Civieltechnisch Centrum Uitvoering Research en Regelgeving

GEOTECHNICAL EXCHANGE FORMAT FOR CPT-DATA

Version: 1, 1, 2

Original: June 1999, first update: November 2000; second update: September 2002; third update: April 2004; fourth update: September 2006

18051999 1626

PREFACE

For geotechnical in-situ investigation the cone penetration test has been used world-wide. Based on the results of this type of soil investigation insight in the build-up and the bearing capacity of the subsoil will be gathered.

Usually the output of the cone penetration test is available in a digital form according to a customer specific format. This seems to be an ideal situation, as each customer gets this output in the format he asked for. However, the result is that there is still a number of formats, which are hard to be interchanged thus being a hindering for a sustainable storage of these data. Moreover, due to the variation in formats there is a continuous need for different conversion programmes for the use of these digital cone penetration data in the design of structures.

Besides the mentioned disadvantages, this variation in formats leads to waste of time, money and energy. For a start in the Netherlands these costs amount to at least NLG 600.000 or Euro ≈ 270.000 a year (price level 1999).

This situation has induced the development of a standard format.

The first step in this process was an inquiry among a large number of users in order to determine the content of the standard format. The next step was a research into the available international formats. Comparison of this research with the results of the inquiry leads to the choice of one existing format as a basis to derive the new standard. Besides the new standard format a number of tools are developed, a/o. verification software and a viewer. By now several Dutch companies and organisations are using this standard format. In the mean time a number of computer applications is making use of this new standard format.

At the time of compiling of this manual, the research committee "Standardisation digital CPT-results" comprised:

F.J.J.A. van Dam, *chairman*	Ministry of Transport, Public Works and Water Management, Directorate-General for Public Works and Water Management, Civil Engineering Division
W.A. Nohl, *secretary*	Fugro Ingenieursbureau
Dr. H. den Adel	GeoDelft
P. van Asten	A.P. v.d. Berg
C.N. Bremmer	Netherlands Institute of Applied Geoscience TNO
F.P.H. Engering	GeoDelft
S.K. Jonker	Ministry of Transport, Public Works and Water Management, Directorate-General for Public Works and Water Management, Road and Hydraulic Engineering Division
A.G.M. Knibbeler	MOS Geotechnics
W.J. van Niekerk	Ballast Nedam Engineering
A. Jonker, *coordinator*	CUR
Prof. J.K. Vrijling, *mentor*	CUR

Besides these members of the research committee a number of corresponding members were involved:

The software and this report are available free at www.geonet.nl/ gef, with the possibility to make a download.
The CUR-organisation guarantees that the format will be maintained; if there are any questions or tips, please inform us.
Infodesk: Fred Jonker, '   +31 182 54 06 30

June 1999   The Board of the CUR
November 2000
September 2002
April 2004
September 2006

TABLE OF CONTENTS

1   INTRODUCTION

A new exchange format for digital cone penetration test data
Cone penetration tests are extensively used in soil mechanics to determine the layer structure and the bearing capacity of the subsoil. Data from the cone penetration test is stored digitally and supplied to the client in the format they request. The result is a large variety of formats which makes mutual exchange problematic and hinders durable storage of penetration test data. The standard format in accordance with GEF-CPT-Report brings an end to this confusing situation.

Why a new format?
Existing formats are specifically directed at a client and are therefore not unambiguous and exchangeable. In cases where there are large quantities of penetration test data delivered in a variety of formats, this not only leads to communication problems but also delays and increased costs.

New format in accordance with GEF-CPT-Report

Uniform:
Conversions belong to the past; the format offers completeness, as the structure stores all relevant information.

Flexible:
In addition to certain minimal information, the user can add specific data.

Unambiguous:
Storage of the measurement data is unambiguous. In the case of measured pore water pressure, for instance, the level at which this is measured is also stated (in the cone or at a higher level). It is also possible to include more than one pore water pressure measurement.

Directly applicable:
'Links" with the GEF-CPT-Report were made for various companies during the development traject. This means that there is already application software which can use penetration test data directly from the GEF-CPT-Report. A "link" is also supplied to convert GEF-CPT-Report files into NENGEO format (and conversely). Furthermore, the direct applicability is enhanced by the availability of an "Excel-link" for importing and processing penetration test data as required.

Freely available tools:
The format is provided with freely available tools for verifying the supplied data and for making "links". The verification software checks whether the structure of the data file complies with that of the GEF-CPT-Report (not a contents verification of the data file, but a check whether the structure satisfies GEF-CPT-Report). For verification purposes, a simple viewer is also provided.

Usefulness

The continuous development traject, involving a large number of experts, has resulted in high quality and efficiency. It will be possible to use the new format efficiently, particularly on large projects involving many parties.

GEF and GEF-CPT-Report

- GEF (Geotechnical Exchange Format) is a general language structure for storing and transferring geotechnical information. GEF states in a procedural way how a new structure (a set of rules for the storage of measurements) should be composed. This report provides a basis for a general exchange of digital cone penetration test data.
- GEF-CPT-Report is the specific structure for reporting cone penetration test data.

GEF Verification is a stand-alone application which can be used to verify if files comply with the new GEF-CPT-Report Format. Verification consists of checking for syntax errors and contextual inconsistencies in digital CPT-files using the GEF-CPT-Report Format. The software opens a GEF-file and performs a verification. A log of the errors that are found is given. Batch verification of GEF-files is also possible. In the case of the verification of a single file, the file itself as well as a graph, displaying the most important data, viz. cone resistance, sleeve friction, friction ratio and pore water pressure, can be displayed.

GEF Verification 1.0 was developed by NITG-TNO for LWI and released in September 1998.

GeoDelft and NITG-TNO have assembled a library which can be used to create conversion programs between other formats and GEF. This library was named GEFLIB.

A conversion tool named ***GEF-NENGEO/NENGEO-GEF Conversion*** was developed to convert between the CPT-file format NENGEO and the GEF-CPT-Report format.

This document will describe the following:

1. The GEF language
2. The format for reporting CPT results
3. The GEF verification tool
4. The GEF library
5. The GEF-NENGEO/NENGEO-GEF conversion tool

(Nov 2000 N) Since its introduction in June 1999 a wide range of experience has been gained in working with the Geotechnical Exchange Format for the Cone Penetration Test. Users have provided feedback which allowed us to improve the appliability of GEF-CPT-Report, provide additional explanation on some features and fix bugs. The results of the working experience is added to the original report. In the text supplementory information or corrections can be recognized by (Month Year C), like at the start of this paragraph. A C signals a correction, a N is a new feature, I is informative or illustrative.

(2006 Sept N) The latest version is GEF-CPT-Report, 1, 1, 2, gefcr112.pdf

2   FORMAT OF A GEF-CPT-REPORT FILE

In accordance with GEF, the file contents is divided into two main components: the header and the data block. The header contains the following information:

- summary of the original information sources (file tracing)
- description of the cone penetration data (data descriptive)
- description of the subsequent measurement and calculation procedures (procedure descriptive)
- structure information about the file (file descriptive).

The data block is a table containing the measured data and the calculated information.

2.1   Header

A complete list of the items which can be used and which may appear in the GEF-CPT-report header is given below. A default value is given for several items. If this default value is applicable, the item can be omitted.

Items printed in **bold text** in the following sections are **always** to be included in a GEF-CPT-report file, while the other items are optional.

2.1.1   File tracing

- **Name of executing company**
- **Order number**
- **Date when GEF-CPT-Report file is created**
- **Identification number of the cone penetration test**
- **Employee, responsible for the data**

2.1.2   Data descriptive

- Data format (this must be ASCII for a GEF-CPT-Report)
- **Number of columns in the data block**
- **Number of lines in the data block**
- **Column information = description for each column**
- Definition of "invalid measurement value" for each column.

2.1.3 Procedure descriptive

Project information
- Project name
- Client name
- Name of location.

Apparatus and procedures
- Type and serial number of the penetration cone
- Nominal surface area of the cone tip in mm^2
- Nominal surface area of the friction casing in mm^2
- Net surface quotient of cone tip and friction casing
- Distance between cone and centre of friction casing in mm
- Location of the PPT filter (u1, u2 or u3)
- Type of cone penetration test (Cone, possibly supplemented with Friction, PPT and/or inclination)
- Use of back-flow compensator (yes/no)
- Reference to standard (NEN 5140 or 3680)
- Class of penetration test in accordance with NEN 5140.

Location of penetration test
- Coordinate system used
- X and Y coordinates of the penetration test location
- Reference level (Z coordinate)
- Height of the selected fixed horizontal surface (= usually ground level) with respect to the reference level
- Description of pre-drilled/pre-excavated soil
- Groundwater level
- Unusual circumstances.

Measuring
- Date the penetration test was carried out
- Time when penetration test began
- Depth of first observation with respect to the selected fixed horizontal surface (for pre-testing, excavation or -drilling)
- Final depth of penetration test
- Stop criteria
- Zero values of all measurement elements before and after penetration test
- Minimal and maximum values per column.

Comments
- Mass and geometry of the probe apparatus, including anchoring
- Method for processing interruptions
- Correction method for zero drift
- Remarks.

2.1.3.1 Analysis

- Calculation formula for calculated columns or references to the standard or a publication where this method of calculation is described

Reporting
- Printing format for the columns in the data block

2.1.4   File descriptive

- **GEF version number**
- **GEF-CPT-Report Procedure Code**
- Type of computer system.

(Nov 2000 N)
- **GEF version number**
- **Code for reporting the data:**
  - **either Procedurecode for GEF-CPT-Report**
  - **or   Reportcode for GEF-CPT-Report**
- Type of computer system.

(April 2004 N) More specificly:
- For files of version 1,0,0, the keyword Procedurecode is the mandatory codeword, describing the file type and version:
  #PROCUDURECODE = GEF-CPT-Report,1,0,0, reference document
- For file, version 1,1,0 and up, the file description must either be stated in Reportcode or in Procedurecode. Reportcode is the preferred keyword:
  #REPORTCODE = GEF-CPT-Report, 1, 1, 0, reference document

This means that when reading GEF-files and when the keyword Reportcode is not found in a file, the contents of keyword Procedurecode –if present- is used. When both keywords are missing, the file type can not be determined and the file can not be recognized or processed as a file conform GEF-CPT-Report. In the rare case both Reportcode and Procedurecode are encountered, Procedurecode is ignored for the determination of the type of file. Reportcode prevails. So we encourage, when writing new GEF-files, only to use Reportcode.

In short:

Version 1,0,0	Version 1,1,0 and up
#PROCUDURECODE = GEF-CPT-Report,1,0,0, reference document	**#REPORTCODE = GEF-CPT-Report,1,1,0**, reference document
	Depreciated:
	#PROCUDURECODE = GEF-CPT-Report,1,0,0, reference document

2.2   Data block

The data block is composed of a variable number of columns, of which two columns are reserved for the two compulsory measurement values: the penetration length and the cone resistance. The other

columns are available for the remaining direct measurement values and the derived results. A number of quantities are defined in Section 3.4.

A text field can be appended as the last column in the data block to add comments on a specific measurement scan, for example reference to a dissipation test.
(<u>Nov 2000 I</u>) Additionally these text fields require the GEF code words columntext, recordseparator, and columnseparator.

3 CPT REPORT FILE IN GEF FORMAT

3.1 Code words used in the CPT Report

The starting point of the CPT Report file is that the measurement variables and text which it sets out have a fixed position. In accordance with the GEF definition, there is room for 1500 measurement variables and texts, where the first 128 variables and texts within the GEF-CPT-Report definition are reserved for (future) "fixed" data (see Sections 3.2 and 3.3). Users can extend the list by using further free variables and texts (numbers 129 up to and including 1500).

The exact definition of the code words is defined in "GEF, release 1.0.0" (see appendix 2).

Four types of variables are given in the list below, indicated between []:

(<u>Nov 2000 I</u>)
- Character   a single readable symbol
- Text   readable text with a maximum of 256 characters, without commas, backslashes, equals signs or hashes (, \ = #)
- Number   an integer number
- Figure   a floating point number.

Items printed in **bold text** in the list below must **always** be present in a CPT Report file, while the other items are optional. The italic text provides brief information about the relevant code word.

#GEFID	**=**	**1,0,0**	*releasenumber GEF*

(<u>Nov 2000 N</u>) or depending on the use of the Child or Parent code word

#GEFID	**=**	**1,1,0**	*release number GEF*
#COLUMN	**=**	**[number]**	*the number of columns in the data block*
#COLUMNINFO	=	[number], [text], [text], [number]	*column number, dimension, quantity, quantity number. See table in section 3.4*
#COLUMNINFO	**=**	**1, m, penetration length, 1**	
#COLUMNINFO	**=**	**2, MPa, Cone value, 2**	
#COLUMNMINMAX	=	1, [figure], [figure]	
#COLUMNMINMAX	=	2, [figure], [figure]	
#COLUMNMINMAX	=	3, …, … etc.	
#COLUMNSEPARATOR	=	[character]	*text dividing columns (default = space)*
#COLUMNTEXT	=	[number], [text] *text on or off*	
		0 = off	
		1 = on	
#COLUMNVOID	=	1, [figure]	*definition of "no value"*
#COLUMNVOID	=	2, [figure]	
#COLUMNVOID	=	3, ... etc.	
#COMPANYID	**=**	**[text], [text], [integer]**	*executing company*
#DATAFORMAT	=	ASCII (this is the compulsory data format)	
#FILEDATE	**=**	**[number], [number], [number]**	*yyyy, mm, dd*
#FILEOWNER	**=**	**[text]**	
#LASTSCAN	**=**	**[number]**	*number of measurement scans in data block*
#MEASUREMENTTEXT	=	1, [text], client	

#MEASUREMENTTEXT	=	2, [text], project name
#MEASUREMENTTEXT	=	3, [text], name of location
#MEASUREMENTTEXT	=	4, [text], cone type and serial number
#MEASUREMENTTEXT	=	5, [text], Mass and geometry of probe apparatus\, incl. anchoring
#MEASUREMENTTEXT	=	6, [text], according to standard *NEN 5140 incl. Class\, NEN 3680,....*
#MEASUREMENTTEXT	=	7, [text], own coordinate system
#MEASUREMENTTEXT	=	8, [text], own reference level

(<u>Nov 2000 N</u>)

#MEASUREMENTTEXT	**=**	**9, [text], fixed horizontal level (= usually ground level)**
#MEASUREMENTTEXT	=	10, [text], orientation of biaxial inclination measurement (N-direction)
#MEASUREMENTTEXT	=	11, [text],unusual circumstances
#MEASUREMENTTEXT	=	20, [text], correction method for zero drift
#MEASUREMENTTEXT	=	21, [text], processing method for interruptions
#MEASUREMENTTEXT	=	22, [text], remarks
#MEASUREMENTTEXT	=	23, [text], remarks
#MEASUREMENTTEXT	=	30, [text], calculation formula for column …
#MEASUREMENTTEXT	=	31, [text], calculation formula for column …

(<u>Sept 2006 N</u>)

#MEASUREMENTTEXT	=	41, [text], railway or dike code
#MEASUREMENTTEXT	=	42, [text], method for the determination of the ZID
#MEASUREMENTTEXT	=	43, [text], method for the determination of the XYID
#MEASUREMENTTEXT	=	44, [text], Orientation X axis inclination
#MEASUREMENTVAR	=	1, [figure], mm^2, Nom. surface area of cone tip
#MEASUREMENTVAR	=	2, [figure], mm^2, Nom. surface area of friction casing
#MEASUREMENTVAR	=	3, [figure], -, Net surface area quotient of cone tip
#MEASUREMENTVAR	=	4, [figure], -, Net surface area quotient of friction casing
#MEASUREMENTVAR	=	5, [figure], mm, cone distance to centre of friction casing
#MEASUREMENTVAR	=	6, [number], -, friction present
#MEASUREMENTVAR	=	7, [number], -, PPT u1 present
#MEASUREMENTVAR	=	8, [number], -, PPT u2 present
#MEASUREMENTVAR	=	9, [number], -, PPT u3 present
#MEASUREMENTVAR	=	10, [number], -, inclination measurement present
#MEASUREMENTVAR	=	11, [number], -, use of back-flow compensator
#MEASUREMENTVAR	=	12, [number], -, type of penetration test
#MEASUREMENTVAR	=	13, [figure], m, pre-excavated depth
#MEASUREMENTVAR	=	14, [figure], m, groundwater level
#MEASUREMENTVAR	=	15, [figure], m, water depth (for offshore activities works)
#MEASUREMENTVAR	=	16, [figure], m, end depth of penetration test
#MEASUREMENTVAR	=	17, [number], -, Stop criteria
#MEASUREMENTVAR	=	20, [figure], MPa, zero measurement of cone before penetration test
#MEASUREMENTVAR	=	21, [figure], MPa, zero measurement of cone after penetration test
#MEASUREMENTVAR	=	22, [figure], MPa, zero measurement friction before penetration test
#MEASUREMENTVAR	=	23, [figure], MPa, zero measurement friction after penetration test
#MEASUREMENTVAR	=	24, [figure], MPa, zero measurement PPT u1 before penetr. test

#MEASUREMENTVAR	=	25, [figure], MPa, zero measurement PPT u1 after penetr. test
#MEASUREMENTVAR	=	26, [figure], MPa, zero measurement PPT u2 before penetr. test
#MEASUREMENTVAR	=	27, [figure], MPa, zero measurement PPT u2 after penetr. test
#MEASUREMENTVAR	=	28, [figure], MPa, zero measurement PPT u3 before penetr. test
#MEASUREMENTVAR	=	29, [figure], MPa, zero measurement PPT u3 after penetr. test
#MEASUREMENTVAR	=	30, [figure], degrees, zero measurement inclination before penetr. test
#MEASUREMENTVAR	=	31, [figure], degrees, zero measurement inclination after penetr. test
#MEASUREMENTVAR	=	32, [figure], degrees, zero measurement inclination NS before penetr. test
#MEASUREMENTVAR	=	33, [figure], degrees, zero measurement inclination NS after penetr. test
#MEASUREMENTVAR	=	34, [figure], degrees, zero measurement inclination EW before penetr. test
#MEASUREMENTVAR	=	35, [figure], degrees, zero measurement inclination EW after penetr. test

(Sept 2006 N)

#MEASUREMENTVAR	=	41, [figure], km, location in 'line coordinate'
#MEASUREMENTVAR	=	42, [figure], degrees, angle between positive X and North

(April 2004 N) See section 2.1.4

Version 1, 0, 0

#PROCEDURECODE	**=**	**GEF-CPT-Report, 1,0,0** *release of CPT-Report*

Version 1, 1, 0

(Nov 2000 C) or (see remarks before section 3.2) (Nov 2000 N)

#REPORTCODE	**=**	**GEF-CPT-Report, 1,1,0, -**	*release of CPT-Report*
#PROCEDURECODE	=	GEF-CPT-Report, 1,1,0, -	*release of CPT-Report*

- Reportcode is preferred.
- It is either Reportcode of Procedurecode, not both

Version 1,1,1

(Sept 2002 N) or (see section 3.3, Table 3.1 and Table 3.2)

#REPORTCODE	**=**	**GEF-CPT-Report, 1,1,1, -**	*release of CPT-Report*

- Reportcode is preferred.
- It is either Reportcode of Procedurecode, not both

#PROJECTID	**=**	**[text], [text], [text]**	*order number*
#RECORDSEPARATOR	=	[character] *symbol at end of a measurement scan (default = CR/LF)*	
#REPORTDATAFORMAT	=	[character] *print format per column, according to FORTRAN-definition*	
		Iw = Integer, w positions long	
		Fw.d = Floating pointing number, w positions long with d decimal positions	
		Ew.d = Idem, but with exponent	
#SPECIMENVAR	=	1, [figure], m, [text], *depth in m –mv and sample code according to NEN 5104 of the pre-drilled soil*	
#SPECIMENVAR	=	n , [figure], m, [text], *depth in m –mv and sample code according to NEN 5104 of the pre-drilled soil*	
#STARTDATE	=	[number], [number], [number]	*yyyy, mm, dd*
#STARTTIME	=	[number], [number], [number]	*hh, mm, ss.s*

#TESTID	=	**[text]**	*identifying number of penetration test*
#XYID	=	[number], [figure], [figure] , [figure] , [figure]	

coordinate system, X, Y, delta X, delta Y

The coordinate systems are linked to a country code so that the
first numbers 0000-0009 are defined free or international.

00000 = own coordinate system *see #MEASUREMENTTEXT = 7*

00001 = Geographic Coordinate System

01000 = SPCS

31000 = RD: coordinate system = Cartesian, date= RD1918,
projection method = stereographic

31001 = UTM-3N: coordinate system = Cartesian, date =
ED50, projection method = Mercator, central meridian = 3°OL

31002 = UTM-9N: coordinate system = Cartesian, date =
ED50, projection method = Mercator, central meridian = 9°OL

32000 = Belgian Bessel: coordinate system = geographic,
date = BD72, projection method = Belgian Lambert

49000   = Gauss-Krüger: coordinate system = Cartesian, date =
Potsdam, projection method = Transversal Mercator

#ZID	=	**[number], [figure] , [figure]**	*height system, Z, delta Z*

The height systems are linked to a country code. 000-0009 are
defined free or international

00000 = own reference level *see #MEASUREMENTTEXT = 8*

00001 = Low Low Water Spring

31000 = NAP

32000 = Ostend Level

32001 = TAW

49000 = Normal Null

#EOH	=

In order to facilitate self-description of the code words, two special code words have been defined:

#STRUCTURETEXT	=	[code word], [text], [text], …	*semantic definition of the code word*
#STRUCTURETYPE	=	[code word], [text], [text], .…	*syntactic definition of the code word.*

Remarks.
- The code word Procedurecode is conceived for referring to the quality system of the engineering
  company that performed the CPT. Their quality manual will provide detailed information of the
  entire process of the methods for measurement, analysis, filing and reporting a cone penetration
  test.
  - If information is available about the process of measuring, analysing, filing an reporting a test,
    Procedurecode should refer to this information.
  - If information about measuring, analysing and filing is absent and if the data being reported
    comply the rules as stated in this document, Procedurecode should read: GEF-CPT-Report
- The code word Reportcode is conceived for providing information about the process of reporting
  data. E.g. if it reads "GEF-CPT-Report , 1, 1, 0", the reader knows that the report is in accordance

with the rules of CUR's definition for the exchange of results of cone penetration tests, as described in the November 2000 edition of this document.
- The figures Release, Version and Update provide information about the specific definition of the report. If a report complies to all required items as indicated in this text by (Nov 2000 N), its version figure should read 1. If it uses only a few of these new items, the report is still complying the rules of the original version of June 1999, being a 1,0,0 report.
- In order to be able to recognise a file as being a GEF-CPT-Report file, the following rules are followed:
(April 2004 N)
Version 1,0,0
#PROCEDURECODE = GEF-CPT-Report, 1, 0, 0
Version 1,1,0 and up
#REPORTCODE = GEF-CPT-Report, 1, 1, 0   (preferred)
The use of #procedurecode = GEF-CPT-Report, 1, 1, 0 is depreciated, however still allowed.

3.2   Reserved MEASUREMENTVAR's

The list in section 3.1 assigns a number of MEASUREMENTVAR variables. In a GEF-CPT-Report these variables can only be used for the allotted quantities. The table below provides an overview of the numbers reserved for MEASUREMENTVARs.

Sequential number	[Default] value	Unit	Quantity
1	[1000]	mm^2	nom. surface area cone tip
2	(Nov 2000 C) [15000]	mm^2	nom. surface area friction sleeve
3		-	net surface area quotient of cone tip
4		-	net surface area quotient of friction sleeve
5	[100]	mm	distance of cone to centre of friction sleeve
6	0= no 1= yes	-	friction present
7	0= no 1= yes	-	PPT u1 present
8	0= no 1= yes	-	PPT u2 present
9	0= no 1= yes	-	PPT u3 present
10	0= no 1= yes	-	inclination measurement present
11	0= no 1= yes	-	use of back-flow compensator
12	0= electronic penetration test 1= mechanical discontinue 2= mechanical continue	-	type of cone penetration test
13		m	pre-excavated depth
14		m	groundwater level (Nov 2000 N) with respect to the datum of the height system in ZID
15		m	water depth (for offshore activities)

Sequential number	[Default] value	Unit	Quantity
16		m	end depth of penetration test
17	0= end depth reached 1= max. penetration force 2= cone value 3= max. friction value 4= max. PPT value 5= max. inclination value 6= obstacle 7= danger of buckling	-	stop criteria
18-19			for future use
20		MPa	zero measurement cone before penetration test
21		MPa	zero measurement cone after penetration test
22		MPa	zero measurement friction before penetration test
23		MPa	zero measurement friction after penetration test
24		MPa	zero measurement PPT u1 before penetration test
25		MPa	zero measurement PPT u1 after penetration test
26		MPa	zero measurement PPT u2 before penetration test
27		MPa	zero measurement PPT u2 after penetration test
28		MPa	zero measurement PPT u3 before penetration test
29		MPa	zero measurement PPT u3 after penetration test
30		degrees	zero measurement inclination before penetration test
31		degrees	zero measurement inclination after penetration test
32		degrees	zero measurement inclination NS before penetration test
33		degrees	zero measurement inclination NS after penetration test
34		degrees	zero measurement inclination EW before penetration test
35		degrees	zero measurement inclination EW after penetration test
36-40			for future use
41		km	mileage
42		degrees	Orientation between X axis inclination and North. See section 3.7 <u>Sept 2006 N</u>

(<u>Nov 2000 N</u>). The reference level in measurementvars 14 (the elevation of the ground water level) is
the datum of the height system as used in the code word ZID.

3.3   Reserved MEASUREMENTTEXT's

The list in section 3.1 assigns a number of MEASUREMENTTEXT variables. These texts can only be used in a GEF-CPT-Report for the allotted quantities. The table below provides an overview of the numbers reserved for MEASUREMENTTEXT.

Sequential number	Quantity
1	client
2	name of the project
3	name of the location
4	cone type and serial number
5	Mass and geometry of probe apparatus, including anchoring
6	applied standard, including class
7	own coordinate system
8	own reference level
9	fixed horizontal level (usually: ground level or flow bed)
10	orientation direction biaxial inclination measurement (N-direction)
11	unusual circumstances
12-19	for future use
20	correction method for zero drift
21	method for processing interruptions
22	remarks
23	remarks
24-29	for future use
30	calculation formula or reference for column number…
31	calculation formula or reference for column number…
32	calculation formula or reference for column number…
33	calculation formula or reference for column number…
34	calculation formula or reference for column number…
35	calculation formula or reference for column number…
36-40	for future use
41	highway, railway or dike code
42	method for the determination of the ZID, see Table 3.1; Sept 2002 N
43	method for the determination of the XYID, see Table 3.2; Sept 2002 N
44	Orientation of the X axis of the inclination measurement (optional), see section 3.7. Sept 2006 N

The accuracy of the values listed in XYID and ZID depends on the method of determination of the X, Y and Z coordinates. The method can be listed in measurementtexts 42 and 43. Note that the use of these measurementtexts are only standardised from GEF-CPT-Report release 1, version 1 and update 1 on. In GEF-CPT-Report 1,0,0 and 1,1,0 measurementtexts 42 and 43 have no meaning.

Abreviation	Method
MMET	Measured, surveying
MDGP	Measured, differential GPS
MGOV	Measured, other methods
MH10	Estimated, contour map 1:10.000
MT25	Estimated, Topographic map 1:25.000
MT50	Estimated, Topographic map 1:50.000
MAHN	Estimated, *'Actueel Hoogtebestand Nederland'*
MSOV	Estimated, other methods
MONB	Estimated, unknown method
MFIC	Fictive value

Table 3.1   Methods for the determination of the height of fixed horizontal level of the CPT, as reported in ZID. Code for measurementtext 42.

Abreviation	Method
LMET	Measured, surveying
LGPS	Measured, GPS
LDGM	Measured, diff. GPS, > 5 m
LDGN	Measured, diff. GPS, between 1 and 5 m
LDGZ	Measured, diff. GPS, < 1m
LGOV	Measured, other methods
LT10	Estimated, Topographic map 1:10.000
LT25	Estimated, Topographic map 1:25.000
LT50	Estimated, Topographic map 1:50.000
LD01	Estimated, detailed map 1:100
LD02	Estimated, detailed map 1:200
LD05	Estimated, detailed map 1:500
LD10	Estimated, detailed map 1:1000
LD25	Estimated, detailed map 1:2500
LSOV	Estimated, other methods
LONB	Estimated, method unknown

Table 3.2   Methods for the determination of the position of the CPT: XYID. Code for measurementtext 43.

3.4 Definition of columns in the data block

The following table lists 20 quantities numbers. Each number is unequivocally linked to a physical quantity: the number identifies which physical quantity is listed in a specific column.

Measurement value or calculated value	Unit	Quantity number
penetration length	**m**	**1**
measure cone resistance q_c	**MPa**	**2**
friction resistance	MPa	3
friction number	%	4
pore pressure u_1	MPa	5
pore pressure u_2	MPa	6
pore pressure u_3	MPa	7
inclination (resultant)	degrees	8
inclination N-S	degrees	9
inclination E-W	degrees	10
corrected depth, measured below the fixed horizontal surface	m	11
time	s	12
corrected cone resistance q_t	MPa	13
net cone resistance q_n	MPa	14
pore ratio B_q	-	15
cone resistance number Nm		16
weight per unit volume, γ	kN/m^3	17
in-situ, initial pore pressure u_o	MPa	18
total vertical soil pressure, s_{v0}	MPa	19
effective vertical soil pressure, s'_{v0}	MPa	20
Inclination in X direction	degrees	21 (Sept 2006 N) See 3.7
Inclination in Y direction	degrees	22 (Sept 2006 N) See 3.7
Electric conductivity	S/m	23 (Sept 2006 N)
Reserved for future use		24-30
Bx (magnetic field strength in X direction)	nT	31 (Sept 2006 N) See 3.8
By (magnetic field strength in Y direction)	nT	32 (Sept 2006 N)
Bz (magnetic field strength in Z direction)	nT	33 (Sept 2006 N)
Btot (total magnetic field strength)	nT	34 (Sept 2006 N)
Magnetic inclination	degrees	35 (Sept 2006 N)
Magnetic declination	degrees	36 (Sept 2006 N)

It should be noted that the penetration length (= the uncorrected depth of the cone below the fixed horizontal surface) is the first quantity in the data block.

(Nov 2000 N) In GEF-CPT-Report 1,0,0 the directly measured values of all quantities are values taken at the same time as the cone resistance is observed. From GEF-CPT-Report 1,1,0 on, data in a scan refer to the values which are measured at the same penetration length as the cone resistance is

observed. When time, characterized by quantity number 11, is reported, its value in a particular scan relates to the penetration length of the cone tip.

(Nov 2000 I) Sections 3.5 and 3.6 are added.

3.5 Length, depth and elevation

These three quantities must be used with care. The standard in civil engineering is being followed, see Figure 3.1
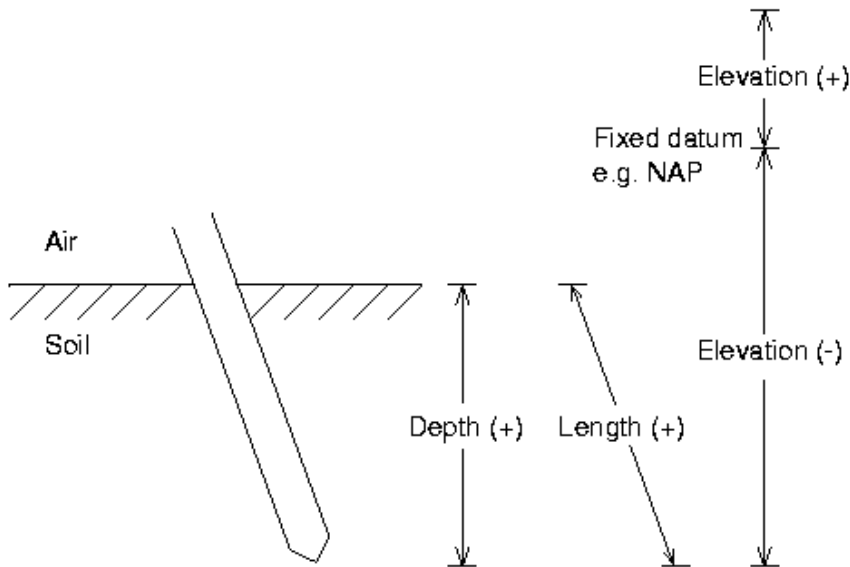

Figure 3.1   The relation between length, depth and elevation

- Elevation is measured with respect to a datum: e.g. a national standard. If the vertical position of a point is higher than the datum, its elevation is positive, if the position of a point is lower than the datum, its elevation is negative.
- Length is the distance along a path. A distance is always a positive quantity. The penetration length of the cone is therefore positive.
- Depth is the length of the projection of a path on a vertical line, so it is a positive quantity.
- "Depth with respect to a datum" is synonymous with elevation.

Since in Figure 3.1 the path of the cone is inclined, its penetration length is larger than its depth. Both quantities are positive. The tip of the cone is beneath the datum, so the elevation of the tip of the cone is negative. It may lead to confusion that in common day practice, especially in spoken language, the theoretical difference between depth and elevation has vanished. Depth is being used when "depth with respect to a datum" (elevation) is meant.

3.5.1 Penetration length

Penetration length is a length. A length is a quantity with a positive value, therefore the penetration length, as listed in the column with quantity number 1, must be positive. The verification program for GEF-CPT-Report will report an error in a GEF-CPT-Report 1,1,0 file, when the penetration length is negative. Depth, characterized by quantity number 11, is the projection of the path of the cone tip on a

vertical line. It is corrected for the inclination of the penetration path. Therefore GEF-CPT-Report 1,1,0 requires that the column, characterized by quantity number 11, contains positive numbers.

3.6 Reference level

In GEF-CPT-Report 1, 0, 0 the level of referencing the penetration length is not a mandatory item. This may lead to a non-unique interpretation of the actual location of the measured cone resistance. Therefore the CUR committee E15 has decided to provide for means which allow for a unique interpretation regarding depth, by adding Measurementtext number 9 and ZID to the list of mandatory items.
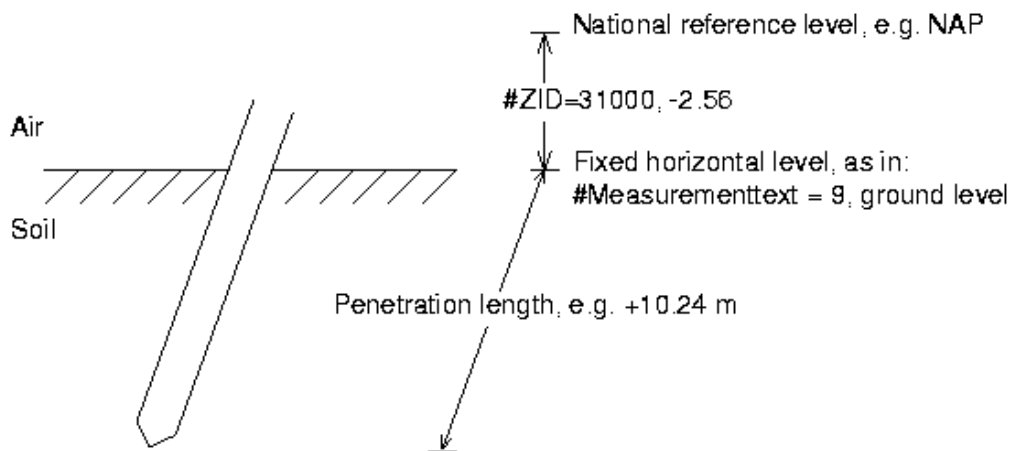
Figure 3.2   National reference level, fixed horizontal level and penetration length

Measurementtext number 9 provides information about the elevation of the horizontal reference level for a CPT. Although the user is free to define his of her own reference level, e.g. the base of the foundation of an existing building, the CUR committee E15 strongly advises to select either groundlevel or the sea or the river bed as the fixed horizontal level. This level usually coincides with the level at which a CPT is being started. Additionally to the mandatory appearance of measurementtext number 9 in GEF-CPT-Report, the code word ZID is declared compulsory as well. ZID must provide information about the elevation of the reference level, which is recorded in Measurementtext number 9. ZID enables the calculation of the elevation of each reading, with respect to a datum, a national reference point.

In order to simplify the use of the standard and the interpretation of the readings, three examples are given. For reasons of clarity only a part of the header and data block is displayed. The absolute reference level is chosen to be either NAP, which is the national reference level in the Netherlands, which is indicated by type '31000' in ZID or Low Low Water Spring. The principle as explained in these examples is not restricted to these particular height systems, each national standard will do.

3.6.1 Example 1

In this example the fixed horizontal reference level coincides with ground level. Ground level will be the starting point for the cone penetration test. The first reading will be at ground level, penetration length is 0.0. Ground level is found to be 5 m higher than the datum: zero level of NAP ($\equiv$31000). Furthermore the inclination of the cone is constant: 20°.
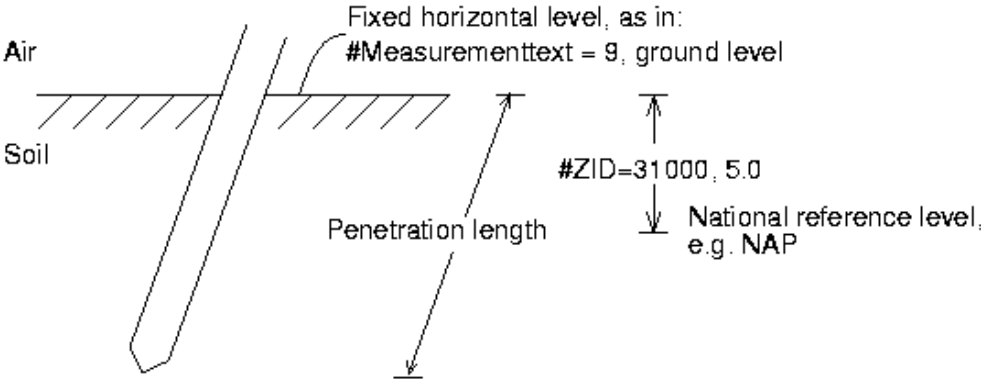
Figure 3.3   Selection of the fixed reference level: groundlevel

```
#MEASUREMENTTEXT = 9, ground level, fixed horizontal reference level
#ZID = 31000, 5.0
```

penetration length [m]	depth [m]	elevation with respect to NAP [m]
0.00	0.0	5.00
0.02	0.019	4.981
0.04	0.038	4.962
0.06	0.056	4.944
0.08	0.075	4.925
0.10	0.093	4.907
etc	etc	etc
5.30	4.98	+0.02
5.32	4.999	+0.001
5.34	5.018	-0.018
5.36	5.037	-0.037
etc.	etc	etc.

Table 3.3   Relative and absolute location of the readings

The calculation of the location of the code tip with respect to a national reference level is performed by:

$$\text{location with respect to datum of national reference level} = \text{Value in ZID} - \text{depth} \qquad (3.1)$$

Note that in equation (3.1) depth is meant in its pure definition: the projection of the penetration length on a vertical line.

3.6.2 Example 2

In this example a layer of soil, 1.8 m tick, had to be removed due to the presence of rubble. This is indicated in the GEF file by Measurementtext 13: pre-excavated depth. Since this is a depth, its value is positive. To signal an invalid cone resistance a columnvoid for column number 2 (cone resistance) is –100 [MPa]. The horizontal reference level is ground level, which is 3 m below the absolute reference level (NAP≡31000). The cone has a constant inclination of 20° with respect to a vertical line.

```
#COLUMNVOID = 2, -100.0
#MEASUREMENTTEXT = 9, ground level, fixed horizontal reference level
#MEASUREMENTVAR= 13, 1.8, m, pre-excavated depth
#ZID = 31000, -3.0
```
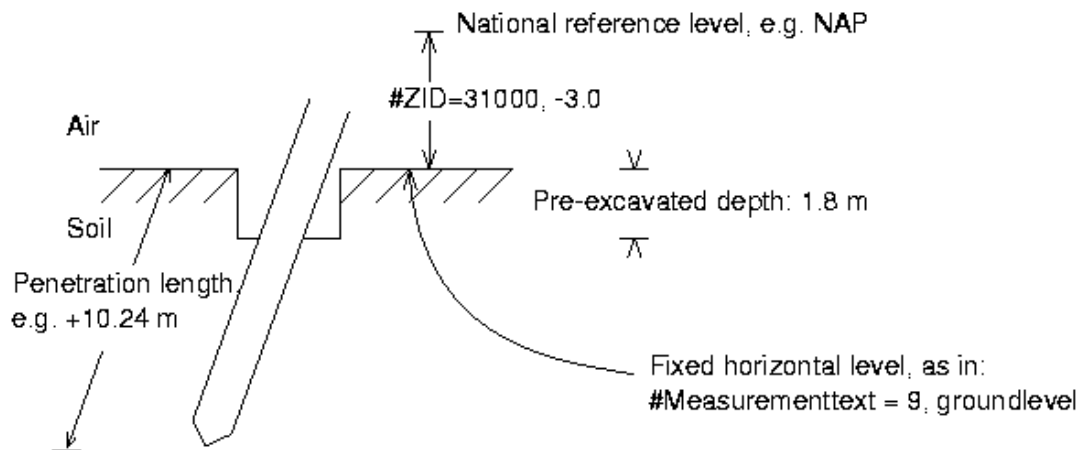

Figure 3.4   Pre-excavation

Penetration length is the length with respect to the fixed horizontal reference level. When a layer of 1.8 m of soil is removed, no values of the penetration length between 0 and 1.8 m are available. A cone resistance in air or water makes no sense. There are two possibilities to list the data. The first one is to remove all readings from the data file which refer to penetration lengths within the layer of removed soil: between 0 and 1.8 m of depth. The first scan has a penetration length of 1.8 m. The second method reports the values which refer to penetration lengths within the removed layer by their Columnvoid value. Both methods are listed in Table 3.4. Any other method is not in agreement with GEF-CPT-Report. Verification software will report deviations from the GEF-CPT-Report standard.

25

Method 1		Method 2			
		pen. length [m]	cone resist. [MPa]	depth [m]	elevation [m]
		0.00	-100	0	-3.00
		0.02	-100	0.019	-3.019
pen. length [m]	cone resist. [MPa]	etc	etc	etc	etc
		1.78	-100	1.673	-4.673
1.80	0.5	1.80	0.5	1.691	-4.691
1.82	0.5	1.82	0.5	1.710	-4.710
1.84	0.5	1.84	0.5	1.729	-4.729
1.86	0.5	1.86	0.5	1.748	-4.748
1.88	0.5	1.88	0.5	1.767	-4.767
etc	etc	etc	etc	etc	etc

Table 3.4   Penetrationlength, depth and elevation of the readings with pre-excavation

According to our expectations there is no difference in the location with respect to NAP, as visualised by both methods. So the report will either start at a penetration length of 1.80 m, which value has to be the same as listed in measurementvar 13, or has to list columnvoid at least up to a penetration length equal to the value as listed in measurementvar 13. In the CUR committee E15 exists a slight preference for method 1, since it seems more natural than method 2.

3.6.3   Example 3

A similar situation occurs when a cone penetration test is performed at sea. In such cases CUR committee E15 strongly advises to select the sea bed as the fixed horizontal reference, to be reported in measurementtext 9. The value of ZID reports the elevation of the sea bed with respect to Low Low water Sping (=00001). The elevation of the sea bed is –40 m. For educational reasons the path of the cone is chosen to be inclined by 20°, see Figure 3.5.
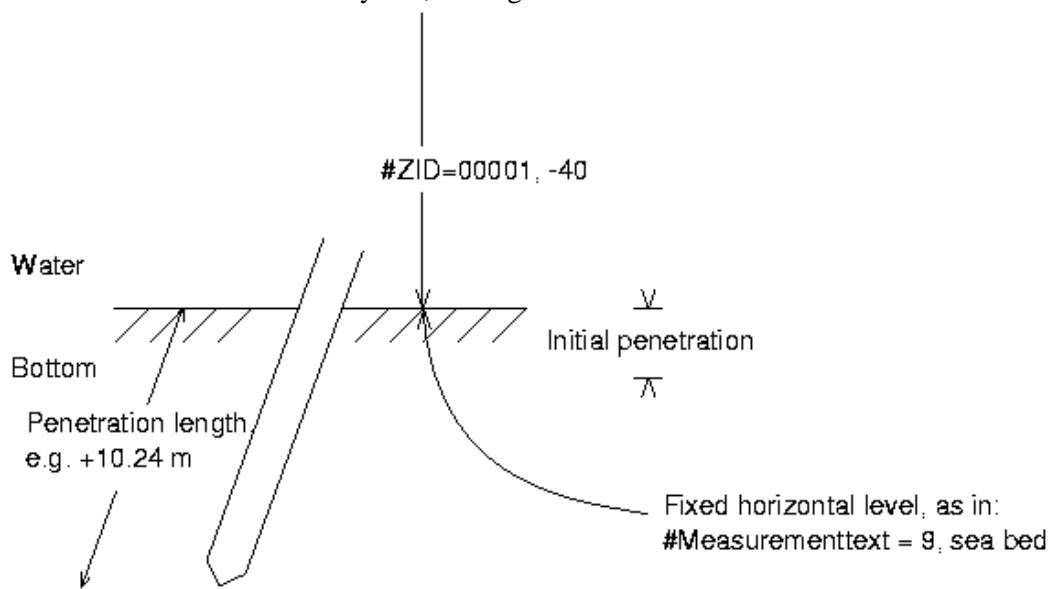

Figure 3.5   The fixed horizontal level is the sea bed.

Due to the rather soft nature of the sea bed it it always difficult to distiguish the difference between water and sea bed. Therefore an initial penetration will occur. The initial penetration contributes to the uncertainty in the elevation of the tip of the cone. Since the sea bed is far below the reference level, the elevation of the cone tip is negative.

(<u>Sept 2006 N</u>) Sections 3.7 and 3.8 are added.

3.7   Direction of inclination measurement

In a GEF-CPT-Report file the inclination of the cone can be presented in two perpendicular directions. The CUR committee E12 has chosen these directions as North-South and East-West. In practical situations sometimes the directions are indicated with respect to a local coordinate system, which is a coordinate system relative to the compass rose. This is optional. **The CUR committee strongly recommends to use the North-South and East-West direction.**

These directions with respect to a local coordinate system can be represented as an X and Y direction. In order to relate the directions of the inclinations with respect to the compass, the direction of the X axis with respect to the compass must be known. Note that the penetration length, corrected for inclination, is calculated by means of the resultant inclination, which is a vectorial sum of the inclinations in both directions. The actual directions of the individual inclinations no longer matters in the resultant inclination, so the resultant inclination does not depend on the choice of reference system.

If the perpendicular inclinations are measured with respect to a local coordinate system, the quantity numbers of these inclinations should be: 21 for the X direction and 22 for the Y direction.

The inclination is defined in the keywords COLUMNINFO:

```
#COLUMNINFO = 5, degrees, Inclination X, 21
#COLUMNINFO = 6, degrees, Inclination Y, 22
```

The X and Y axis usually correspond to a local coordinate system, e.g. the X axis is parallel to a sheetpile wall or a road. When the inclination is given in X and Y direction, a description of the orientation of the X axis should –**this is an obligation**- be presented as a text in measurementtext 44. For example, when the X axis is parallel to a sheetpile wall:

```
#MEASUREMENTTEXT = 44, The X direction is parallel to the sheetpile wall,
Orientation X axis
```

Optionally the direction of the XY coordinate system can be presented in the file. The direction is defined as the angle between North and the positive X direction. Its value is stored in measurementvar 42. For example, when the angle between the positive X axis and North is 37 degrees:

```
#MEASUREMENTVAR = 42, 37, degrees, angle between positive X and North
```

In this example the positive X direction lies between North North East and North East.

Which North? Since the magnetic North is constantly changing and since the angle between magnetic North and celestial North -the latter indicated by the polar star- is a function of the location on earth,. North means the celestial North. This is the same as North on a (high quality) map.

3.8   Magnetic field

Some cones are equiped with a sensor which is sensitive to magnetic fields. In this way the local magnetic field of the earth can be measured.

Remarks.
1. This quantity is optional.
2. The total magnetic field of the earth is currently approximately 0.5 Gauss. That is 50000 nT. 1 nT is the same as 1 gamma.
3. The magnetic inclination is at the earth' equator approximately 0 degrees, near the magnetic poles about 90 degrees.
4. Btot, inclination and declination are a representation in polar coordinates of the cartesian Bx, By and Bz.

4 EXAMPLES OF PENETRATION TESTS IN GEF-CPT-REPORT FORMAT

4.1 The minimum report of a cone penetration test in GEF-CPT-Report

```
#GEFID                  =       1,0,0
(Nov 2000 C)
#PROCEDURECODE          =       GEF-CPT-Report, 1,1,0, -
#COMPANYID              =       CPT bv, Sondeerburg, 31
#PROJECTID              =       CT, 380730
#FILEDATE               =       1998,02,18
#TESTID                 =       C2-265
#FILEOWNER              =       W.A. van Buuren
#COLUMN                 =       2
#LASTSCAN               =       1251
#COLUMNINFO             =       1, m, penetration length, 1
#COLUMNINFO             =       2, MPa, Cone, 2
(Nov 2000 N)
#MEASUREMENTTEXT        =       9, ground level, horizontal reference level
(Nov 2000 N)
#ZID                    =       31000, -2.41
#EOH                    =
(Nov 2000 N)
0.12   0.205
0.14   0.199
0.16   0.219
0.18   0.252
0.20   0.298
0.22   0.338
0.24   0.437
…..
…..
24.80   21.828
24.82   22.057
24.84   21.929
24.86   21.433
24.88   19.936
24.90   18.599
24.92   17.926
24.94   18.004
24.96   18.567
24.98   19.387
25.00   19.64
25.02   19.747
25.04   20.261
25.06   21.368
25.08   23.121
```

4.2 Extensive cone penetration test in GEF-CPT-Report format

#GEFID	=	1,0,0
#COLUMN	=	11
#COLUMNINFO	=	1, m, penetration length, 1
#COLUMNINFO	=	2, MPa, Cone value, 2
#COLUMNINFO	=	3, MPa, Friction, 3
#COLUMNINFO	=	4, MPa, Pore pressure u2, 6
#COLUMNINFO	=	5, degrees, Inclination NS, 9
#COLUMNINFO	=	6, degrees, Inclination EW, 10
#COLUMNINFO	=	7, m, corrected depth, 11
#COLUMNINFO	=	8, MPa, corrected cone value, 12
#COLUMNINFO	=	9, %, friction number, 4
#COLUMNINFO	=	10, s, time, 12
#COLUMNINFO	=	11, MPa, excess pore pressure, 15
(Nov 2000 N)		
#COLUMNMINMAX	=	1, 1.52, 57.68
#COLUMNMINMAX	=	2, 0.33, 61.12
#COLUMNMINMAX	=	3, 0.000, 1.324
#COLUMNMINMAX	=	4, -0.064, 2.060
#COLUMNMINMAX	=	5, 0.02, 9.25
#COLUMNMINMAX	=	6, .04, 8.41
(Nov 2000 N)		
#COLUMNMINMAX	=	7, 1.52, 57.52
#COLUMNMINMAX	=	8, -0.522, 60.892
#COLUMNMINMAX	=	9, -0.164, 119.189
#COLUMNMINMAX	=	10, 1, 3995
#COLUMNMINMAX	=	11, -0.557, 1.511
#COLUMNSEPARATOR	=	:
#COLUMNTEXT	=	1, on
#COLUMNVOID	=	1, -99999
#COLUMNVOID	=	2, -99999
#COLUMNVOID	=	3, -99999
#COLUMNVOID	=	4, -99999
#COLUMNVOID	=	5, -99999
#COLUMNVOID	=	6, -99999
#COLUMNVOID	=	7, -99999
#COLUMNVOID	=	8, -99999
#COLUMNVOID	=	9, -99999
#COLUMNVOID	=	10, -99999
#COLUMNVOID	=	11, -99999
#COMPANYID	=	CPT bv, Sondeerburg, 31
#DATAFORMAT	=	ASCII
#FILEDATE	=	1998, 02, 29
#FILEOWNER	=	W.A. van Buuren
#LASTSCAN	=	2808
#MEASUREMENTTEXT	=	1, NS, client
#MEASUREMENTTEXT	=	2, HSL-line, project name
#MEASUREMENTTEXT	=	3, Franeker, name of location

#MEASUREMENTTEXT	=	4, C5W1-007, cone type and serial number

(<u>Nov 2000 C</u>)

#MEASUREMENTTEXT	=	5, Ballast wagon 18; 25 tons: no anchoring, equipment
#MEASUREMENTTEXT	=	6, NEN 5140 class 1, applied standard

(<u>Nov 2000 C</u>) In this example measurementstexts 7 and 8 are removed, since they confuse the user.

#MEASUREMENTTEXT	=	9, ground level, fixed horizontal .level
#MEASUREMENTTEXT	=	10, lighthouses, N-direction inclinometer
#MEASUREMENTTEXT	=	11, Torrential rain, Unusual circumstances
#MEASUREMENTTEXT	=	20, Zero drift of the cone elements remains within the norm therefore no correction, Correction method
#MEASUREMENTTEXT	=	21, No special processing used, method of processing interruptions
#MEASUREMENTTEXT	=	22, At 12.25 m a thin gravel layer, remarks

(<u>Nov 2000 C</u>)

#MEASUREMENTTEXT	=	30, The corrected cone value is corrected according to "Soil Characterisation by In Situ Tests" 1998-01-05 sect 2.16., calculation

(<u>Nov 2000 C</u>)

#MEASUREMENTTEXT	=	31, Excess pore pressure $dU = U - U_0$ where U_0 is the groundwater level at that place, calculation
#MEASUREMENTVAR	=	1, 1000, mm^2, Nom. surface area cone tip

(<u>Nov 2000 C</u>)

#MEASUREMENTVAR	=	2, 15000, mm^2, Nom. surface area friction element
#MEASUREMENTVAR	=	3, 0.62, -, Net surface area quotient of the cone tip
#MEASUREMENTVAR	=	4, 1.0, -, Net surface area quotient of the friction casing

(<u>Nov 2000 C</u>)

#MEASUREMENTVAR	=	5, 100, mm, distance between cone and centre of friction casing
#MEASUREMENTVAR	=	6, 1, -, Friction present
#MEASUREMENTVAR	=	7, 0, -, PPT u1 present
#MEASUREMENTVAR	=	8, 1, -, PPT u2 present
#MEASUREMENTVAR	=	9, 0, -, PPT u3 present
#MEASUREMENTVAR	=	10, 1, -, inclination measurement present
#MEASUREMENTVAR	=	11, 1, -, use of back-flow compensator

(<u>Nov 2000 C</u>)

#MEASUREMENTVAR	=	12, 0, -, electronic cone penetration test

(<u>Nov 2000 N</u>)

#MEASUREMENTVAR	=	13, 1.52, m, pre-excavated depth

(<u>Nov 2000 N</u>)

#MEASUREMENTVAR	=	14, 0.10, m, groundwater level with respect to datum in ZID

(<u>Nov 2000 N</u>)

#MEASUREMENTVAR	=	16, 57.52, m, End depth of probe
#MEASUREMENTVAR	=	17, 6, -, Stop criteria: obstacle
#MEASUREMENTVAR	=	20, 0.000, MPa, zero measurement before penetration test
#MEASUREMENTVAR	=	21, -0.001, MPa, zero measurement after penetration test,
#MEASUREMENTVAR	=	22, 0.0000, MPa, zero measurement friction before penetration test
#MEASUREMENTVAR	=	23, 0.0002, MPa, zero measurement friction after penetration test
#MEASUREMENTVAR	=	26, 0.0000, MPa, zero measurement PPT u2 before penetr. test
#MEASUREMENTVAR	=	27, 0.0003, MPa, zero measurement PPT u2 after penetr. test

#MEASUREMENTVAR	=	32, 0.01, gr, zero measurement inclination NS before penetr. test
#MEASUREMENTVAR	=	33, -.02, gr, zero measurement inclination NS after penetr. test
#MEASUREMENTVAR	=	34, 0.01, gr, zero measurement inclination EW before penetr. test
#MEASUREMENTVAR	=	35, 0.03, gr, zero measurement inclination EW after penetr. test

(April 2004 C)

#REPORTCODE	=	GEF-CPT-Report, 1,1,0, -
#PROJECTID	=	CT, 380731, 02
#RECORDSEPARATOR	=	!
#REPORTDATAFORMAT	=	F7.2 F7.3 F8.4 F8.4 F5.1 F5.1 F9.2 F9.3 F6.2 I6 F7.2
#SPECIMENVAR	=	1, 0.00, m, 15 = pure peat
#SPECIMENVAR	=	2, 0.40, m, 10 = sand clayish
#SPECIMENVAR	=	3, 0.80, m, 20 = gravel silty
#SPECIMENVAR	=	4, 1.30, m, 15 = pure peat
#STARTDATE	=	1998, 02, 01
#STARTTIME	=	10, 03, 59
#STRUCTURETEXT	=	COLUMNINFO, column number in data block, unit, quantity, quantity-number
#STRUCTURETYPE	=	COLUMNINFO, integer, string, string, integer
#TESTID	=	C2-366

(Nov 2000 C)

#XYID	=	31000, 123456.543, 110011.22, 0.001, 0.01

(Nov 2000 C)

#ZID	=	31000, 2.01, 0.01
#EOH	=	

(Nov 2000 C) (all data are corrected)

1.52:0.382:0.0127:-0.0021:0.2:0.4:1.52:0.384:3.32:1:-0.02:!
1.54:0.382:0.0137:0.0045:0.2:0.4:1.54:0.379:3.59:2:-0.01:!
1.56:0.375:0.0151:0.0126:0.3:0.3:1.56:0.366:4.03:3:0.00:!
1.58:0.375:0.0164:0.0191:0.2:0.4:1.58:0.361:4.37:4:0.00:example commentary text 1!
1.60:0.414:0.0169:0.0051:0.3:0.4:1.59:0.410:4.08:5:-0.01:!
....
57.54:21.648:0.3706:0.0407:8.6:5.2:57.39:21.619:1.71:3987:-0.53:!
57.56:18.683:0.369:0.1252:8.6:5.1:57.41:18.593:1.98:3988:-0.45:!
57.58:16.735:0.3643:0.2507:8.6:5.2:57.43:16.554:2.18:3989:-0.33:!
57.60:15.499:0.3722:0.4095:8.5:5.2:57.45:15.204:2.40:3990:-0.17:example commentary text 2!
57.62:16.239:0.386:0.5281:8.5:5.2:57.47:15.859:2.38:4438:-0.05:!
57.64:18.495:0.3914:0.5549:8.5:5.1:57.48:18.095:2.12:4440:-0.02:!

(<u>Nov 2000 I</u>) Sections 5.1, 5.2 and 5.3 are added.

5   HINTS AND TIPS

5.1   Special characters in GEF

In GEF the hash (#), the equals sign (=) and the comma (,) have a special meaning. # signals the start of a new code word, = signals the end of a code word while the comma separates two fields of information. Therefore it is not possible to use these signs as part of a field without special precautions. In order to use these characters, they have to be taken literal. The same method as in the Unix operating system is applied: escaping special characters with a backslash. This makes the backslash a special character as well.

Example. In reporttext 201 the following text has to be stored: "Height = 15 m, lot #3". The unambigual way to store this info is:

```
#REPORTTEXT = 201, Height \= 15 m\, lot \#3, -
```

The general GEF software stores this information as: "Height \= 15 m\, lot \#3" (without the double quotes). The function to retrieve the text (in this case: get_reporttext_tekst) returns the text exactly as it was stored: Height \= 15 m\, lot \#3. The CUR committee has decided that it is up to the user to add and remove these backslahses, when he applies e.g. reporttexts in a graphical representation of a CPT.

5.2   Pre-excavation

There are several reasons to perform a CPT. One of them is characterisation of the subsoil. If by any means cone penetration is not possible within the first few meters below ground level, e.g. due to cobbles, bricks etc., such a layer is removed. CPT data on this layer is not available. The CUR committee strongly advises to characterise the layers, which are not covered by the actual CPT. The code words Specimenvar and Specimentext are suited for the description or characterisation of soil samples.

Example. A layer of 0.75 meter is pre-excavated due to stray bricks. The type of soil is reported by:

```
#measurementvar = 13, 0.75, m, pre-excavated depth
#specimenvar = 1, 0.25, m, peat with plant roots and bricks
#specimenvar = 2, 0.4, m, clay very silty and bricks
#specimenvar =3, 0.75, m, silt moderate sandy and bricks
```

The levels reported in the value field of the specimenvar's are the lower boundary of the layer. Their values are expressed as a length; its origin is the fixed horizontal level, as reported in measurementtext 9.

5.3   Coordinate systems and their units

The code words XYID and ZID provide information about the location of a test. The first field of these code words state the type and nature of the coordinate system. Each coordinate system uses units. ZID referring to the NAP datum is expressed in meters, XYID referring to RD (31000) is expressed in meters, whereas geographical coordinates (00001) are expressed in degrees.

When local coordinates (00000) are being used, their units are unknown. The CUR committee advises to report the units of any local coordinate system (meters, feet, fathoms or furlongs) in the appropriate measurementtexts 7 and 8.

Example. A CPT is performed 15 m perpendicular to the fence of an airport. The elevation of the ground level is 2.54 m lower than the top of the foundation of the adjacent 380 kV pole. The code words in the header should read:

```
#MEASUREMENTTEXT = 7, measured perpendicular to the fence of the airport in meters
#MEASUREMENTTEXT = 8, measured with respect to the top of the foundation of the
                      adjacent 380 kV pole in meters
#XYID = 0, 15
#ZID = 0, -2.54
```

6 WHAT IS VERIFIED BY *GEF VERIFICATION*

When the program *GEF Verification* is started an empty screen is shown. The program is operated by using the menu options or optionally by using the toolbar of which the buttons represent some of the common functions in the menus.

File® Open

This opens a GEF-file. A file selection box allows the user to browse directories for GEF-files. By default only files with the extension .GEF are shown, but this can be changed in the 'show files of type' box. To select a batch (=multiple files) the shift and control buttons must be used in combination with the mouse. After opening the verification is automatically performed and the verification log is shown on the screen.

File® Close

This closes GEF-files that have been opened. The screen will appear empty again.

File® Save logfile as…

The verification log can be saved in text format as a file with a filename that can be chosen by the user. Use the .TXT extension if you would like the file to open with Notepad.

File® Convert NENGEO Files…

This converts NENGEO-files to GEF-files. The file open box automatically lists files with a .SON extension. As in File:Open it is possible to change this extension and in the same way it is possible to select multiple NENGEO-files. After selection the files are automatically converted to GEF-files and saved in the same directory with the same name but with the extension .GEF instead of .SON. It is not possible to convert NENGEO files which contain multiple sessions. If a corrupt NENGEO file or a NENGEO file with multiple sessions is encountered the user is informed that the file can not be converted.

File® Exit

This exits *GEF Verification*

View® Verification

The screen can only display one of the three views at a time:
Verification, File or Curve.
The verification view shows the log file with the verification results.

ViewⓇ**File**

This option can only be selected if a single file is opened. The content of the GEF-file is shown in text format.

ViewⓇ**Curve**

This option can only be selected if a single file is opened and the errors found in the verification are not related to errors in the data block. It shows graphs of the 4 most important quantities (if present) in a GEF-CPT-Report file as a function of depth.

ViewⓇ**Toolbar**

Toggles between showing the toolbar or not.

ViewⓇ**Statusbar**

Toggles between showing the statusbar or not.

Options

Toggle between:

- Only verifying the header of the GEF-file
- Verifying both the header and the data block of the GEF-file.

About

Displays the about box

6.1 Verification of GEF

A CPT-file in GEF-CPT-Report format consists of a header and a data block section.
GEF Verification verifies the following:

#GEFID in first line

If the first line does not contain the #GEFID code word no further checks will be done. The file is considered not to be a GEF-file

Code word identification

The header sequentially searches for code words which must always start with a '#'-sign. The end of the code word is indicated by the '='-sign. Between the code word and the '='-sign, space is allowed.
An error is reported if after 1024 characters a '#'-sign has not been found.
An error is reported if a '#' is found, but after 1024 characters a'='-sign misses.
An error is reported if a code word is unknown.

Checking the number of parameters

After the '='-sign a code word has a certain number of parameters separated by comma's. Some parameters are obligatory, others are optional. An error is reported if the number of parameters is smaller than the minimum number of obligatory parameters or larger than the maximum number of parameters possible for the specific code word.

Type-checking the parameters

An error is reported if a parameter has the wrong type. For example if a certain parameter is a string(text), but an integer(number) is expected, this will be reported

Repeated code words

Some code words can only be used once. Others can be used more often, but only once, in combination with a certain parameter (for example with a certain column). *GEF Verification* reports an error if code words are encountered which have already been used or have already been used in combination with a certain parameter.

Warning for wrong version

GEF Verification 1.0 verifies GEF-CPT-Report 1.0.0. If a GEF-file has a different version the software reports a warning.

Obligatory code words in GEF-CPT-Report

The following code words are obligatory code words in GEF-CPT-Report only:

- #GEFID
- #COLUMN
- #COLUMNINFO for each column
- #COMPANYID
- #FILEDATE
- #FILEOWNER
- #LASTSCAN
- #PROCEDURECODE
- (Nov 2000 N) either #PROCEDURECODE and or #REPORTCODE
- #PROJECTID
- #TESTID
- (Nov 2000 N) #ZID
- (Nov 2000 N) #MEASUREMENTTEXT = 9, etc
- #EOH

(April 2004 N)
- In version 1,0,0 the keyword #PROCEDURECODE = GEF-CPT-Report, 1, 0, 0 is mandatory.
- In versions 1,1,0 and up, either #REPORTCODE = GEF-CPT-Report, 1, 1, 0 (or #PROCEDURECODE = GEF-CPT-Report, 1, 1, 0) is mandatory. The use of Reportcode is preferred. In the exceptional case that both Reportcode and Procedurecode are present, the

contents of procedurecode is neglected when determining the type and version of a GEF-CPT-Report file.

If any of these code words was not found after searching the entire file, an error is reported.
If the #COLUMN or #LASTSCAN code word are, missing **GEF Verification** does not have enough information to start reading the data block. Consequently, the curve cannot be displayed.

Check the parameters of #COLUMNINFO

The code word #COLUMNINFO assigns a certain parameter like cone resistance, friction ratio, pore water pressure, corrected depth, slope etc. to a specific column number in the GEF-file. Each parameter has its own unambiguous identification number.
An error is reported if a parameter is assigned to two different columns, since this would create an ambiguous situation when locating the correct column for a specific parameter.
An error is reported if parameter 1 'Length' or parameter 2 'Cone Resistance' have not been assigned to a column. The definition of the GEF-CPT-Report file format says these parameters *must* be present in the file.

Check data block

In the header it is optionally possible to specify a column separator and a record separator. It is also possible to allow the use of extra text in the data block if the #COLUMNTEXT code word is used.
GEF Verification reads the data block and *stops* if an error occurs. If this error occurs, the type of error is reported. If an error occurs when reading the data block, it is not possible to view any curves.

Minimum and maximum values of the columns

If the data block has been read, it is possible to calculate the minimum and maximum value of each column. These values can be compared to the minimum and maximum values stated by the (optional) code word #COLUMNMINMAX in the headerblock and tested for. If the comparison gives different values, an error is reported.

APPENDIX 1:

GLOSSARY FOR STANDARDISING DIGITAL DATA OF CONE PENETRATION TESTS

The table below briefly describes all the concepts used.

Concept	Description
[integer]	integer number, no decimals allowed
[character]	a number, character or punctuation mark
[number]	integer number, no decimals allowed
[text]	numbers, characters, punctuation marks
apparatus	probe apparatus and data acquisition system to perform cone penetration test (pushing, measuring, registering and storing)
ASCII	American Standard Code Information Interchange
back-flow compensator	facility to compensate the probe length for upwards movements of the probe housing
calculated columns	column data stored in GEF and calculated externally, based on known calculation formulae where appropriate
calculation formula	formula for calculating new quantities, such as friction figure is the quotient of skin friction and cone resistance, using (different) measurement data possibly supplemented with extra parameters
calculation procedures	software component which converts measured data into calculated data
character	single readable character
class of the penetration	one of the three NEN 5140-defined (quality) classes test in accordance with NEN 5140
code words	words defined in GEF, also described as a string name
computer system	such as DOS, Unix, Apple
cone penetration test	measurement of the mechanical soil resistance using a cone over the specified depth of traject
Cone Penetration Test Report format	CPT-Report, using GEF
cone resistance q_c	the resistance needed during the penetration test to move the cone tip
cone tip	part of the penetration cone which defines the tip resistance q_c
column	collection of data defined using the same fixed position on a line of each individual registration with the depth/time
column information	definition of the content and description of a data column in the file
column number	the number of a column
compulsory measurement values	length and cone resistance (minimum content)
coordinate system	definition used for x,y, and sometimes z coordinates, such as the Geographical coordinate system: longitude and latitude
corrected cone resistance q_t	the cone resistance corrected for the difference in pore water pressure below and above the cone tip
corrected depth	depth of the penetration cone, measured beneath a fixed horizontal reference level, taking into account the deviation of the casing with respect to the vertical
country code	code of the country for defining the reference height level
CR/LF	control characters which indicate the end of a line
data block	part of the file where the measured and calculated data are stored in

Concept	Description
	accordance with the definition specified by the header block
data, calculated	data calculated using the known calculation formulae
data descriptive	data describing its own contents
data, fixed	static data
data format	definition of the data storage
date of penetration test	day on which a CPT was carried out, given as dd-mm-yyyy
(Nov 2000 C) yyyy,mm,dd	description of the year with four characters, the month with two characters, the day of the month with two characters
default value	value which applies if no other value is input
(Nov 2000 I) depth	length of the projection on a vertical line, of the path of the penetration.
depth of first observation	depth below the selected horizontal (fixed) reference level used to register the data which can be considered as in-situ measurements (for example pre-test, -excavating or -drilling)
digital	in symbols, coded, used to store documents via computers
dimension	see unit
dissipation test	specifying the change in pore water pressure in the penetration cone in the time at a constant depth after the penetration cone is stationary
effective vertical soil $\sigma'_{v;0}$ stress	calculated effective vertical granular stress, being the total wet weight per surface area of the above-lying soil minus the prevailing pore water pressure
(Nov 2000 I) elevation	position of a point with respect to a datum.
executing company	name of company performing the cone penetration test
excess pore pressure ratio DPPR	ratio number between measured excess pressure and the cone resistance q_c :DPPR = $(u - u_o)/q_c$
figure	decimal number
file	digital file
file descriptive	definition of a digital file including its definitions used for storage, such as definition of the foundation for the description (GEF version number, for example)
file tracing	possibility to trace who created the file
final depth	depth at which the cone penetration test stops
fixed position	defined place in GEF
format	the only word which in principle cannot be used in this project, in combination with other words intended as (agreed) structure of...
friction figure R_f	quotient of local friction and cone resistance
GEF definition	definition of the GEF format in written form
Geotechnical Exchange Format	agreed name of the exchange format
inclination (resultant not direction-oriented)	deviation from the vertical in degrees
inclination EW	deviation from the vertical in EW direction in degrees
inclination NS	deviation from the vertical in NS direction in degrees
groundwater level	level of the groundwater beneath the ground level
header block	part of the file which describes the stored data
height of the selected horizontal reference level (= usually	height

Concept	Description
ground level) beneath fixed reference level	
identification number of penetration test	number of the cone penetration test for internal processing
in-situ, initial water pressure u_o	prevailing static pore pressure in the soil
interruptions	temporary interruption of one or more components of the penetration process
keywords	not used, see code words
scan	a collection of measurement values for one depth
maximum value	maximum registered measurement value of a parameter during a cone penetration test
measured cone resistance q_c	the resistance necessary to move the cone tip downwards during the cone penetration test
measurement elements	the part of the apparatus used to register the measurement values (e.g. the stretching gauge for the cone tip and not the probe rod)
measurement data	collection of measurement values
measurement procedures	pre-written series of actions to collect measurement data
measurement scan	in principle not used (see measurement data)
measurement texts	in principle not used (description uses code words, column information and columns)
measurement variables	in principle not used (description uses code words, column information and columns)
measurement value	a measured value
measurement	the collection of measured values (such as cone resistance)
minimum values	minimum registered measurement value during a cone penetration test
mm	description of the month of the year with two characters
NEN 3680	Dutch Standard for performing cone penetration tests (only valid for mechanical penetration tests)
NEN 5140	Dutch Standard for performing electronic cone penetration tests
net cone resistance q_n	cone resistance corrected for pore pressure and the effective vertical soil stress
net surface area quotient	ratio of the gross surface area to the net surface area above the cone tip in relation to the action of pore pressure
number	an integer number
original information sources	information about who created the file
order number	order number defined by the user processing the file (this can therefore change during the life-time of the file)
parameter	in principle not used, see quantity
remarks	circumstances worth mentioning during measurement which may influence the interpretation of the results, such as a power failure
point of time when penetration test starts	hour, minute, seconds since start of the cone penetration test or recording the zero measurements
pore pressure u_1	measured pore pressure in the cone tip
pore pressure u_2	measured pore pressure directly behind the cone tip
pore pressure u_3	measured pore pressure directly above the friction casing
pore pressure ratio B_q	ratio number between measured excess pore pressure and the cone

Concept	Description
	resistance q_c corrected for the total soil pressure $B_q = (u-u_o)/(q_c-\sigma_{vo})$
print format	format of printed values
penetration cone	instrument used to measure the mechanical soil resistance
penetration data	data collected using the penetration cone
penetration length	distance traversed by the penetration cone in the soil
penetration location	location of the starting point of the cone penetration test
penetration report	report of the measurement results
procedure descriptive	providing a description of the procedure for the evaluation of data
procedures	see measurement procedures
processing	registration/display method (in particular, interruptions)
project information	description of project information which is relevant to file management and reporting
quantities	name of the data in one column
quantity number	number representing the type of data in one column
reference level	fixed level, for example NAP but not curbstone
release	version of the GEF definition
release number	number of the version of the GEF definition
report	form of data transfer to the client
results	in principle not used, see calculated data
results, deduced	in principle not used, see calculated data. The distinction between deduced and 'ordinary' results is formed by defining the relationship between measured and calculated data; empirical formulae are used for the deduced results.
separating character	defined character which indicates the division between two columns
friction	friction along the friction casing
friction casing	cylindrical part of the probe cone, directly above the cone tip, which measures the friction along the cone casing
standard	definition agreed and confirmed by standardisation institute for actions, qualitative or procedural
stop criteria	defined type of exceeding of one or more of the requirements of the cone penetration test
structure	defined structure
structure information	definition of the structure
text	readable text of 256 characters maximum, without commas or #s
text field	string
time	time passed since the start of the cone penetration test or recording the zero measurements
total vertical soil pressure, σ'_{v0}	calculated total wet weight per unit area of the soil above
type of penetration test	cone (resistance) possibly supplemented by local friction
unit	for example MPa, m or %
unusual circumstances	circumstances worth mentioning during the cone penetration test which may influence the interpretation of the result, such as an exceptional groundwater level
weight per unit volume, γ	weight of wet soil in weight per unit volume
water depth	depth of the bottom of the water with respect to the water surface
PPT filter (u_1, u_2, or u_3)	filter that only allows water to pass (or any other liquid) and

Concept	Description
	protects the pore pressure transducer against contact with soil grains
X and Y coordinates	horizontal coordinates
yyyy	description of the year using four characters
Z coordinate	vertical coordinate
zero measurement	read-out of the constant value of a measuring instrument, without the instrument being affected
zero drift	change in the zero value during or after a test
zero values	measured value during the zero measurement