Technical description

Jakob Harden[†]

[†]Graz University of Technology, Graz, Austria

Contact email: Jakob Harden, jakob.harden@tugraz.at

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Abstract

This document is a technical description of a subset of datasets from test series 1. Test series 1 includes a series of ultrasonic-pulse-transmission tests on cement pastes at early stages. The datasets included in that subset are the basis of the analysis presented in the manuscript submitted on 2023-03-31 to *DGZfP Jahrestagung 2023* by Jakob Harden. It is published under the license CC-BY-4.0 to support the explanations in the manuscript and for the collective benefit.

1 Introduction

This document contains the technical description of the datasets of a series of ultrasonic pulse transmission tests (UPTT) created by the author of this document (see title page) in the course of his PhD thesis. This test series was created to get information about the behaviour of cement pastes at its early stages. The design of the test series is based on the variation of two different parameters. The water-cement-ratio $w/c = [0.40, 0.45, 0.50, 0.55, 0.60]$ and the distance between the actuator and the sensor $d = [25, 50, 70]mm$. This results in a two-dimensional parameter grid. For each grid point $(w/c, d)$, tests were carried out six times to gain information about the stability of the tests. The result is a collection of 90 datasets containing the measurement data of the UPTT's and other subsidiary tests performed in the course of the UPTT's (fresh paste density, solid sample density, environment temperature, specimen temperature). Here it is to mention that not all subsidiary tests were carried out for all tests (e.g. sample temperature and fresh paste density). This subset of test series 1 contains all datasets for the distance $d = 50mm$ and the repetition numbers 4 to 6 (3 turns for each water-cement-ratio = 15 datasets). It is also the basis of the analysis presented in the manuscript submitted on 2023-03-31 to *DGZfP Jahrestagung 2023* by Jakob Harden. The test device used for the UPTT's is the FreshCon device (developed at the University of Stuttgart, Germany). The materials used for the cement paste blends are ordinary Portland cement (CEM I 42.5 N) and tap water. An elaborate description of devices, materials, mixtures and test operation procedures is stored in the data set structure along with the measurement results. This record is published to support the explanations in the manuscript and for the collective benefit. Especially for those, who have no access to the required laboratory facilities and test equipment. To allow others to make use of these datasets freely, an open license was chosen by the author of this document (Creative Commons 4.0 Attribution, CC-BY-4.0).

2 License

The datasets and this document are licensed under a Creative Commons 4.0 Attribution license.

3 Files, datasets

All datasets of this record are stored in the compressed TAR-archive **data_dgzfp23.tar.xz**. Each file represents one data set which includes a collection of laboratory tests. In table 1 one can find a list of all datasets included in this subset of test series 1. To ensure data integrity, the SHA256 checksum is also provided along with the files. Furthermore, the main test parameters are reflected in the file names. The file names are a concatenation of the test series id <tsid>, the water-cement-ratio <wcr>, the distance between the actuator and sensor <dist> in mm and the repetition number <rn>. Filename structure: **<tsid>_wc<wcr>_d<dist>_<rn>.oct**. As example: a test performed on a cement paste with a water-cement ratio of 0.40, the distance between actuator and sensor of $50mm$ and the repetition number of 6 is stored in **ts1_wc040_d50_6.oct**.

Table 1: File listing.

File name	SHA256 checksum
ts1_wc040_d50_4.oct	a4ebffc56778697b2a1dd97a0f5a238c0d8918d91048dc23f8d141d31d334d33
ts1_wc040_d50_5.oct	9f69266505776a926075a9a7e7820c3f997ea25eef8b0ded84c6468d378646dc
ts1_wc040_d50_6.oct	f9f1fdb01f5168cb0ef9b3c0b32bbd603ca1a98544f44ff08f1e2863471a2451
ts1_wc045_d50_4.oct	b65f5ae50352872ed4b93bb044fc96a133dd355d932d34c2466c6205b441317b
ts1_wc045_d50_5.oct	2a09b6feec690f00f03d09bfd05d495c329852ba521ec08ce57fdd294af94c18
ts1_wc045_d50_6.oct	c5f489aa566511f1d45165949fa696e0257ef5bac0b85d94ddb6d727e8b2f756
ts1_wc050_d50_4.oct	f2a7881099390bb07efe685786628adead0fc288d036caf100826739213754a1
ts1_wc050_d50_5.oct	631690138281ba68d0915f7cb7d9c25711a14ca4206dcc8f8d4340b3ea760d54
ts1_wc050_d50_6.oct	e1d4746f239beae21825428b8014d5992f514d1f32ca62c41d77a4185f730714
ts1_wc055_d50_4.oct	d71f46a2040b5618d91eeaa83dc58806b455b7de1a6e4dd15766294bc4bb71c0
ts1_wc055_d50_5.oct	787c600bf696f78c729ed34dc33d284fe27405f415fb35fefd6790b5a080d420
ts1_wc055_d50_6.oct	34012810d5e19ef5a9935b022f17246aed3c0a68b072a282fe7ced6bd14b1ea2
ts1_wc060_d50_4.oct	2aa4cb31d9e1f5a877e714f66f0c5caf9b956ae5acc3ef4ce152c4985776c2ab
ts1_wc060_d50_5.oct	b540005ef92551370d9cb05f3d804db81a23e2c920de369a132a744f756128b5
ts1_wc060_d50_6.oct	e64f2400c23e2cd323a08ad82964addce117d0c38a4e6c436d01324ad09deabc

4 File format

The datasets were compiled by a set of command scripts written by the author of this document using the GNU octave 6.2.0 script language. Those scripts convert the ASCII files returned by the FreshCon device but also manually collected test results into GNU octave's native binary file format (*.oct). All data is stored in a C-like hierarchical data structure in the data set files. Datasets can be loaded into memory by running the following command on the GNU octave command line:

```
>>> ds = load("path/to/dataset/file.oct", "dataset").dataset;
```

To access certain content of the hierarchical data set structure, use the dot-operator:

```
>>> var = ds.aut(1).a03.v;
```

The previous command stores the value v of the given name a03 of author number one aut(1) in var.

5 Data set structure

As mentioned before, the data set structure is a C-like, hierarchical structure. It contains several substructures made of atomic elements containing the data. There are three defined types of atomic elements: the atomic reference element (ARE), the atomic attribute element (AAE) and the atomic data element (ADE). All atomic elements consist of simple structure fields representing the lowest level structure of the data structure.

5.1 Atomic elements

Atomic reference element (ARE): Atomic reference elements are used to link objects to each other. This is to avoid copies of recurring content (e.g. information about a specimen, that was used in several subsidiary tests). They consist of a set of fields described in table 1.

Field	Description	Data type
obj	object type (always "ARE")	string
ver	version number [major, minor]	uint16
t	tag, a descriptive name	string
i	referenced id	uint, [uint]
r	referenced object name	{string}
d	description	string

Figure 1: Fields of atomic reference elements (ARE)

Atomic attribute element (AAE): Atomic attribute elements are used to store text only (e.g. additional description of the parent data structure). They consist of a set of fields described in table 2.

Atomic data element (AAE): Atomic data elements are used to store values in combination with value type and physical unit (e.g. measurement data). They consist of a set of fields described in table 3.

Field	Description	Data type
obj	object type (always "AAE")	string
ver	version number [Major, Minor]	[uint16]
t	tag, a descriptive name	string
v	value, text	string, {string}
d	description	string

Figure 2: Fields of atomic attribute elements (AAE)

Field	Description	Data type
obj	object type (always "ADE")	string
ver	version number [Major, Minor]	[uint16]
t	tag, a descriptive name	string
vt	value type enumerator	string, see table 4
v	value of given value type	according to value type
u	unit	string
d	description	string

Figure 3: Fields of atomic data elements (ADE)

5.2 Structure hierarchy

The hierarchy of the data structure consists of top-level substructures containing various atomic elements or other lower-level substructures (e.g. test collection). A list of main substructures is shown in table 5. A more detailed overview of the structure hierarchy is show in table 2.

Data type	Description
string	character array, character = 8 bit
string_arr	1D cell array (vector) of strings
string_mat	2D cell array (matrix) of string
boolean	unsigned integer, 8 bit
boolean_arr	1D array (vector) of type boolean
boolean_mat	2D array (matrix) of type boolean
uint	unsigned integer
uint_arr	1D array (vector) of type uint
uint_mat	2D array (matrix) of type uint
int	signed integer
int_arr	1D array (vector) of type int
int_mat	2D array (matrix) of type int
single	single precision floating point number, 32 bit
single_arr	1D array (vector) of type single
single_mat	2D array (matrix) of type single
double	double precision floating point value, 64 bit
double_arr	1D array (vector) of type double
double_mat	2D array (matrix) of type double

Figure 4: Available value types for atomic data elements

L	C	Path	Description
0	1	ds	structure root
1	1	ds.meta_ser	test series metadata
1	1	ds.meta_set	data set metadata
1	N	ds.loc	geo location information, GPS coordinates
1	1	ds.lic	license information
1	N	ds.aut	author information
1	N	ds.dev	test device information
1	N	ds.mat	test material information
1	1	ds.rec	mixture/blend recipe definition
1	1	ds.mix	mixture component information
1	N	ds.spm	test specimen information, specimen I and II
1	1	ds.tst	test collection
2	1	ds.tst.s01	fresh paste density
2	1	ds.tst.s02	solid specimen density, specimen I
2	1	ds.tst.s03	solid specimen density, specimen II
2	1	ds.tst.s04	ultrasonic measurement distance, specimen I
2	1	ds.tst.s05	ultrasonic measurement distance, specimen II
2	1	ds.tst.s06	ultrasonic pulse transmission test (compression wave), specimen I
2	1	ds.tst.s07	ultrasonic pulse transmission test (shear wave), specimen II
2	1	ds.tst.s08	specimen temperature, specimen II
2	1	ds.tst.s09	environment temperature

Figure 5: Top-level substructures. L ... hierarchy level. C ... cardinality.

Table 2: Dataset data structure listing.

Path	Type	Tag	Description
ds	struct_dataset	—	**structure root**
ds.meta_ser	struct_metaser	—	**substructure**
ds.meta_ser.r01	ARE	author	author reference
ds.meta_ser.r02	ARE	license	license reference
ds.meta_ser.d01	ADE	series_id	test series id
ds.meta_ser.a01	AAE	series_code	test series code
ds.meta_ser.a02	AAE	series_name	test series name
ds.meta_ser.a03	AAE	description	test series description
ds.meta_ser.a04	AAE	abstract	test series abstract
ds.meta_ser.a05	AAE	context	test series context
ds.meta_ser.a06	AAE	date_start	test series start date
ds.meta_ser.a07	AAE	date_end	test series end date
ds.meta_set	struct_metaset	—	**substructure**
ds.meta_set.r01	ARE	author	author reference
ds.meta_set.r02	ARE	series	test series reference
ds.meta_set.r03	ARE	location	location reference
ds.meta_set.r04	ARE	license	license reference
ds.meta_set.d01	ADE	dataset_id	data set id
ds.meta_set.a01	AAE	dataset_code	data set code
ds.meta_set.a02	AAE	dataset_name	data set name
ds.meta_set.a03	AAE	description	description, general
ds.meta_set.a04	AAE	description_abstract	description, abstract
ds.meta_set.a05	AAE	description_methods	description, methods
ds.meta_set.a06	AAE	description_tableofcontents	description, tableofcontents
ds.meta_set.a07	AAE	created_by	data set creator name
ds.meta_set.a08	AAE	collected_by	data set collector name
ds.meta_set.a09	AAE	copyrighted_by	data set copyrighter name
ds.meta_set.a10	AAE	date_created	date created
ds.meta_set.a11	AAE	date_collected	date collected
ds.meta_set.a12	AAE	date_copyrighted	date copyrighted
ds.meta_set.a13	AAE	size	data set size, number of files
ds.meta_set.a14	AAE	format	data set file format
ds.meta_set.a15	AAE	version	data set version
ds.meta_set.a16	AAE	context	data set context
ds.meta_set.a17	AAE	rawdata_directory	data set rawdata directory
ds.meta_set.a18	AAE	rawdata_archive	data set rawdata archive

Table2 – continued from previous page

Path	Type	Tag	Description
ds.loc	struct_loc	—	**substructure**
ds.loc.d01	ADE	location_id	location id
ds.loc.d02	ADE	geolocation	geo location, latitude, longitude
ds.loc.a01	AAE	country	country
ds.loc.a02	AAE	state_province	state or province
ds.loc.a03	AAE	city	city
ds.loc.a04	AAE	zipcode	zip code, postal code
ds.loc.a05	AAE	street	street name
ds.loc.a06	AAE	housenumber	house number
ds.loc.a07	AAE	description	location description
ds.lic	struct_lic	—	**substructure**
ds.lic.r01	ARE	author	author reference
ds.lic.d01	ADE	license_id	license id
ds.lic.a01	AAE	license_code	license code
ds.lic.a02	AAE	rightsholder	rights holder
ds.lic.a03	AAE	rights	rights description, e.g. Creative Commons Attribution 4.0 International
ds.lic.a04	AAE	rights_uri	rights URI, e.g. https://spdx.org/licenses/CC-BY-4.0.html
ds.lic.a05	AAE	rights_identifier_scheme	rights identifier scheme, e.g. SPDX
ds.lic.a06	AAE	rights_identifier_scheme_uri	rights identifier scheme URI, e.g. https://spdx.org/licenses/
ds.lic.a07	AAE	license_description	license description
ds.lic.a08	AAE	spdx_icon	license icon (spdx)
ds.lic.a09	AAE	spdx_id	license id (spdx)
ds.aut	struct_aut	—	**substructure**
ds.aut.d01	ADE	author_id	author id
ds.aut.a01	AAE	name	full name
ds.aut.a02	AAE	givenname	given name, first name
ds.aut.a03	AAE	familyname	family name, surname
ds.aut.a04	AAE	initials	initials
ds.aut.a05	AAE	title_pfx	title before the name (prefix)
ds.aut.a06	AAE	title_sfx	title behind the name (suffix)
ds.aut.a07	AAE	organization	organization name
ds.aut.a08	AAE	department	department name
ds.aut.a09	AAE	role	role in organization/department
ds.aut.a10	AAE	country	country
ds.aut.a11	AAE	state_province	state or province
ds.aut.a12	AAE	city	city name
ds.aut.a13	AAE	zipcode	zip code, postal code

Table2 – continued from previous page

Path	Type	Tag	Description
ds.aut.a14	AAE	street	street name
ds.aut.a15	AAE	email	email address
ds.aut.a16	AAE	name_identifier_type	name identifier type, e.g. ORCID
ds.aut.a17	AAE	name_identifier_type_uri	name identifier type uri, e.g. https://orcid.org/
ds.aut.a18	AAE	name_identifier	name identifier, e.g. ORCID id
ds.aut.a19	AAE	description	author description
ds.dev	struct_dev	—	**substructure array**
ds.dev.d01	ADE	device_id	device id
ds.dev.a01	AAE	name	device name
ds.dev.a02	AAE	vendor	vendor name
ds.dev.a03	AAE	product	product name
ds.dev.a04	AAE	category	device category
ds.dev.a05	AAE	usage	device usage
ds.dev.a06	AAE	description	device description
ds.dev.s01	ADE	data_array	array contains 7 elements
ds.mat	struct_mat	—	**substructure array**
ds.mat.d01	ADE	material_id	material id
ds.mat.a01	AAE	name	material name
ds.mat.a02	AAE	vendor	vendor name
ds.mat.a03	AAE	product	product name
ds.mat.a04	AAE	category	material category
ds.mat.a05	AAE	description	material description
ds.mat.a06	AAE	storage_place	material storage place
ds.mat.a07	AAE	storage_condition	material storage condition
ds.rec	struct_rec	—	**substructure**
ds.rec.d01	ADE	recipe_id	recipe id
ds.rec.a01	AAE	recipe_code	recipe code
ds.rec.s01	struct_mix_component	—	array contains 2 elements
ds.rec.s02	ADE	w/c-ratio	water-cement-ratio, mass of water divided by mass of cement
ds.mix	struct_mix	—	**substructure**
ds.mix.r01	ARE	author	author reference
ds.mix.r02	ARE	device	device reference
ds.mix.r03	ARE	recipe	recipe reference
ds.mix.r04	ARE	location	location reference
ds.mix.d01	ADE	mixture_id	mixture id
ds.mix.d02	ADE	datetime	—
ds.mix.d03	ADE	mixing_time	mixing/blending time

Table2 – continued from previous page

Path	Type	Tag	Description
ds.mix.d04	ADE	speed_level	mixer speed level
ds.mix.d05	ADE	agitator_speed	mixer agitator speed
ds.mix.d06	ADE	attachment_speed	mixer attachment speed
ds.mix.a01	AAE	operator	operator name
ds.mix.a02	AAE	procedure	procedure description
ds.mix.a03	AAE	description	general description
ds.spm	struct_spm_paste	—	**substructure array**
ds.spm.r01	ARE	author	author reference
ds.spm.r02	ARE	mixture	mixture reference
ds.spm.r03	ARE	device	device reference
ds.spm.r04	ARE	location	location reference
ds.spm.d01	ADE	specimen_id	specimen id
ds.spm.d02	ADE	datetime	date and time, seconds since epoch (UTC)
ds.spm.a01	AAE	specimen_code	specimen code
ds.spm.a02	AAE	operator	operator name
ds.spm.a03	AAE	procedure	procedure description
ds.spm.a04	AAE	description	general description
ds.tst	struct_test	—	**substructure**
ds.tst.s01	struct_test_fpd	—	**substructure**
ds.tst.s01.r01	ARE	author	author reference
ds.tst.s01.r02	ARE	mixture	mixture reference
ds.tst.s01.r03	ARE	device	device reference
ds.tst.s01.r04	ARE	location	location reference
ds.tst.s01.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s01.d02	ADE	beaker_volume	beaker volume
ds.tst.s01.d03	ADE	gross_weight	gross weight, measurement result
ds.tst.s01.d04	ADE	beaker_weight	beaker weight, net weight, measurement result
ds.tst.s01.d05	ADE	specimen_weight	specimen weight, calculated value
ds.tst.s01.d06	ADE	specimen_density	specimen density, calculated value
ds.tst.s01.a01	AAE	testname	test name
ds.tst.s01.a02	AAE	operator	operator name
ds.tst.s01.a03	AAE	procedure	procedure description
ds.tst.s01.a04	AAE	calculation	calculation description, formula
ds.tst.s01.a05	AAE	description	general description
ds.tst.s02	struct_test_ssd1	—	**substructure**
ds.tst.s02.r01	ARE	author	author reference
ds.tst.s02.r02	ARE	specimen	specimen reference

Table2 – continued from previous page

Path	Type	Tag	Description
ds.tst.s02.r03	ARE	device	device reference
ds.tst.s02.r04	ARE	location	location reference
ds.tst.s02.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s02.d02	ADE	specimen_weight	specimen weight, measurement result
ds.tst.s02.d03	ADE	floating_specimen_weight	floating specimen weight, measurement result
ds.tst.s02.d04	ADE	water_temperature	water temperature of water basin, measurement result or estimation based on environment temperature
ds.tst.s02.d05	ADE	water_density	density of water in basin, calculated value
ds.tst.s02.d06	ADE	water_weight_displaced	weight of displaced water, calculated value
ds.tst.s02.d07	ADE	specimen_volume	specimen volume, calculated value
ds.tst.s02.d08	ADE	specimen_density	specimen density, calculated value
ds.tst.s02.a01	AAE	testname	test name
ds.tst.s02.a02	AAE	operator	operator name
ds.tst.s02.a03	AAE	procedure	procedure description
ds.tst.s02.a04	AAE	calculation	calculation description, formula
ds.tst.s02.a05	AAE	description	general description
ds.tst.s03	struct_test_ssd1	—	**substructure**
ds.tst.s03.r01	ARE	author	author reference
ds.tst.s03.r02	ARE	specimen	specimen reference
ds.tst.s03.r03	ARE	device	device reference
ds.tst.s03.r04	ARE	location	location reference
ds.tst.s03.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s03.d02	ADE	specimen_weight	specimen weight, measurement result
ds.tst.s03.d03	ADE	floating_specimen_weight	floating specimen weight, measurement result
ds.tst.s03.d04	ADE	water_temperature	water temperature of water basin, measurement result or estimation based on environment temperature
ds.tst.s03.d05	ADE	water_density	density of water in basin, calculated value
ds.tst.s03.d06	ADE	water_weight_displaced	weight of displaced water, calculated value
ds.tst.s03.d07	ADE	specimen_volume	specimen volume, calculated value
ds.tst.s03.d08	ADE	specimen_density	specimen density, calculated value
ds.tst.s03.a01	AAE	testname	test name
ds.tst.s03.a02	AAE	operator	operator name
ds.tst.s03.a03	AAE	procedure	procedure description
ds.tst.s03.a04	AAE	calculation	calculation description, formula
ds.tst.s03.a05	AAE	description	general description
ds.tst.s04	struct_test_umd1	—	**substructure**
ds.tst.s04.r01	ARE	author	author reference

Table2 – continued from previous page

Path	Type	Tag	Description
ds.tst.s04.r02	ARE	specimen	specimen reference
ds.tst.s04.r03	ARE	device	device reference
ds.tst.s04.r04	ARE	location	location reference
ds.tst.s04.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s04.d02	ADE	total_distance	total distance, mesurement result
ds.tst.s04.d03	ADE	spacer_thickness	thickness of spacer disks, steel washer, measurement result
ds.tst.s04.d04	ADE	specimen_thickness	distance between actuator and sensor, calculated value
ds.tst.s04.a01	AAE	testname	test name
ds.tst.s04.a02	AAE	operator	operator name
ds.tst.s04.a03	AAE	procedure	procedure description
ds.tst.s04.a04	AAE	calculation	calculation description, formula
ds.tst.s04.a05	AAE	description	general description
ds.tst.s05	struct_test_umd1	—	**substructure**
ds.tst.s05.r01	ARE	author	author reference
ds.tst.s05.r02	ARE	specimen	specimen reference
ds.tst.s05.r03	ARE	device	device reference
ds.tst.s05.r04	ARE	location	location reference
ds.tst.s05.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s05.d02	ADE	total_distance	total distance, mesurement result
ds.tst.s05.d03	ADE	spacer_thickness	thickness of spacer disks, steel washer, measurement result
ds.tst.s05.d04	ADE	specimen_thickness	distance between actuator and sensor, calculated value
ds.tst.s05.a01	AAE	testname	test name
ds.tst.s05.a02	AAE	operator	operator name
ds.tst.s05.a03	AAE	procedure	procedure description
ds.tst.s05.a04	AAE	calculation	calculation description, formula
ds.tst.s05.a05	AAE	description	general description
ds.tst.s06	struct_test_utt	—	**substructure**
ds.tst.s06.r01	ARE	author	author reference
ds.tst.s06.r02	ARE	specimen	specimen reference
ds.tst.s06.r03	ARE	device	device reference
ds.tst.s06.r04	ARE	location	location reference
ds.tst.s06.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s06.d02	ADE	zerotime	time span between adding water to cement and test start
ds.tst.s06.d03	ADE	interval_steps	number of interval steps, number of measurements
ds.tst.s06.d04	ADE	interval_length	interval length, time span between measurements
ds.tst.s06.d05	ADE	pulse_voltage	device setting, pulse generator voltage
ds.tst.s06.d06	ADE	pulse_width	device setting, pulse generator puse width

Table2 – continued from previous page

Path	Type	Tag	Description
ds.tst.s06.d07	ADE	sampling_rate	device setting, oscilloscope sampling rate
ds.tst.s06.d08	ADE	recorded_block_size	recording block size, number of recorded samples
ds.tst.s06.d09	ADE	num_init_samples	number of initial samples before trigger point
ds.tst.s06.d10	ADE	num_signals	number of recorded signals
ds.tst.s06.d11	ADE	sig_maturity	signal/specimen maturity array [num_signals x 1]
ds.tst.s06.d12	ADE	sig_times	signal sample time array [num_samples x 1]
ds.tst.s06.d13	ADE	sig_magnitudes	signal magnitude matrix [num_samples x num_signals]
ds.tst.s06.a01	AAE	testname	test name
ds.tst.s06.a02	AAE	operator	operator name
ds.tst.s06.a03	AAE	procedure	procedure description
ds.tst.s06.a04	AAE	calculation	calculation description, formula
ds.tst.s06.a05	AAE	description	general description
ds.tst.s06.a06	AAE	ss_filepath	settings file path, full qualified path
ds.tst.s06.a07	AAE	ss_filename	settings file name
ds.tst.s06.a08	AAE	ss_filehash	settings file hash, sha-256
ds.tst.s06.a09	AAE	mm_filepath	measurements file path, full qualified path
ds.tst.s06.a10	AAE	mm_filename	measurements file name
ds.tst.s06.a11	AAE	mm_filehash	measurements file hash, sha-256
ds.tst.s06.a12	AAE	data_dirpath	signal data directory path, full qualified path
ds.tst.s06.a13	AAE	data_filepath	signal data file path list, full qualified paths num_signals x 1
ds.tst.s06.a14	AAE	data_filename	signal data file name list num_signals x 1
ds.tst.s06.a15	AAE	data_filehash	signal data file hash list, sha-256 num_signals x 1
ds.tst.s07	struct_test_utt	—	**substructure**
ds.tst.s07.r01	ARE	author	author reference
ds.tst.s07.r02	ARE	specimen	specimen reference
ds.tst.s07.r03	ARE	device	device reference
ds.tst.s07.r04	ARE	location	location reference
ds.tst.s07.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s07.d02	ADE	zerotime	time span between adding water to cement and test start
ds.tst.s07.d03	ADE	interval_steps	number of interval steps, number of measurements
ds.tst.s07.d04	ADE	interval_length	interval length, time span between measurements
ds.tst.s07.d05	ADE	pulse_voltage	device setting, pulse generator voltage
ds.tst.s07.d06	ADE	pulse_width	device setting, pulse generator puse width
ds.tst.s07.d07	ADE	sampling_rate	device setting, oscilloscope sampling rate
ds.tst.s07.d08	ADE	recorded_block_size	recording block size, number of recorded samples
ds.tst.s07.d09	ADE	num_init_samples	number of initial samples before trigger point
ds.tst.s07.d10	ADE	num_signals	number of recorded signals

Table2 – continued from previous page

Path	Type	Tag	Description
ds.tst.s07.d11	ADE	sig_maturity	signal/specimen maturity array [num_signals x 1]
ds.tst.s07.d12	ADE	sig_times	signal sample time array [num_samples x 1]
ds.tst.s07.d13	ADE	sig_magnitudes	signal magnitude matrix [num_samples x num_signals]
ds.tst.s07.a01	AAE	testname	test name
ds.tst.s07.a02	AAE	operator	operator name
ds.tst.s07.a03	AAE	procedure	procedure description
ds.tst.s07.a04	AAE	calculation	calculation description, formula
ds.tst.s07.a05	AAE	description	general description
ds.tst.s07.a06	AAE	ss_filepath	settings file path, full qualified path
ds.tst.s07.a07	AAE	ss_filename	settings file name
ds.tst.s07.a08	AAE	ss_filehash	settings file hash, sha-256
ds.tst.s07.a09	AAE	mm_filepath	measurements file path, full qualified path
ds.tst.s07.a10	AAE	mm_filename	measurements file name
ds.tst.s07.a11	AAE	mm_filehash	measurements file hash, sha-256
ds.tst.s07.a12	AAE	data_dirpath	signal data directory path, full qualified path
ds.tst.s07.a13	AAE	data_filepath	signal data file path list, full qualified paths num_signals x 1
ds.tst.s07.a14	AAE	data_filename	signal data file name list num_signals x 1
ds.tst.s07.a15	AAE	data_filehash	signal data file hash list, sha-256 num_signals x 1
ds.tst.s08	struct_test_tem	—	**substructure**
ds.tst.s08.r01	ARE	author	author reference
ds.tst.s08.r02	ARE	specimen	specimen reference
ds.tst.s08.r03	ARE	device	device reference
ds.tst.s08.r04	ARE	location	location reference
ds.tst.s08.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s08.d02	ADE	tem_maturity	temperature measurement time array, specimen maturity [num_signals x 1]
ds.tst.s08.d03	ADE	tem_tcpl1	thermocouple-1, temperature magnitude array [num_signals x 1]
ds.tst.s08.d04	ADE	tem_tcpl2	thermocouple-2, temperature magnitude array [num_signals x 1]
ds.tst.s08.d05	ADE	tem_tcpl3	thermocouple-3, temperature magnitude array [num_signals x 1]
ds.tst.s08.d06	ADE	tem_tcpl4	thermocouple-4, temperature magnitude array [num_signals x 1]
ds.tst.s08.a01	AAE	testname	test name
ds.tst.s08.a02	AAE	operator	operator name
ds.tst.s08.a03	AAE	procedure	procedure description
ds.tst.s08.a04	AAE	calculation	calculation description, formula
ds.tst.s08.a05	AAE	description	general description
ds.tst.s08.a06	AAE	placement_tcpl1	placement of thermocouple 1
ds.tst.s08.a07	AAE	placement_tcpl2	placement of thermocouple 2
ds.tst.s08.a08	AAE	placement_tcpl3	placement of thermocouple 3

Table2 – continued from previous page

Path	Type	Tag	Description
ds.tst.s08.a09	AAE	placement_tcpl4	placement of thermocouple 4
ds.tst.s08.a10	AAE	data_dirpath	temperature data directory path, full qualified path
ds.tst.s08.a11	AAE	data_filepath	temperature data file path
ds.tst.s08.a12	AAE	data_filename	temperature data file name
ds.tst.s08.a13	AAE	data_filehash	temperature data file hash, sha-256
ds.tst.s09	struct_test_env1	—	**substructure**
ds.tst.s09.r01	ARE	author	author reference
ds.tst.s09.r02	ARE	device	device reference
ds.tst.s09.r03	ARE	location	location reference
ds.tst.s09.d01	ADE	datetime	date and time, seconds since epoch (UTC)
ds.tst.s09.d02	ADE	temperature	environment temperature at test start
ds.tst.s09.a01	AAE	testname	test name
ds.tst.s09.a02	AAE	operator	operator name
ds.tst.s09.a03	AAE	procedure	procedure description
ds.tst.s09.a04	AAE	calculation	calculation description, formula
ds.tst.s09.a05	AAE	description	general description