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Database of test and validation sequences for collectors and stores

Note: This is a first example / proposal how the database can be structured

1. Introduction

In the European Standards EN 12975, EN 12976 and ENV 12977 numerical computer models and mathematical procedures for the determination of certain parameters based on measured data are included. The aim is to set up a data base for measured data (test and verification sequences) in order to validate the numerical models and evaluation procedures described in the standards.

This database is containing measured data for solar collectors and heat stores.

The following information should be included in the data base

- Description of collector
- Description of the location and orientation of the test site (only required for collectors)
- Information about the test sequences required for the determination of the parameters and the verification sequences
- Information about the format of the data files included
- Address of the person responsible for the data

Solar Collectors

1.C Collector COL1

1.C.1 Description of the collector

The absorber consists out of 10 absorberstrips (Teknoterm, selective coated). The absorberstrips are divided into two serial bunches with 5 parallel stripes each. The collector case is build up out of aluminium profile and a 0.5 mm aluminium back. The insulation at the back is 30 mm PU foam and 20 mm mineral wool. Side insulation is 30mm mineral wool. The collector has the gross area of 5.85 m² (length 4063 mm, width 1440 mm) and was mounted horizontal. The transparent cover consists out of 4 structured glass sheets (structure pointing towards the absorber). The aperture area of 5.09 m² is thus divided by 3 vertical aluminium bars to hold the glass covers. The test was performed with water as heat carrier and the mass flow rate during the test was adjusted to 50 kg/(m²h).

1.C.2 Description of the location and orientation of the test site

Location: Stuttgart, Germany
 Local Latitude: 48.78°
 Local Longitude: 9.2°
 Standard Longitude: 15.0°

Collector tilt: 48°
 Collector azimuth: 5.71° west

1.C.3 Test and verification sequences

The test and verification sequences were performed on the basis of prEN 12975:2000
 6.3.4.6.2 Description of test days.

The verification sequences are selected among the sequences not used for parameter identification. It should be used at least 2 sequences showing enough variability within the surrounding conditions. The mean temperature of the two sequences shall differ by at least 30 K.

sequence	name of data file
Day type 1 according to 6.3.4.6.2	750205tf.30
Day type 2 according to 6.3.4.6.2	750105tf.30
1 st Day type 3 according to 6.3.4.6.2	751704tf.30
2 nd Day type 3 according to 6.3.4.6.2	7524041t.30

Day type 4 according to 6.3.4.6.2	7524042t.30
Verification day type 2	7517041t.30
Verification day type 4	752304tf.30

Table 1.C3.1: Test and verification sequences for collector COL1

1.C.4 Data files

To ensure the maximum flexibility in the evaluation of the data the selection does not strictly follow the requirements of the prEN 12975-2. The only criterion for the data selection has been a positive collector output. The time step of the data points is equidistant (30 seconds). The format of the data files is listed in Table 2. Has a quantity not been measured during the test the channel is denoted by “9999”.

column	quantity	unit
1	time	[s]
2	hemispherical solar irradiation	[W/m ²]
3	direct solar irradiation	[W/m ²]
4	diffuse solar irradiation	[W/m ²]
5	long wave irradiance	[W/m ²]
6	surrounding air temperature	[°C]
7	collector inlet temperature	[°C]
8	collector outlet temperature	[°C]
9	mean collector temperature	[°C]
10	collector mass flow rate	[kg/(m ² h)]
11	useful power extracted from collector	[W/m ²]
12	incidence angle of the direct solar irradiance	[°]
13	angle between the normal of the collector surface and the projection of the line of sight to the sun into the longitudinal (east –west) plane	[°]

14	angle between the normal of the collector surface and the projection of the line of sight to the sun into the transvers (north –south) plane	[°]
15	surrounding wind speed	[m/s]
16	time derivative of the mean fluid temperature	[K/s]

Table 1.C.4.1: Format of the data files for collector COL1

1.C.5 Contact person

The measured data of the test and verification sequences are provided by:

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Stores

1.S Store ST01

1.S.1 Description of the store

The store is discharged in a direct way and charged via a solar loop or an auxiliary loop heat exchanger. Hence, according to the classification of stores given in Table 1 of ENV 12977,3 the store belongs to group 2.

The nominal volume is 280 litres. The store vessel as well as the heat exchangers are made of steel that is enamelled for corrosion protection. Both the solar loop heat exchanger and the auxiliary loop heat exchanger consist of a smooth tube with a fluid content of 5,7 litres. Design drawings of the store are shown in Figure 1.S.1.1 to Figure 1.S.1.3.

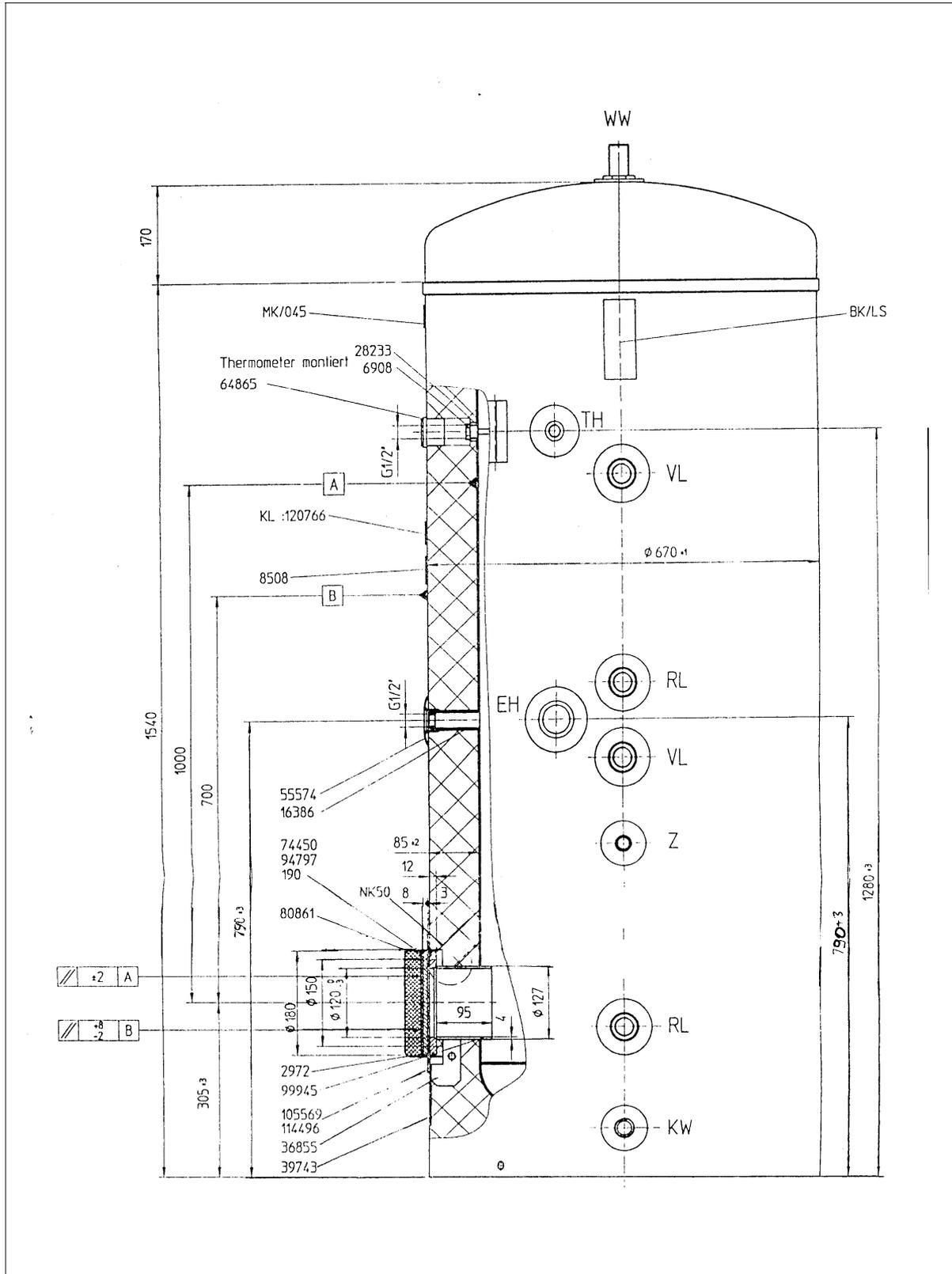


Figure 1.S.1.2: Side view of store STO1

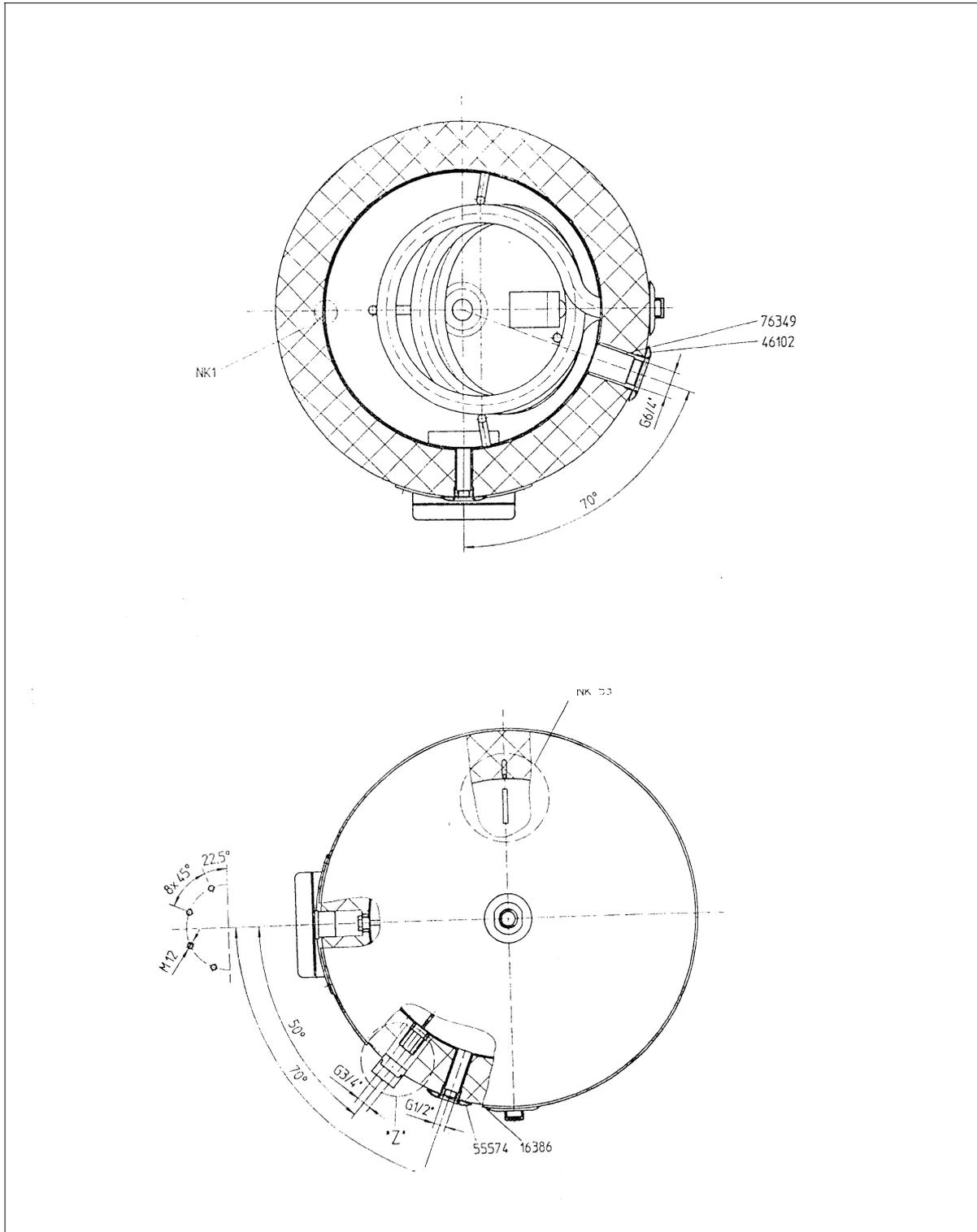


Figure 1.S.1.3: Bird's view of store STO1

1.S.2 Test and verification sequences

The test and verification sequences were performed on the basis of prEN 12977. The numbers for the sequences given in Table C1 refer to the corresponding section of prEN 12977. For the tests water was used inside the store and as heat transfer fluid for both heat exchangers.

The store was connected to the test facility in the following way:

Tap water inlet at the bottom (connection KW) and outlet at top (connection HW).

Solar loop heat exchanger and auxiliary loop heat exchanger:

Inlet at the upper connection (VL) and outlet at the lower connection (RL).

sequence	name of data file
Test C according to 6.3.2.1.1.2	CX_0610.DAT
Test S according to 6.3.2.1.2	SX_0809.DAT
Test L according to 6.3.2.1.3.2	LX_0627.DAT
Test NiA according to 6.3.2.1.4	AXN_0327.DAT
Test NB according to 6.3.2.1.6.2	BXN_0528.DAT
Test V according to 8.2.1.1.3	DX_0612.DAT
Test NiV according to 8.2.1.2	DXN_0530.DAT

Table 1.S2.1: Test and verification sequences of store STO1

1.S.3 Data files

All data files are located in the directory DATA (ASCII-Format). The time step of the data points is equidistant (1.5 minutes). The format of the data files is listed in Table C2.

column	quantity	unit
1	time	[h]
2	ambient temperature	[°C]
3	tap water inlet temperature (cold) of the store	[°C]
4	tap water outlet temperature (hot) of the store	[°C]

5	tap water volume flow rate	[m ³ /s]
6	solar loop heat exchanger inlet temperature	[°C]
7	solar loop heat exchanger outlet temperature	[°C]
8	solar loop heat exchanger volume flow rate	[m ³ /s]
9	not used	-
10	auxiliary loop heat exchanger inlet temperature	[°C]
11	auxiliary loop heat exchanger outlet temperature	[°C]
12	auxiliary loop heat exchanger volume flow rate	[m ³ /s]
13	not used	-

Table 1.S.3.1: Format of the data files for store STO1

1.S.4 Contact person

The measured data of the test and verification sequences are provided by:

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