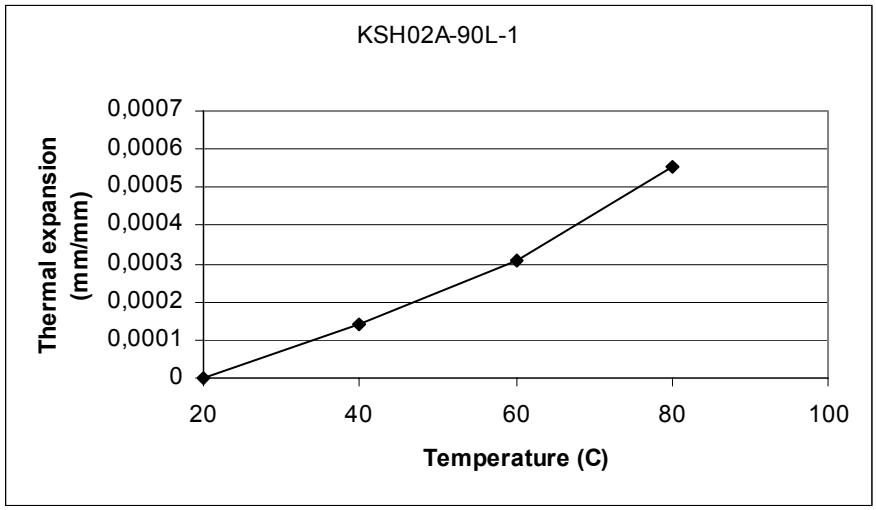
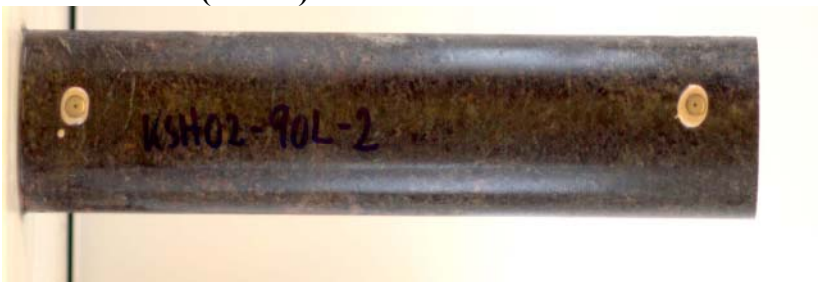




***Figure 5-1.*** *Specimen KSH02-90L-1.*

The coefficient of thermal expansion for specimen KSH02-90L-1 was measured to be 9.3 x 10$^{-6}$ mm/mm°C and the specimen had a wet density to 2770 kg/m$^3$.

**KSH02-90L-2 (314.33)**



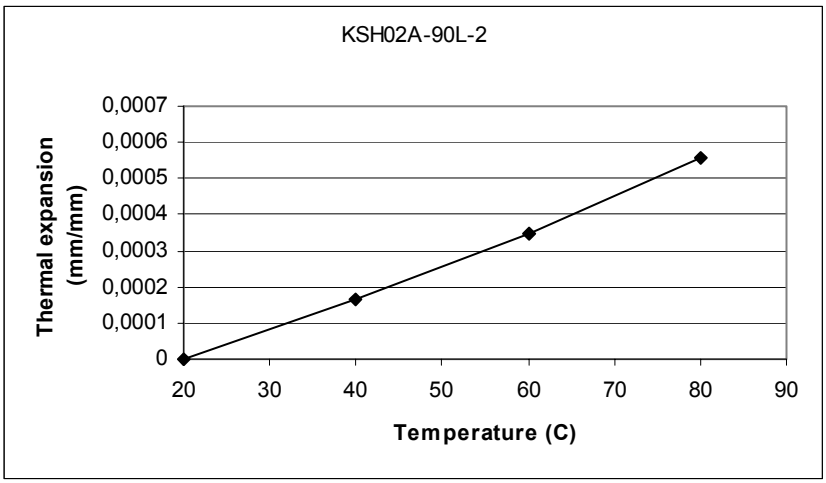
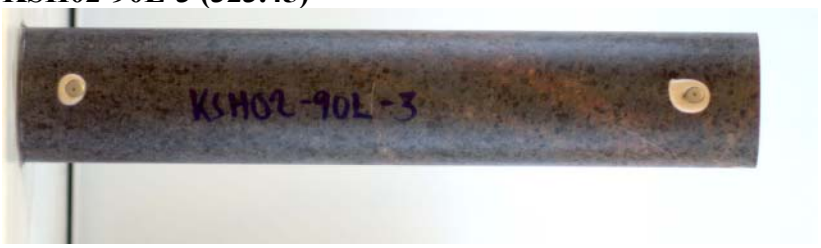




***Figure 5-2.*** *Specimen KSH02-90L-2.*

The coefficient of thermal expansion for specimen KSH02A-90L-2 was measured to be 9.3 x $10^{-6}$ mm/mm°C and the specimen had a wet density of 2760 kg/$m^3$.

**KSH02-90L-3 (323.45)**



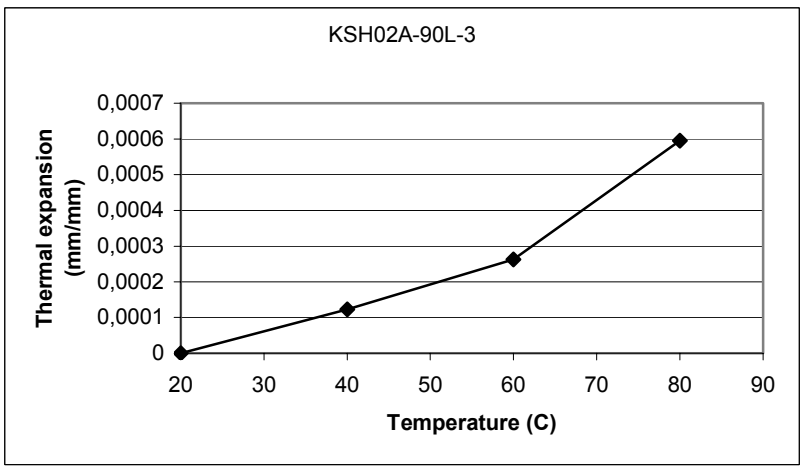




***Figure 5-3.*** *Specimen KSH02-90L-3.*

The coefficient of thermal expansion for specimen KSH02A-90L-3 was measured to be 9.9 x $10^{-6}$ mm/mm°C and the specimen had a wet density of 2780 kg/$m^3$.

**KSH02-90L-4 (324.78)**

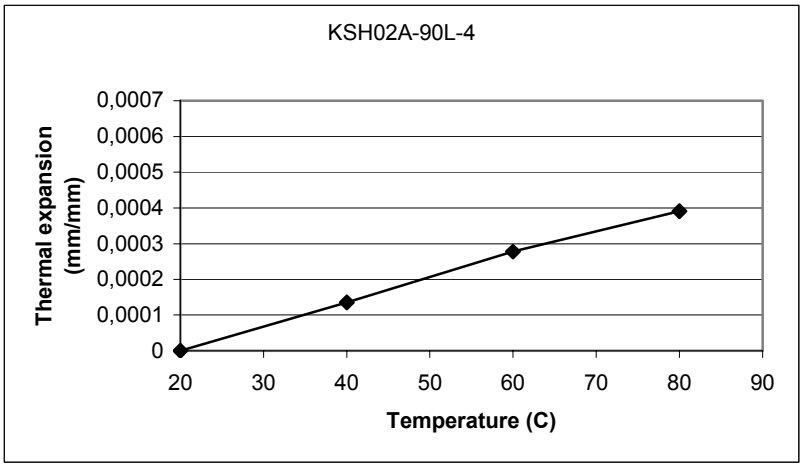
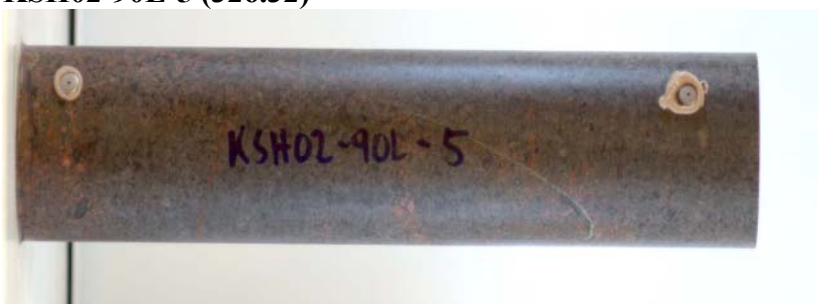




***Figure 5-4.*** *Specimen KSH02-90L-4.*

The coefficient of thermal expansion for specimen KSH02A-90L-4 was measured to be 6.5 x $10^{-6}$ mm/mm°C and the specimen had a wet density of 2770 kg/$m^3$.

**KSH02-90L-5 (326.32)**



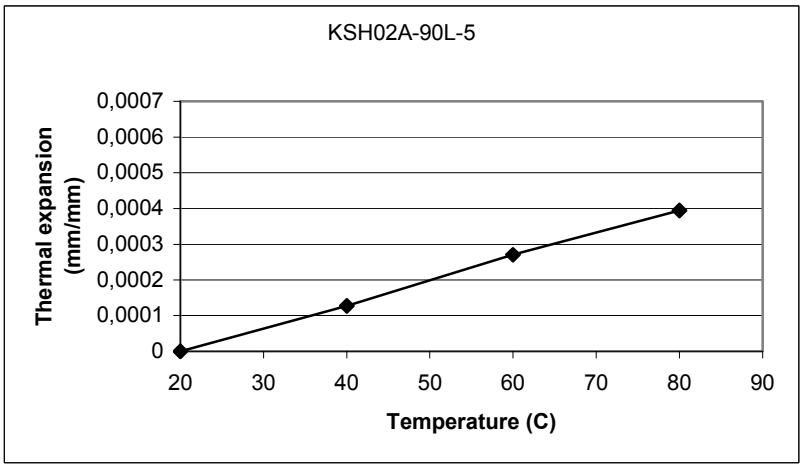
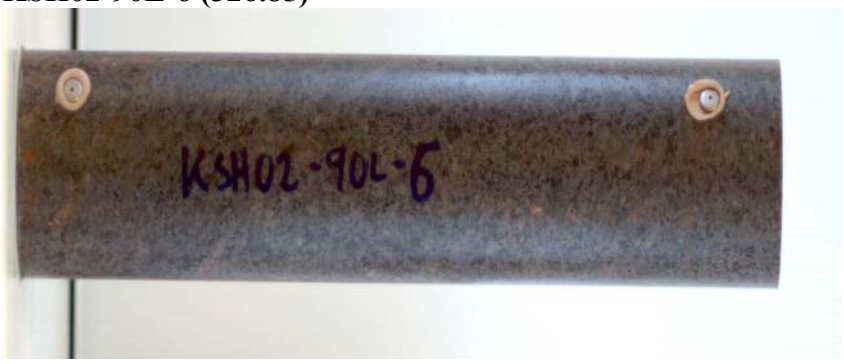




***Figure 5-5.*** *Specimen KSH02-90L-5.*

The coefficient of thermal expansion for specimen KSH02A-90L-5 was measured to be 6.6 x $10^{-6}$ mm/mm°C and the specimen had a wet density of 2750 kg/$m^3$.

**KSH02-90L-6 (326.85)**



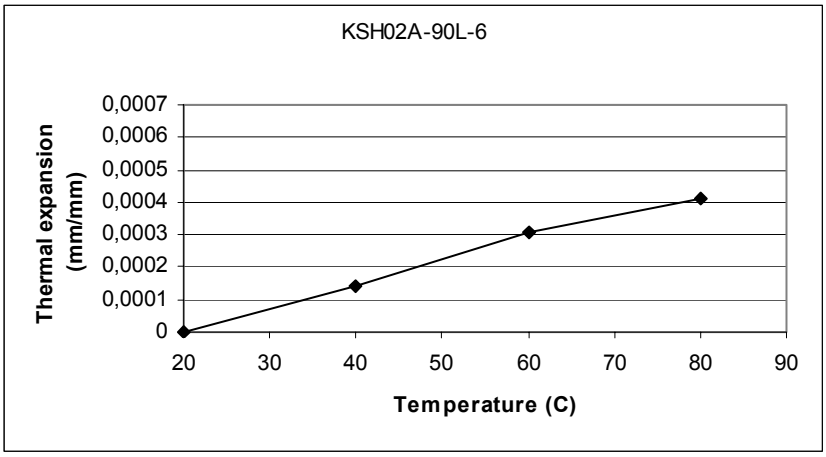




***Figure 5-6.*** *Specimen KSH02-90L-6.*

The coefficient of thermal expansion for specimen KSH01A-90L-6 was measured to be 6.8 x $10^{-6}$ mm/mm°C and the specimen had a wet density of 2750 kg/$m^3$.

## 5.2 Results for the entire test series

**Table 5-1. Summary of the results for the coefficient of thermal expansion and wet density of the tested specimens.**

| Specimen | Coefficient of thermal expansion between 20 and 80°C (mm/mm°C) | Wet density (Kg/$m^3$) |
|---|---|---|
| KSH01A-90L-1 | 9.3 x $10^{-6}$ | 2770 |
| KSH01A-90L-2 | 9.3 x $10^{-6}$ | 2760 |
| KSH01A-90L-3 | 9.9 x $10^{-6}$ | 2780 |
| KSH01A-90L-4 | 6.5 x $10^{-6}$ | 2770 |
| KSH01A-90L-5 | 6.6 x $10^{-6}$ | 2750 |
| KSH01A-90L-6 | 6.8 x $10^{-6}$ | 2750 |
| Median | 8.1 x $10^{-6}$ | |
| Maximun value | 9.9 x $10^{-6}$ | |
| Minimun value | 6.5 x $10^{-6}$ | |

## 5.3 Discussion

The variation between the samples is approximately 3 mm/mm°C which is more than 10 times the uncertainty of the measurement (0,2 x $10^{-6}$ mm/mm°C).

# References

**NT BUILD 479.** Natural Building stones: Coefficient of thermal expansion.

## Checklist – measurements

**Kvalitetsdokument** **Blankett** **BMm-QR 51**
Version 1,0
Utfärdat 2003-12-19
Författare Lotta Carlsson
Godkännare Matz Sandström
Sida 1(1)

**Bygg och Mekanik**
**Checklista längdutvidgning**

Fyll i datum och signatur i rutorna. ***Appendix 1 KSH02A thermal expansion***
***Sida 1 av 1***

Instrument (inventarienr): 102266

| Prov id | Provberedning | Limning mätdubbar | Vattenmättning | Vattenmättnads densitet | Provning |
|---|---|---|---|---|---|
| KSHO2A-1 | 04-01-08 Lej | 04-01-27 Lej | 04-02-05 Lej | | 04-02-20 04-03-03 |
| -2 | 04-01-08 Lej | 04-01-27 | 04-02-05 | | 04-02-20 04-03-03 |
| -3 | 04-01-08 Lej | 04-01-27 | 04-02-05 | | 04-02-20 04-03-03 |
| -4 | 04-01-08 Lej | 04-01-27 | 04-02-05 | | 04-02-20 04-03-03 |
| -5 | 04-01-08 Lej | 04-01-27 | 04-02-05 | | 04-02-20 04-03-03 |
| -6 | 04-01-08 Lej | 04-01-27 | 04-02-05 | | 04-02-20 04-03-03 Lej |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

# Determination of the linear coefficient of thermal expansion

## Längdutvidgningskoefficient

Provningsmetod: NT BUILD 479

Vattenmättad temperaturintervall 20-80 C

Borrhål/nivå:

1 skaldel motsvarar 3,97 mikrostrain = 3,97x10-6 strain

Delta l = längdförändringen i mm = strain x l

| **Prov id** | **Skalvärde start** | **Skalvärde vid mätning** | **Differens skaldelar** | **strain** | **Delta l** | **l** | **Längdutvidgningskoeff** | **Längdutv** |
|---|---|---|---|---|---|---|---|---|
| | 20 C | 2004-01-20 40C | | (mm/mm) | | | mm/mm per grader C | mm/mm |
| KSH02A-90L-1 | 10 | 42 | 32 | 0,00012704 | 0,025408 | 200,0 | 0,00000635 | 0,000127 |
| KSH02A-90L-2 | -7 | 28 | 35 | 0,00013895 | 0,02779 | 200,0 | 0,00000695 | 0,000139 |
| KSH02A-90L-3 | 1 | 31 | 30 | 0,0001191 | 0,02382 | 200,0 | 0,00000596 | 0,000119 |
| KSH02A-90L-4 | 12 | 41 | 29 | 0,00011513 | 0,023026 | 200,0 | 0,00000576 | 0,000115 |
| KSH02A-90L-5 | 15 | 46 | 31 | 0,00012307 | 0,024614 | 200,0 | 0,00000615 | 0,000123 |
| KSH02A-90L-6 | 6 | 33 | 27 | 0,00010719 | 0,021438 | 200,0 | 0,00000536 | 0,000107 |
| | | 2004-01-23 40C | | | | | | |
| KSH02A-90L-1 | 10 | 45 | 35 | 0,00013895 | 0,02779 | 200,0 | 0,00000695 | 0,000139 |
| KSH02A-90L-2 | -7 | 36 | 43 | 0,00017071 | 0,034142 | 200,0 | 0,00000854 | 0,000171 |
| KSH02A-90L-3 | 1 | 32 | 31 | 0,00012307 | 0,024614 | 200,0 | 0,00000615 | 0,000123 |
| KSH02A-90L-4 | 12 | 46 | 34 | 0,00013498 | 0,026996 | 200,0 | 0,00000675 | 0,000135 |
| KSH02A-90L-5 | 15 | 48 | 33 | 0,00013101 | 0,026202 | 200,0 | 0,00000655 | 0,000131 |
| KSH02A-90L-6 | 6 | 41 | 35 | 0,00013895 | 0,02779 | 200,0 | 0,00000695 | 0,000139 |
| | | 2004-01-24 40C | | | | | | |
| KSH02A-90L-1 | 10 | 46 | 36 | 0,00014292 | 0,028584 | 200,0 | 0,00000715 | 0,000143 |
| KSH02A-90L-2 | -7 | 35 | 42 | 0,00016674 | 0,033348 | 200,0 | 0,00000834 | 0,000167 |
| KSH02A-90L-3 | 1 | 33 | 32 | 0,00012704 | 0,025408 | 200,0 | 0,00000635 | 0,000127 |
| KSH02A-90L-4 | 12 | 46 | 34 | 0,00013498 | 0,026996 | 200,0 | 0,00000675 | 0,000135 |
| KSH02A-90L-5 | 15 | 47 | 32 | 0,00012704 | 0,025408 | 200,0 | 0,00000635 | 0,000127 |
| KSH02A-90L-6 | 6 | 42 | 36 | 0,00014292 | 0,028584 | 200,0 | 0,00000715 | 0,000143 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# Längdutvidgningskoefficient

Provningsmetod: NT BUILD 479

Vattenmättad temperaturintervall 20-80 C
Borrhål/nivå:

1 skaldel motsvarar 3,97 mikrostrain = 3,97x10-6 strain
Delta l = längdförändringen i mm = strain x l

| **Prov id** | **Skalvärde start** 20 C | **Skalvärde vid mätning** 2004-01-25 60C | **Differens skaldelar** | **strain** (mm/mm) | **Delta l** | **l** | **Längdutvidgningskoeff** mm/mm per grader C | **Längdutv** mm/mm |
|---|---|---|---|---|---|---|---|---|
| KSH02A-90L-1 | 10 | 81 | 71 | 0,00028187 | 0,056374 | 200,0 | 0,00000705 | 0,000282 |
| KSH02A-90L-2 | -7 | 74 | 81 | 0,00032157 | 0,064314 | 200,0 | 0,00000804 | 0,000322 |
| KSH02A-90L-3 | 1 | 66 | 65 | 0,00025805 | 0,05161 | 200,0 | 0,00000645 | 0,000258 |
| KSH02A-90L-4 | 12 | 80 | 68 | 0,00026996 | 0,053992 | 200,0 | 0,00000675 | 0,000270 |
| KSH02A-90L-5 | 15 | 80 | 65 | 0,00025805 | 0,05161 | 200,0 | 0,00000645 | 0,000258 |
| KSH02A-90L-6 | 6 | 81 | 75 | 0,00029775 | 0,05955 | 200,0 | 0,00000744 | 0,000298 |
| | | 2004-01-26 60C | | | | | | |
| KSH02A-90L-1 | 10 | 88 | 78 | 0,00030966 | 0,061932 | 200,0 | 0,00000774 | 0,000310 |
| KSH02A-90L-2 | -7 | 80 | 87 | 0,00034539 | 0,069078 | 200,0 | 0,00000863 | 0,000345 |
| KSH02A-90L-3 | 1 | 68 | 67 | 0,00026599 | 0,053198 | 200,0 | 0,00000665 | 0,000266 |
| KSH02A-90L-4 | 12 | 82 | 70 | 0,0002779 | 0,05558 | 200,0 | 0,00000695 | 0,000278 |
| KSH02A-90L-5 | 15 | 83 | 68 | 0,00026996 | 0,053992 | 200,0 | 0,00000675 | 0,000270 |
| KSH02A-90L-6 | 6 | 83 | 77 | 0,00030569 | 0,061138 | 200,0 | 0,00000764 | 0,000306 |
| | | 2004-01-27 60C | | | | | | |
| KSH02A-90L-1 | 10 | 87 | 77 | 0,00030569 | 0,061138 | 200,0 | 0,00000764 | 0,000306 |
| KSH02A-90L-2 | -7 | 80 | 87 | 0,00034539 | 0,069078 | 200,0 | 0,00000863 | 0,000345 |
| KSH02A-90L-3 | 1 | 67 | 66 | 0,00026202 | 0,052404 | 200,0 | 0,00000655 | 0,000262 |
| KSH02A-90L-4 | 12 | 82 | 70 | 0,0002779 | 0,05558 | 200,0 | 0,00000695 | 0,000278 |
| KSH02A-90L-5 | 15 | 83 | 68 | 0,00026996 | 0,053992 | 200,0 | 0,00000675 | 0,000270 |
| KSH02A-90L-6 | 6 | 83 | 77 | 0,00030569 | 0,061138 | 200,0 | 0,00000764 | 0,000306 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# Längdutvidgningskoefficient

Provningsmetod: NT BUILD 479

Vattenmättad temperaturintervall 20-80 C
Borrhål/nivå:

1 skaldel motsvarar 3,97 mikrostrain = 3,97x10-6 strain
Delta l = längdförändringen i mm = strain x l

| Prov id | Skalvärde start | Skalvärde vid mätning | Differens skaldelar | strain | Delta l | l | Längdutvidgningskoeff | Längdutv |
|---|---|---|---|---|---|---|---|---|
| | 20 C | 2004- 80C | | (mm/mm) | | | mm/mm per grader C | mm/mm |
| KSH02A-90L-1 | 10 | 155 | 145 | 0,00057565 | 0,11513 | 200,0 | 0,00000959 | 0,000576 |
| KSH02A-90L-2 | -7 | 130 | 137 | 0,00054389 | 0,108778 | 200,0 | 0,00000906 | 0,000544 |
| KSH02A-90L-3 | 1 | 140 | 139 | 0,00055183 | 0,110366 | 200,0 | 0,00000920 | 0,000552 |
| KSH02A-90L-4 | 12 | 108 | 96 | 0,00038112 | 0,076224 | 200,0 | 0,00000635 | 0,000381 |
| KSH02A-90L-5 | 15 | 112 | 97 | 0,00038509 | 0,077018 | 200,0 | 0,00000642 | 0,000385 |
| KSH02A-90L-6 | 6 | 109 | 103 | 0,00040891 | 0,081782 | 200,0 | 0,00000682 | 0,000409 |
| | | 2004- 80C | | | | | | |
| KSH02A-90L-1 | 10 | 147 | 137 | 0,00054389 | 0,108778 | 200,0 | 0,00000906 | 0,000544 |
| KSH02A-90L-2 | -7 | 134 | 141 | 0,00055977 | 0,111954 | 200,0 | 0,00000933 | 0,000560 |
| KSH02A-90L-3 | 1 | 147 | 146 | 0,00057962 | 0,115924 | 200,0 | 0,00000966 | 0,000580 |
| KSH02A-90L-4 | 12 | 111 | 99 | 0,00039303 | 0,078606 | 200,0 | 0,00000655 | 0,000393 |
| KSH02A-90L-5 | 15 | 114 | 99 | 0,00039303 | 0,078606 | 200,0 | 0,00000655 | 0,000393 |
| KSH02A-90L-6 | 6 | 110 | 104 | 0,00041288 | 0,082576 | 200,0 | 0,00000688 | 0,000413 |
| | | 2004- 80C | | | | | | |
| KSH02A-90L-1 | 10 | 150 | 140 | 0,0005558 | 0,11116 | 200,0 | 0,00000926 | 0,000556 |
| KSH02A-90L-2 | -7 | 133 | 140 | 0,0005558 | 0,11116 | 200,0 | 0,00000926 | 0,000556 |
| KSH02A-90L-3 | 1 | 155 | 154 | 0,00061138 | 0,122276 | 200,0 | 0,00001019 | 0,000611 |
| KSH02A-90L-4 | 12 | 111 | 99 | 0,00039303 | 0,078606 | 200,0 | 0,00000655 | 0,000393 |
| KSH02A-90L-5 | 15 | 116 | 101 | 0,00040097 | 0,080194 | 200,0 | 0,00000668 | 0,000401 |
| KSH02A-90L-6 | 6 | 110 | 104 | 0,00041288 | 0,082576 | 200,0 | 0,00000688 | 0,000413 |
| | | 2004- 80C | | | | | | |
| KSH02A-90L-1 | 10 | 150 | 140 | 0,0005558 | 0,11116 | 200,0 | 0,00000926 | 0,000556 |
| KSH02A-90L-2 | -7 | 133 | 140 | 0,0005558 | 0,11116 | 200,0 | 0,00000926 | 0,000556 |
| KSH02A-90L-3 | 1 | 156 | 155 | 0,00061535 | 0,12307 | 200,0 | 0,00001026 | 0,000615 |
| KSH02A-90L-4 | 12 | 110 | 98 | 0,00038906 | 0,077812 | 200,0 | 0,00000648 | 0,000389 |
| KSH02A-90L-5 | 15 | 115 | 100 | 0,000397 | 0,0794 | 200,0 | 0,00000662 | 0,000397 |
| KSH02A-90L-6 | 6 | 109 | 103 | 0,00040891 | 0,081782 | 200,0 | 0,00000682 | 0,000409 |

| **Prov id** | längdutv mm/mm | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40 | 40 | 40 | **median 40** | 60 | 60 | 60 | **median 60** | 80 | 80 | 80 | 80 | **median 80** |
| KSH02A-90L-1 | 0,000127 | 0,000139 | 0,000143 | **0,000139** | 0,000282 | 0,00031 | 0,000306 | **0,000306** | 0,000576 | 0,000544 | 0,000556 | 0,000556 | **0,000556** |
| KSH02A-90L-2 | 0,000139 | 0,000171 | 0,000167 | **0,000167** | 0,000322 | 0,000345 | 0,000345 | **0,000345** | 0,000544 | 0,00056 | 0,000556 | 0,000556 | **0,000556** |
| KSH02A-90L-3 | 0,000119 | 0,000123 | 0,000127 | **0,000123** | 0,000258 | 0,000266 | 0,000262 | **0,000262** | 0,000552 | 0,00058 | 0,000611 | 0,000615 | **0,000596** |
| KSH02A-90L-4 | 0,000115 | 0,000135 | 0,000135 | **0,000135** | 0,00027 | 0,000278 | 0,000278 | **0,000278** | 0,000381 | 0,000393 | 0,000393 | 0,000389 | **0,000391** |
| KSH02A-90L-5 | 0,000123 | 0,000131 | 0,000127 | **0,000127** | 0,000258 | 0,00027 | 0,00027 | **0,00027** | 0,000385 | 0,000393 | 0,000401 | 0,000397 | **0,000395** |
| KSH02A-90L-6 | 0,000107 | 0,000139 | 0,000143 | **0,000139** | 0,000298 | 0,000306 | 0,000306 | **0,000306** | 0,000409 | 0,000413 | 0,000413 | 0,000409 | **0,000411** |

| | 20 | 40 | 60 | 80 |
|---|---|---|---|---|
| KSH02A-90L-1 | 0 | 0,000139 | 0,000306 | 0,000556 |
| KSH02A-90L-2 | 0 | 0,000167 | 0,000345 | 0,000556 |
| KSH02A-90L-3 | 0 | 0,000123 | 0,000262 | 0,000596 |
| KSH02A-90L-4 | 0 | 0,000135 | 0,000278 | 0,000391 |
| KSH02A-90L-5 | 0 | 0,000127 | 0,00027 | 0,000395 |
| KSH02A-90L-6 | 0 | 0,000139 | 0,000306 | 0,000411 |

# Appendix 3

## Determination of wet density

**Vattenmättnadsdensitet**

Uppdrags nr: P302790
Metod: EN 13755, ISRM (1973), avsnitt 3 samt SKB MD 160.002 version 1.0
Provad av: Lej
Datum: 2004-03-08

| | Provmärkning: | Vikt i vatten, Msub (g) | Yttor vikt, Msat (g) | Torr vikt, Ms (g) | Bulk volume, V (cm3) | Pore volume, Vv (cm3) | Porosity, n (%) | Dry density, ρd (g/cm3) | Wet density (g/cm3) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | KSHO2A 90l-1 | 844,28 | 1320,09 | | 476,76 | 1322,74 | 277,44 | 0,000 | 2,769 |
| 2 | -2 | 828,66 | 1298,96 | | 471,24 | 1301,56 | 276,20 | 0,000 | 2,756 |
| 3 | -3 | 843,81 | 1315,45 | | 472,59 | 1318,09 | 278,91 | 0,000 | 2,784 |
| 4 | -4 | 839,38 | 1311,35 | | 472,92 | 1313,98 | 277,85 | 0,000 | 2,773 |
| 5 | -5 | 826,68 | 1297,63 | | 471,89 | 1300,23 | 275,53 | 0,000 | 2,750 |
| 6 | -6 | 813,03 | 1275,51 | | 463,41 | 1278,07 | 275,80 | 0,000 | 2,752 |
| 7 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 8 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 9 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 10 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 11 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 12 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 13 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 14 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 15 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 16 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 17 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 18 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 19 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 20 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| 21 | | | | | 0,00 | 0,00 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| | Medel | 832,640 | 1303,165 | #DIVISION/0! | 134,705 | 373,079 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |
| | std avvikelse | 12,179 | 16,233 | #DIVISION/0! | 218,258 | 604,512 | #DIVISION/0! | #DIVISION/0! | #DIVISION/0! |

| | |
|---|---|
| Vattnets temperatur (‘ | 21,2 |
| Vattnets desitet (ºC): | 0,998 |

| | |
|---|---|
| Våg, inv.nr: | 102291 |
| Termometer, inv.nr: | 102080 |