



NET4GAS, s.r.o.

**HP PIPELINE DN 1400,
NODE KATEŘINSKÝ POTOK –
NODE PŘIMDA
EARTHWORKS – SPECIFICATION**

14.06.2018

DVZ

ILF CONSULTING ENGINEERS

Werner-Eckert-Strasse 7, 81829 München, DE
Jirsíkova 5, 186 00 Praha 8, CZ

Tel: +49 89 25 55 94-0

+420 255 091 420

E-mail: info.muc@ilf.com

info.prg@ilf.com

Web: www.ilf.com



REVISION HISTORY

Rev.	Date	Issue, Purpose	Prepared	Checked	Approved
000	14.06.18	Approved	J. Vaněček	R. Šabata M. Hurník	Y. Schorling
B01	13.04.18	Issue for Review	J. Vaněček	R. Šabata M. Hurník	Y. Schorling
A01	16.01.18	Issue for IDC	J. Vaněček	R. Šabata M. Hurník	Y. Schorling

TABLE OF CONTENTS

1	GENERAL	6
	1.1 Scope of the Document	6
	1.2 Definitions	6
	1.3 Abbreviations	6
	1.4 References	7
	1.4.1 Archive documents	9
	1.5 Codes and Standards	9
	1.6 Terminology	11
	1.6.1 Earthworks Material	11
	1.6.2 Top Soil	11
	1.6.3 Rock	11
	1.6.4 Suitable Material	11
	1.6.5 Unsuitable Material	12
	1.6.6 Fill Material	12
	1.6.7 Open Excavation	12
2	GENERAL REQUIREMENTS	12
3	PROTECTION FOR EXISTING UTILITIES, SERVICES AND PUBLIC	13
4	SAFETY PRECAUTION	13
5	FOUNDATION REQUIREMENTS	14
6	DISPOSAL OF MATERIALS FROM SITE CLEARING	14
7	TOP SOIL STRIPPING	14
	7.1.1 Removal of Top Soil	14
8	SITE GRADING	15
	8.1 Scope of Work	15
	8.2 Excavation pits	15
	8.3 Pipe Trenches	16
9	SUBSURFACE CONDITIONS, SOIL INVESTIGATION	17

EARTHWORKS – SPECIFICATION

14.06.2018

10	SUBSOIL IMPROVEMENT	17
	10.1 General	17
	10.2 Grouting	18
	10.3 Deep Compaction	19
	10.4 Deep Soil Mixing	19
	10.5 Stone columns	20
11	SHEETING AND BRACING	21
	11.1 General	21
	11.2 Sheet piling and Bracing Drawings	21
	11.3 Sheet piling and Bracing Procedures	22
12	PUMPING, DRAINAGE AND WATER DISCHARGE	23
13	EXCAVATION	24
	13.1 General	24
	13.2 Excavation for Structures	25
	13.3 Excavation below Normal Grade	26
	13.4 Subgrade Protection	26
	13.4.1 General	26
	13.4.2 Structures on Flat Foundation	26
14	TRENCH BACKFILL AND COMPACTION	27
	14.1.1 Bedding layer	27
	14.1.2 Backfill	27
15	BACKFILL AND FILL	28
	15.1 General Requirements	28
	15.2 Material Specification	30
	15.2.1 General	30
	15.2.2 Sand or sieved soil for pipe embedding	30
	15.2.3 Structural back fill or fill	31
	15.2.4 Engineering back fill and fill	31
	15.2.5 Non-bearing back fill	32
	15.3 Back Fill and Filling Special Requirements	32

HP Pipeline DN 1400, Node KP – Node Přimda	C4G-HPPL-ILF-GENER-STA-SPC-800-000
EARTHWORKS – SPECIFICATION	14.06.2018
15.3.1 New Paved Areas	32
15.3.2 Common Back Fill and Fill	33
16 COMPACTION OF BACK FILL AND FILL MATERIAL	33
16.1 General Requirements	33
16.2 Compaction Requirements	34
16.3 Testing	36
17 SOIL REPLACEMENT	37
18 COMPACTION EQUIPMENT	37
19 TOLERANCES	37
20 DISPOSAL OF EXCAVATED MATERIAL	37
21 PLACING OF TOP SOIL AND RECULTIVATION	38

TABLES

Table 1: Grain size distribution of stone columns	20
Table 2: Sieve curve for structural back fill or fill	31
Table 3: Sieve curve for engineering back fill or fill	32
Table 4: Compaction requirements within stations	34
Table 5: Testing requirements	36

1 GENERAL

1.1 Scope of the Document

This specification and scope of work contains the requirements for the earthworks for the construction of the new HP Gas Pipeline DN 1400 between Distribution Node Kateřinský potok and Distribution Node Přimda.

1.2 Definitions

Term	Explanation
Project	HP Pipeline DN 1400, Node Kateřinský potok – Node Přimda
Employer, Client	NET4GAS
Consultant Project Engineer	ILF Consulting Engineers
General Contractor	The company or group of companies entrusted by the Employer with Engineering, Procurement and Construction of the project.

1.3 Abbreviations

Term	Explanation
BFS	Bottom Feed System
BTS	Border Transfer Station
CBR	California Bearing Ratio
CGS	Czech Geological Survey (Geofond)
CS	Compressor Station
ČSN	Czech National Standard
DIN	German Institute for Standardization (Deutsches Institut für Normung)
DN	Diameter Nominal

Term	Explanation
EN	European Norm
FOC	Fibre Optic Cable
GDO	Geologically Documented Object
GS	Geological Survey
GWL	Ground Water Level
HP	High Pressure
ISO	International Organisation for Standardisation
PS	Proctor Standard
RU KP	Distribution Node Kateřinský potok
RU Přimda	Distribution Node Přimda
TPG	Technical Regulation for Gas

1.4 References

No.	Number	Title
1	C4G-HPPL-ILF-GENER-GEN-MAN-900 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Feasibility Study (Basis of Design)
2	C4G-HPPL-ILF-GENER-GEN-SEZ-840 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA List of Relevant Regulation, Standards and Specifications
3	C4G-HPPL-ILF-GENER-GEN-SEZ-843 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA List of Relevant N4G Standards
4	C4G-HSKA-ILF-GEN0B-GEN-TZP-011 (Last valid revision)	CAPACITY EXTENSION OF BTS HORA SVATÉ KATEŘINY F.4.1 Geological Report

No.	Number	Title
5	C4G-JI73-ILF-KS007-GEN-TZP-011 (Last valid revision)	COMPRESSOR STATION JIRKOV 73 BAR F.4.1 Geological Report
6	C4G-HPPL-ILF-GENER-GEN-TZP-032 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Geological Report
7	C4G-HSKA-ILF-GEN0B-GEN-TZP-013 (Last valid revision)	CAPACITY EXTENSION OF BTS HORA SVATÉ KATEŘINY F.4.2 Pedological Survey – Report
8	C4G-JI73-ILF-KS007-GEN-TZP-013 (Last valid revision)	COMPRESSOR STATION JIRKOV 73 BAR F.4.2 Pedological Survey – Report
9	C4G-HPPL-ILF-GENER-GEN-TZP-013 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Pedological Survey – Report
10	C4G-HPPL-ILF-GENER-GEN-TZP-011 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Geotechnical Survey – Report
11	C4G-HSKA-ILF-GEN0B-GEN-TZP-018 (Last valid revision)	CAPACITY EXTENSION OF BTS HORA SVATÉ KATEŘINY F.4.10 Undermined Areas Survey – Report
12	C4G-HPPL-ILF-GENER-STR-SPC-802 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Construction Specification
13	C4G-HPPL-GENER-GEN-POS-910 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Principles of Construction Organisation – Pipeline

No.	Number	Title
14	C4G-HPPL-GENER-GEN-POS-911 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Principles of Construction Organisation – Stations
15	C4G-HPPL-ILF-GENER-LIN-VYK-005 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Typical Drawing – Pipeline Ditch
16	C4G-HPPL-ILF-GENER-STA-VYK-010 (Last valid revision)	HP PIPELINE DN 1400, NODE KP – NODE PŘIMDA Typical Drawing – Excavation, Backfill and Compaction for Station Pipeline and Piping
17	C4G-HSKA-ILF-GEN0B -STA-SPC-800 (Last valid revision)	CAPACITY EXTENSION OF BTS HORA SVATÉ KATEŘINY Earthworks – Specification
18	C4G-JI73-ILF-GENER-STA-SPC-800 (Last valid revision)	COMPRESSOR STATION JIRKOV 73 BAR Earthworks – Specification

1.4.1 Archive documents

- RWE Plynoprojekt, 2008: Geological Assessment (archive no. PNP-6-88282)
- PNP Plynoprojekt, 1972 to 1999: Geological Report (archive no. PNP-6-79367)
- UPO, 1995: Geological Report (section Bylany – Hora Svaté Kateřiny)
- Geostar, 2010: Gazelle Gas Pipeline – Soil Investigation (Final Report)
- K-GEO, 2017: BTS HSKA + CS Jirkov 73 bar – Soil Investigation (Final Report)
- Otýs, 2008: Undermined Areas Survey for HP gas pipeline DN 1400 (Report)

1.5 Codes and Standards

No.	Number	Title of standard
-----	--------	-------------------

No.	Number	Title of standard
1	ČSN 72 1006	Compaction control of engineering fills (07/2015)
2	ČSN 72 1018	Laboratory determination of relative mature of cohesionless soils (04/1971)
3	ČSN 73 3050	Earth works. General requirements (09/1987 – 03/2010)
4	ČSN 73 6133	Road earthwork – Design and execution (03/2010)
5	ČSN 73 6186	Test method for the determination of California Bearing ratio and immediate bearing index in-situ (02/2011)
6	ČSN EN 1594	Gas infrastructure – Pipelines for maximum operating pressure over 16 bar – Functional requirements (03/2014)
7	ČSN EN 1610	Construction and testing of drains and sewers (05/2017)
8	ČSN EN 1990 ed. 2	Eurocode: Basis of structural design (04/2004)
9	ČSN EN 1997-1	Eurocode 7: Geotechnical design – Part 1: General rules (09/2006)
10	ČSN EN 1997-2	Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing (03/2008)
11	ČSN EN 13286-2	Unbound and hydraulically bound mixtures – Part 2: Test methods for laboratory reference density and water content – Proctor compaction (04/2011)
12	ČSN EN 13286-47	Unbound and hydraulically bound mixtures – Part 47: Test method for the determination of California Bearing ratio, immediate bearing index and linear swelling (12/2012)
13	DIN 18134	Soil – Testing procedures and testing equipment – Plate load test (04/2012)
14	TDG 702 07	Calculation method for bearing capacity of protection pipes (12/2004)

No.	Number	Title of standard
15	TPG 702 04	Steel gas pipelines and service pipelines for the maximum operating pressure up to 100 bar inclusive (01/2014)
16	TPG 702 05	Bracing gas piping inside hillsides (2/2016)
17	TPG 920 21	Corrosion protection of underground steel constructions, Selection of coating systems (04/2014)
18	TP_T01_01_01_03	Principles for planning, building, refurbishing, and repairing high-pressure gas pipelines and connections up to 100 bar (02/2015)
19	TP_D02_00_01_01	Technical requirements regarding construction, repairs and upgrades of NET4GAS' cable routes (02/2014)

1.6 Terminology

1.6.1 Earthworks Material

Earthworks material is material of a soil or rock type which is on or below the site at the commencement of the Contract, or which is imported to the site to carry out the works.

1.6.2 Top Soil

Top soil shall mean the top layer of soil that can support vegetation.

1.6.3 Rock

Rock shall mean hard naturally occurring materials which require the use of blasting or approved pneumatic tools for removal but excluding individual masses less than 0,50 m³.

1.6.4 Suitable Material

All material which is acceptable in accordance with the Contract for use in the bulk earthwork is suitable material.

1.6.5 Unsuitable Material

Material containing any of the following shall be deemed to be unsuitable material.

- Material susceptible to swell, soil with a liquid limit exceeding 80 % and/or a plasticity index, exceeding 55 %, highly reactive clays and collapsible soils
- Peat, vegetation, timber, organic, soluble or perishable material
- Dangerous or toxic material or material susceptible to combustion
- Metal, rubber, plastic or synthetic material
- Material having a moisture content greater than the maximum permitted for such materials in the Contract

Materials not meeting the specification requirements for use in the bulk earthworks, including material exceeding specified moisture content limits and/or compacted dry density.

1.6.6 Fill Material

Fill material shall consist of naturally occurring or processed material which at the time of deposition is capable of being compacted in accordance with the specified requirements and has material properties meeting the requirements of the Specification.

1.6.7 Open Excavation

An open excavation is an excavation in open cut without any support of the side slopes.

2 GENERAL REQUIREMENTS

The Contractor shall submit a corresponding method statement for approval by the Project Engineer before starting any particular excavation.

All earthworks are to be performed by the Contractor in such way that they can be checked at any time.

The Contractor bears the sole responsibility for the correctness of his work.

The Contractor bears the sole responsibility for the stability of the side slopes of excavation.

Before the commencement of any earthwork the location of underground services, such as cables, pipes, channels etc. shall be investigated and marked out.

The Client has the right to inspect the work of the Contractor and give instructions at any time.

The Contractor is responsible to provide adequate flood prevention measures in and around the area of the site.

All backfilled or cut slopes at the site shall be protected against washouts or erosion.

3 PROTECTION FOR EXISTING UTILITIES, SERVICES AND PUBLIC

During construction the Contractor shall provide all necessary protection for existing utilities, services and public as may be required by his construction operations.

Permanent protection of certain items shall be as included under other section or as instructed by the Project Engineer.

In addition to the requirements as specified herein, the Contractor shall comply with the following requirements.

- Use all necessary precautionary and protective measures required to maintain existing utilities, services and appurtenances that must be kept in operation. In particular the Contractor shall take adequate measures to prevent undermining of utilities and services presently in service.
- Protecting existing or new utilities and services where required by the Contractor operations and/ or as directed by the Project Engineer. The Contractor shall be responsible for bracing and supporting utilities and services to prevent settlement, displacement or damage.
- The contractor shall use all means necessary to control and minimize dust on roads, construction areas and borrow pits. Surfaces shall regularly watered to prevent dust becoming a nuisance for the public and interfering with the proper execution of the works.

4 SAFETY PRECAUTION

The Contractor is responsible for all necessary safety measures.

Wherever necessary, the sides of excavations in cuts are to be secured by means of support such as timbering, sheet-steel piling, or sprayed concrete (with alluvium anchors when deemed necessary).

The means of support chosen are to be to the fullest satisfaction of the Project Engineer. The Contractor is responsible for all temporary support measures carried out in the excavations.

The excavation is to be conducted by the Contractor in such a way that disturbance of surrounding soil is prevented.

Particular care is to be taken with regard to the maintenance of stability when excavating in the vicinity of already existing works. The Contractor is to comply with all the instructions of the Project Engineer as to the securing of the sides of the excavation. In doing so, however, he is not exempted from any of his responsibilities as stated in the contract. No timber or other supporting material is to be left in any excavation without specific approval.

Proper strutting, sheeting and bracing, including re-arrangement of the installations shall be carried out when necessary to achieve stabilization and protection of slopes. Methods of excavation to reduce risks of slides, etc. shall be the Contractor's expense.

5 FOUNDATION REQUIREMENTS

The Contractor shall submit to the Client for approval the detail foundation design including proposed methods for soil improvement. Foundations shall be designed according to relevant Eurocodes with National Annexes of these standards.

Maximum allowable settlement for design of foundations and other support structure must not exceed the values specified in ČSN EN 1997-1 (Table NA.1 – Limiting values of settlement).

6 DISPOSAL OF MATERIALS FROM SITE CLEARING

In general all tree trunks, limbs, roots, stumps, brush, foliage and other vegetation shall become the property of the Contractor and shall be removed and disposed of by him off the project site. Other materials shall be removed from the site and disposed of at approved dumping areas. More details about disposal of material shall be specified in documents "Principles of Construction Organisation – Pipeline" (no. C4G-HPPL-GENER-GEN-POS-910 – the last valid revision) and "Principles of Construction Organisation – Stations" (no. C4G-HPPL-GENER-GEN-POS-911 – the last valid revision).

7 TOP SOIL STRIPPING

7.1.1 Removal of Top Soil

The top soil shall be removed in the complete thickness defined by the design documentation and Pedological survey and shall be cleared of roots, stones or other contamination. The top soil shall be stored on site separated from other excavation materials.

8 SITE GRADING

8.1 Scope of Work

The Contractor shall furnish all labour, materials, equipment and incidentals necessary to perform all excavation, disposal, backfill, fill and grading required completing work indicated on the drawings and specified herein.

The work shall include but not necessarily be limited to:

- All mass excavation, fill and backfill
- Compactions
- Forming of embankments
- All soil improvement provisions
- Excavation works for any kind of structures, pipe trenches and manholes, traffic and paved areas
- Levelling and compaction of excavation surface
- All related work such as dewatering, etc.
- Construction procedures relative to the stability of excavations for structures and pipelines, such as sloping, sheeting and bracing
- Removal of unsuitable and surplus soil material

The following items form minimum criteria which shall be observed by the Contractor when planning an excavation, sheeting and bracing schedule.

8.2 Excavation pits

A maximum slope according to soil type and determination according to the applicable standards shall be used for open excavation. If excavation is in sound rock sides of excavation may be vertical. The max allowable slope and depth of excavation shall be determined by the responsible geotechnical engineer on site.

Any vertical-sided excavation carried to a depth greater than 1,5 m measured from existing ground level shall be sheeted and braced.

High cut slopes are to be cut step by step unless otherwise directed by the Project Engineer; while doing this, the slopes may by no means be undercut. Cuts in slopes in danger of sliding are to be made in layers (segments) steps (terraces). The slopes are to be secured as quickly as possible after having been laid open according to the instructions of the Project Engineer. At slopes in danger of sliding, drainage and

water gutters must be provided along the ridges of the slopes before earth removal is begun.

During the earth removal works, any water present is to be immediately channelled to the nearest main drainage channel in such a manner that the works can proceed uninterrupted. The water is to be collected in pump sumps and pumped out, in case gravitational water removal methods cannot be employed.

The Contractor have the fully responsibility to protect the excavation pits from ground water and rain water.

The stockpiling of excavated soil, backfill or construction materials within a minimum distance of 1,5 times excavation depth from the top edge of the excavation is prohibited.

All excavation pits shall be marked and lightened against accidents.

Embankments are to be carried out with a maximum tolerance of ± 100 mm to the lines and grades shown in the drawings.

8.3 Pipe Trenches

Excavation shall be completed in accordance with the following trench dimensions if not otherwise stated on the drawings:

- Trench width at the bottom of pipe: pipe diameter + 200 mm (for both sides)
- Trench depth: bottom of pipe + 200 mm
- Width between trench wall and pipeline (cable): 1200 mm (for welding in a trench)

Excavation within stations less than 1,50 m in depth may at the Contractor's option and after approval by the Client be accomplished without sheeting.

Excavations within stations to depths greater than 1,5 m shall be sheeted and braced unless excavation is in sound rock. The maximum depth of excavation in rock without bracing shall be determined by the responsible geotechnical engineer on site.

The sloping of pipe trenches outside stations depends on particular soil conditions. Implementation of excavation shall respect requirements specified in the document "Typical Drawing – Pipeline Ditch" (no. C4G-HPPL-ILF-GENER-LIN-VYK-005 – the last valid revision) and also in ČSN EN 1610 (especially Article 6).

Excavations shall be performed in accordance with design documentation according to ČSN EN 1594, ČSN EN 1610, TPG 702 04, and Government Decree no. 591/2006 Coll., on more detailed minimal requirements on occupational and health safety at construction sites.

The minimum cover above pipes in ditch shall be at least 0,8 m (for normal soil) or 1,1 m (for agricultural land). The minimum cover for cables in ditch shall be min. 1,0 m (for normal soil) or 1,1 m (for agricultural land).

In case of main line trench the excavated material is stockpiled closer than 1,5 times excavation depth, see the typical drawing for ditch.

Excavations and the protection of side slopes and backfill are to be rigidly controlled by the Contractor to the approved schedule. If the Contractor fails to protect side slopes, any resulting damage from a slope failure shall be repaired at the Contractor's expense.

The Contractor have the fully responsibility to protect the pipe/cable trenches from surface water inflow.

9 SUBSURFACE CONDITIONS, SOIL INVESTIGATION

The Contractor may obtain information regarding the nature of the topography and geology of the site from the Geological Report.

The Geological Report is made available to the Contractor for his information only, to be used at his own risk.

In the past soil investigation works have been carried out near interest area (Geostar, 2010). All boreholes (except KB 01 to KB 07, KB 28 to KB 44 and KB 251 to KB 254) are relevant for the new HP Gas Pipeline DN 1400. Geological conditions were also based on a previously performed geological surveys (UPO, 1995 or PNP-6-79367, 1972 to 1999 and K-GEO, 2017) and other archive documents (CGS – Geofond) near this location. Please, refer to Geological and Geotechnical Survey – Reports (chapter “References”).

No claim for extra compensation or extension of time will be considered because of any variation in ground or groundwater conditions between those indicated by the information and those actually encountered in the work.

The Contractor is expected to make such additional examination of the ground as he may feel necessary in order to satisfy himself as to the conditions to be encountered and is responsible for any interpretations that he may place on the information furnished.

10 SUBSOIL IMPROVEMENT

10.1 General

Subsoil improvement means all works contributing to compaction of the subsoil in greater depths as well as the improvement of the soil mechanical characteristics in the subsoil.

Three methods in dependence on soil characteristics are foreseen:

- Grouting
- Deep compaction
- Deep soil mixing
- Stone columns

Surface compaction by means of vibrator-rollers etc. is dealt with in the next chapter entitled "Compaction of Back Fill and Fill Material".

10.2 Grouting

Grouting as a means of subsoil improvement is to be planned for rocky soils only.

If rock is encountered below concrete construction and other supports (foundations) in the course of the drillings, the packer tests for permeability will show whether numerous cracks or voids are to be expected.

If such cracks or voids in the rock give reason to assume that the settlement behaviour will be adversely affected or that vibration will have a negative effect, the rock is to be sufficiently sealed to improve it.

Before grouting is commenced all work particulars, e.g. distribution of boreholes, grouting pressure, grouting sections, kind of grouting material, etc., are to be proposed by the Contractor to the Client for his approval.

If the Client deem the number of grouting to be insufficient, he can order further injections.

The following materials can be used for grouting:

- Suspension (cement-water mixture, possibly with bentonite clay as a stabilizing agent) solutions (all water-glass based chemical methods)
- Solutions (all water-glass based chemical methods)

The Contractor is to submit proof that the chemical components of groundwater or the rock do not react with any grouting material used in such a way as to allow decomposition of the grouting material.

The grouting process is considered finished when no more grouting material can be injected at maximum pressure. If the desired grouting pressure cannot be reached, the velocity and setting speed of the grouting material are to be increased by means of aggregates such as sand, etc.

Should further grouting material be accepted at maximum injection pressure, the grouting process must be continued for at least 10 minutes after having reached maximum grouting pressure.

The Contractor is to keep exact records on the grouting works, indicating all the particulars of these works, for instance the diameter of the drilling, location, position, depth, equipment used, boring time, composition of grouting materials, peculiarities, etc. These reports are to be submitted to the Client within two days at the latest.

Cracks on the surface of the foundation base shall be cleaned to the sound rock and filled with concrete (self-compacting).

10.3 Deep Compaction

Deep compaction is to be performed in (loose) soils below the concrete constructions and other supports (foundations).

This compaction must be performed to such depths as are affected by vibration and the loads imposed by footings.

As regards deep compaction the Contractor has the choice of using vibration and compression or compaction by vibratory replacement depending on the structure of the soil.

The purpose of deep compaction is to improve the subsoil until a modulus of elasticity of at least $E_s = 50$ MPa is obtained.

Accordingly, the Contractor is to indicate the distribution of deep compaction points. In the course of the compaction operations, the degree of compaction and the respective reduction in pore volume are to be determined from the measurement of surface area settlement and relative volume of injected material.

To determine the measure of success of compaction operations, compaction soundings are to be conducted between the individual compaction points before and after the compaction process.

These soundings are to be made using a heavy penetrometer. Verification of deep compaction needs to be checked according to ČSN 72 1006 and ČSN EN 13286-2.

10.4 Deep Soil Mixing

Deep soil mixing is to be performed in (loose) soils below the concrete constructions and other supports (foundations) in order to improve ground performance under imposed load.

Deep soil mixing can be used to improve alluvial ground and disintegrating marlstone up to the depth of approximately 10 m.

If deep soil mixing will be used to improve ground below foundations it has to be applied to the entire whole interest ground area under these structures.

Before deep soil mixing is commenced all work and materials, e.g. distribution and size of pillars of improved ground, kind and amount of material, etc., are to be proposed by the Contractor to the Client for his approval.

10.5 Stone columns

For the foundations under building structures the natural subgrade composed of unsuitable materials (specified in chapter “Disposal of excavated material”) shall be excavated and then refilled with compacted fill material to a minimum thickness of 500 mm. Verification of compacted fill material shall be in accordance with ČSN 72 1006, ČSN 72 1018 and ČSN EN 13286-2.

In order to protect the buildings against unequal settlement especially by the compressor building stone columns are to be performed using BFS method.

This method (BFS) requires the use of a free hanging vibrolance that penetrates the ground through to the lateral vibrations emitted by its tip. During penetration, the subgrade shall be laterally compacted by displacement allowing the vibrolance to create the hole that shall contain the stone column.

When the required depth is reached, the vibrolance is withdrawn to allow the stones to be released from the ground surface into the hole. The stone feeding is done by stages to allow a better compaction of the entire stone column. Each time the hole is filled with stones, the vibrolance goes down again to compact them. This process shall be repeated several times until the stones reach the surface.

Required number, geometry (average length and diameter) and arrangement (space grid and distances) of these stone columns shall be specified in the static calculation of foundations performed by Geotechnical engineer (= Expert).

For the stone column material, grain size distribution is described in the table below. The grain shape shall be sharp edged or only slightly rounded to ensure a sufficient cohesion by mechanical interlocking of the grains.

Table 1: Grain size distribution of stone columns

Sieve opening [mm]	Percentage Passing [%]
100	100

Sieve opening [mm]	Percentage Passing [%]
63	85 – 100
31,5	45 – 80
16,0	30 – 65
8,0	10 – 45
4,0	0 – 15

11 SHEETING AND BRACING

11.1 General

The Terms sheeting and bracing shall cover all necessary methods of support of excavations and vertical support of existing facilities.

Any excavation carried out below 1,50 m depth shall be sheeted and braced unless open excavation with battered slopes is used.

All requirements written below shall be considered in the Method Statement submitted by Contractor.

11.2 Sheeting and Bracing Drawings

The Contractor shall submit to the Client, for approval, drawings of the sheeting and bracing and/or cofferdam systems indicating that the following minimum list of criteria has been incorporated.

All calculations are to be performed by an Expert (= Geotechnical Engineer).

Due allowance for heavy rain and/or high groundwater levels must be made.

Surcharge loading of the sheeting and bracing systems caused by adjacent structures, roadways, walkways, stockpiles of earth fill or construction materials or equipment of any other reason shall be considered.

Dimensions and cross sections of used materials for sheeting and bracing (I-sections, sheet piles, pile curtains, wooden shoulders, anchors, supports and props etc.) also needs to be checked by static calculation.

The overall stability of the excavation and the stability of the bottom of the excavation (against failure by piping and failure by hydraulic heave) shall be analysed according to ČSN EN 1997-1.

11.3 Sheeting and Bracing Procedures

The Client will require that the drawings for the sheeting and bracing system be submitted for approval at least 45 working days prior to the anticipated date of installation.

Approval of the drawings by the Client is for approval only insofar as it affects the finished work, and such approval will not relieve the Contractor of the responsibility in any manner for the adequacy of the design for strength and for the safety of the labourers and inspectors working therein.

If at any time during the course of the work the Client is of the opinion that at any points sufficient or proper supports have not been provided, he may order additional supports to be put in at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports.

The Contractor shall furnish, put in place, and maintain such wood and/or steel sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation necessary for proper construction, and to protect adjacent structure, utilities, roadways and bridges from undermining or other damage.

Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled with suitable fill material and compacted in accordance with ČSN 72 1006 and ČSN EN 13286-2.

When any open excavation is carried out near or under any existing buildings, services, mains, cables and paved surface such as roads, liable to be damaged by settlement, the Contractor shall provide the necessary shoring to prevent damage, whether such existing facilities are indicated on the drawings or not.

The Contractor shall leave in place to be embedded in the backfill all steel and wood sheeting and bracing which the Client may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to people, then structures, utilities or property, whether public or private.

All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with suitable fill material and compacted with tools especially adapted to that purpose, by watering or otherwise as may be directed.

The Client may direct that timber used for sheeting and bracing be cut off at any specified elevation.

The right of the Client to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

No wood sheeting or bracing is to be completely withdrawn if driven below the centre line of any pipe and under no circumstances shall any sheeting or bracing be cut off at a level lower than 300 mm above the top of any pipe.

Wood for bracing and sheeting shall be of adequate section and quality and shall be sound, and free from knots, twists or other weakening effects.

Steel sheeting shall conform according to the applicable standard. The sheeting shall be braced at all times to prevent slips and cave-in of walls or subsidence of adjacent areas.

The system of bracing shall allow for the temporary removal of cross struts. The removal of bracing that allows the sheeting to take lateral loads acting as a cantilever will not be permitted.

12 PUMPING, DRAINAGE AND WATER DISCHARGE

Prior to commencement of work, the contractor shall submit to the client for approval its proposed program and relevant permit for drainage, which shall be in accordance with Section 8 of Act no. 254/2001 on water; and the program for excavation and prevention their flooding. This shall include a detailed description of all pumping arrangements, equipment he proposes to employ and plans and sections of any proposed dykes around excavation.

Earth dykes shall not be constructed within 5 meters of the top of slope of an open excavation. The area enclosed by the dyke shall be sloped to drain to prevent gathering of water.

Only equipment, methods and a program which has been approved by the Client shall be used. However, this approval shall not relieve the Contractor of the responsibility for the satisfactory performance of the drainage system.

The Contractor shall construct all concrete works, pipe works and fills in the dry.

The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations, including groundwater, surface water and rainfall, and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until structures, pipes or fills to be built thereon have been completed to such extent

that they will not be flooded or otherwise damaged, by allowing water level to return to natural elevation.

Dewatering shall be such as to prevent boiling or detrimental under seepage at the base of excavation or the movement of water through or alongside any concrete being placed.

Pumping water from excavations onto pavement in such a manner as to cause dirt to settle out on pavement or in existing drains shall not be permitted.

If it is necessary to interrupt existing drainage, the Contractor shall provide temporary drainage facilities that will prevent damage to public and private interests and to the work in progress and shall restore the original drainage system as soon as the work permits.

13 EXCAVATION

13.1 General

Excavations shall be made of such widths and depths as will provide suitable space for building and structures, pipe trenches and ducts, for bracing, supporting, pumping and drainage, and the bottom of the excavation shall be rendered and in all respects acceptable to the Client.

Soils below normal grade, which become soft, loose, “quick”, or otherwise unsatisfactory for support of the new work as a result of inadequate excavation, dewatering or other construction methods, shall be removed and replaced as hereinafter specified in the chapter “Subgrade Protection” at the Contractor’s expense.

Excavating equipment shall be satisfactory for carrying out the work in accordance with the specifications and technical lists. Machine excavation in clay shall be done with a bucket with a smooth cutting edge. Excavated material, not required to be removed from the site, shall be so placed as to inconvenience as little as possible the work and vehicular and pedestrian traffic. The Contractor shall observe the requirements relating to stability of excavations according to ČSN EN 1997-1 (chapter “Sheeting and Bracing”).

When excavations have reached the depth indicated on the drawings, the Client shall be notified and he may inspect conditions.

Should the excavations be dug deeper than specified in the drawings or than ordered by the Project Engineer, they must be filled up with lean concrete to the proper level in accordance with the Engineers instructions. If sandy or rocky material is used, it must be compacted to the satisfaction of the Project Engineer.

If materials and conditions are not satisfactory to the Client, the Client will issue instructions as to the procedures to be followed.

Excavation below groundwater level (GWL) must be approved by the Project Engineer and kept water-free.

All supports and struts are to be removed in the manner and at the time approved by the Project Engineer. Where necessary, counter struts are to be placed before the original supports of the sides of the excavations are removed. Such counter struts may exert pressure on the permanent work only in specific approval to that effect has been obtained from the Project Engineer.

Timber supports, steel sheet pilings or other shoring materials are to be removed as the works proceed except where specified, directed, or approved by the Project Engineer.

The Contractor solely shall assume the full responsibility for both shoring and strutting of excavations and for dewatering operations.

Existing structures, pipes, cables, conduits etc. which are to remain or have been installed under this Contract or by others shall be protected from damage during all phases of construction and shall be kept in full operation during the execution of this Contract.

13.2 Excavation for Structures

Excavation for structures shall be carried out in conformance with an approved schedule. In general, excavations up to 1,5 m deep may be done without sheeting (in soils or rocks with good physical properties).

Any excavation and filling outside and below neat lines of structures necessitated by the Contractor's failure to protect side slopes from failure shall be at the expense of the Contractor.

The Project Engineer must be given the opportunity to test the soil quality before foundation or footing concrete is poured. If the soil quality does not meet the standard set by the Geotechnical Engineer, the Contractor is to take measures as ordered by the Project Engineer.

No concrete is to be applied to the sides of nor poured in the bottom of any excavation before these have been trimmed and levelled to the full satisfaction of the Project Engineer. The Contractor is to apply all necessary and approved means of support and strutting to the sides of all excavations so that any movement in the ground is prevented. This also shall be performed to the Project Engineer's entire satisfaction.

13.3 Excavation below Normal Grade

If, in the opinion of the Client, the material, in its undisturbed natural condition, at or below the normal grade of the excavation as indicated on the drawings is unsuitable for foundations, it shall be removed to such depth and width as he may direct and be replaced with suitable material as directed by the Client.

If, in the opinion of the Client, a thicker working mat is required, the Contractor shall excavate material below normal grade to a depth as directed by the Client and replace it with the required working mat material.

13.4 Subgrade Protection

13.4.1 General

If through failure of the Contractor to properly care for water, failure to postpone final excavation immediately above the subgrade until shortly before placing of the new work thereon, or other failure or neglect to conduct this excavation work properly so that the natural subgrade soil becomes soft, wet or otherwise disturbed in the opinion of the Client so that it is not in proper condition for construction thereon, the Contractor shall excavate the disturbed material and shall backfill with lean concrete or engineering backfill material (refer to chapter "Engineering back fill or fill") placed in layers not exceeding 200 mm in loose state.

All material and labour costs related to over-excavation, backfill, piles, additional concrete and steel, engineering costs for redesign and other work and materials which may be required shall be borne by the Contractor.

13.4.2 Structures on Flat Foundation

Where structures and conduits are to be constructed on foundation, the bottom 150 mm of native material shall be removed by hand in a manner which will provide a flat bottom of undisturbed soil.

Power machinery shall not be used for this final excavation to subgrade level unless it can be demonstrated to the satisfaction of the Client that a smooth undisturbed surface will result. The bottom of the excavation shall not be subjected to equipment loads or vibrations.

When foundation levels of materials other than rock are encountered in excavations, the final trimming to these levels is to be performed before blinding concrete is applied to foundation or concrete poured in the foundation about to be laid. If the contract stipulates the use of blinding concrete, no trimming of the side walls of the excavation may be done until 24 hours after the placing of the concrete.

When excavation is done up to final level and concrete can't be poured, a protection soil layer is to be provided on the subgrade. Immediately after excavation to the required subgrade elevation a working mat of suitable fill material having a minimum thickness of 200 mm in loose state shall be placed and compacted. This layer shall be removed before blinding concrete is applied. This layer shall be compacted by a minimum of two passes of hand operated compaction consisting of the excavation from disturbance during subsequent placement of pipes, reinforcement, forms and concrete.

No water shall be allowed to enter the excavation while the final excavation is performed and until the working mat has been placed.

14 TRENCH BACKFILL AND COMPACTION

14.1.1 Bedding layer

All buried pipes and appurtenances are to be constructed to the lines and grades indicated on the drawings.

Bedding layer shall be with sand fill placed as a working mat on the undisturbed bottom of the trench to the depths required and then carried up the sides of the pipe to the required depth as shown on the drawings. Material for bedding is specified in the chapter "Sand for pipe embedding".

The materials shall be compacted by hand tools under and around the pipe and brought up evenly on both sides of the pipe using suitable equipment. The bedding material shall be compacted against undisturbed earth or sheeting at the sides of the trench.

The bedding layer shall be placed in layers not exceeding 250 mm in loose state (or thickness 200 mm after compaction). Each layer shall be compacted by a minimum of four passes with a hand operated plate tamper approved by the Client. When in the opinion of the Client, compaction of the bedding may adversely affect the undisturbed condition of the bottom of the trench; the compaction requirement may be reduced.

14.1.2 Backfill

Under pavement and shoulders and sidewalks, backfill shall be compacted by a minimum of two passes of flat-faced mechanical tampers or vibrating soil compactors of a type approved by the Client. Moisture of the compacted material shall be within the interval $\pm 2\%$ from the optimum moisture determined by laboratory test.

The filling shall be continued evenly in layers not exceeding 200 mm in loose state with at least one mechanical tamper for two men shovelling suitable backfill material into the trench. Trench backfill shall be compacted to a minimum density equal to 95 % of the maximum dry density obtained by standard Proctor test.

Where the trench is not constructed beneath pavements, shoulders and sidewalks, the following methods of compaction may be approved.

The common backfill (refer to the chapter “Non-bearing back fill”) shall be placed in layers not exceeding 300 mm in loose state and may be compacted by ramming or rolling or by methods satisfactory to the Client. Compacted layers of backfill need to be checked in accordance with ČSN 72 1006 and ČSN EN 13286-2.

After backfilling is completed, the Contractor shall restore the ground surface to its original grade and condition.

Under sidewalk areas the top 100 mm layer of trench backfill shall consist of compacted fill material (at least 98 % of PS and CBR > 6,5 %). The layer shall be compacted by a minimum of three passes of a mechanical tamper or other equipment approved by the Client.

Implementation and compaction of backfill, padding and bedding used for the pipeline trenches outside stations shall perform and respect according to requirements specified in the document “Typical Drawing – Pipeline Ditch” (no. C4G-HPPL-ILF-GENER-LIN-VYK-005 – the last valid revision).

15 BACKFILL AND FILL

15.1 General Requirements

This section relates to furnishing and placing of material to replace excavated material or fillings for foundations embankments, roads and pipe bedding etc.

Materials, placed in fill areas, shall be deposited to the lines and grades shown on the drawings, making due allowance settlement of the material and for the placing of loam thereon.

No backfilling or filling shall be done without the approval of the Client. The Client may require the removal of any backfill or fill placed without his authorisation. This may be for reasons of checking compaction work, type of material used or the degree of compaction.

Haulage of fill material to an area of fill shall proceed only when the compaction plant operating at the area to be filled is sufficient to achieve the specified requirements for relative compaction of the fill material.

Fill material obtained from excavations within the site shall be deposited in its final location as soon as practicable after it has been excavated and all reasonable measures taken to prevent deterioration of material properties during handling.

Fill material shall be deposited in layers of a thickness appropriate to the compaction equipment to be used.

Layers of fill material shall be horizontal, except for any gradient required for drainage and shall extend over the full area of the formation.

Except in excavations for structures, pits and trenches, if the difference in level between adjacent areas to be filled exceeds 1 meter, the edge of the higher area shall be benched before fill material is placed against it.

The earthworks shall be controlled in such a manner that any compaction of the fill material resulting from the passage of constructional plant or haulage vehicles is uniform over the full width.

Requirements specific to compaction tests needs to be in accordance with ČSN EN 1997-2 (Annex R - Detailed information on compaction testing of soil).

Fill material shall not be deposited by end-tipping, or by other methods which may result in segregation or inadequate compaction of the fill material.

At the end of each day, the surface shall be left with no area that can retain water and if necessary, ditches shall be cut to ensure that this objective is attained.

Any fill material, whether placed and compacted or awaiting placing or compaction, which does not conform to the specification or has been damaged by weather or in any other way, shall be removed and replaced or the damage may be rectified using suitable methods.

Accurate and up-to date records showing dates, weather conditions, approximate elevation, source of material, compaction effort, etc. shall be kept showing when fill is placed in various locations within the Site. This record shall be available for inspection.

The Contractor shall also record the results of all compaction and in-situ density tests and shall identify these results with the various locations and elevations at which fill material has been placed and the location from which the fill was sourced.

In areas of fill material final surfaces sloping at a gradient steeper than 1 vertical to 3 horizontal shall be formed by overfilling and cutting back after compaction. Overfilling shall extend beyond the earthworks final surface by a horizontal distance of 0,5 m or three times the thickness of the compacted layer, whichever is greater.

The surface voids of each layer of rock fill material shall be filled with fragments of rock before the next layer is deposited. The final surface of rock fill material shall also be blinded with fine fill material

Unless otherwise shown on the Drawings or directed by the designer, fill slopes shall generally be 1 vertical to 1,5 horizontal.

The trench shall be dug and left open for the least amount of time to prevent high water levels and risk to public safety. The trench shall be dug only before lowering of pipe is planned so that it is kept open and water-free for a minimum amount of time, to also keep ground water lowering measures to an absolute minimum. The trench has to be kept dry from opening until backfilling and opened for the least amount of time.

15.2 Material Specification

15.2.1 General

Back fill and fill material shall be material supplied to the site, or suitable surplus material from site grading, levelling or excavation work.

In general the following fill materials can be used:

1. Sand or sieved soil for pipe embedding
2. Structural back fill for foundations.
3. Engineering back fill
4. Non-bearing back fill

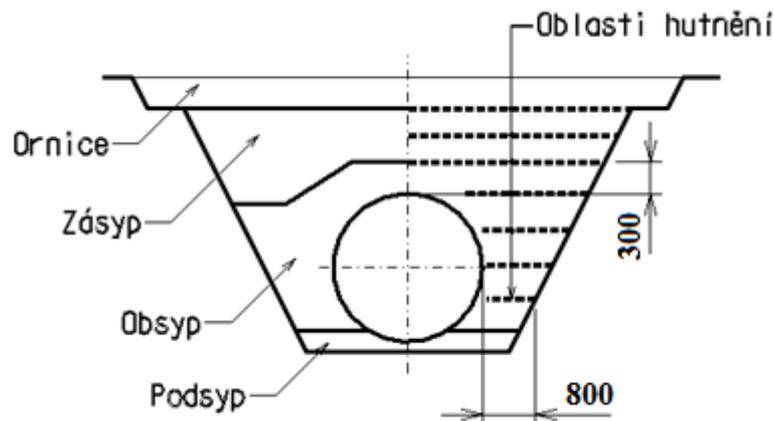


Figure 1: Illustration scheme for bedding, pipeline packing and backfilling of trenches according to N4G Technical Requirement TP_T01_01_01_03 (02/2015)

15.2.2 Sand or sieved soil for pipe embedding

Bedding sand shall full fill the following requirements:

1. Max. grain size $\leq 8,00$ mm, no sharp edges
2. Max. content of fine (passing through sieve opening 0,075 mm) ≤ 15 %

Bedding of pipes shall be laid in layers not exceeding 250 mm (in loose state).

Stones larger than 200 mm and heavier than 15 kg must be removed from the material intended for excavation backfilling.

Bedding and packing of gas pipelines and backfilling of trenches shall to be carried out pursuant to TPG 702 04 and according to TPG 702 05 (Section 6).

15.2.3 Structural back fill or fill

This type of material is applicable for back fill and fill under the pipes.

Structural fill shall be placed in layers not exceeding 150 mm measured before compaction where hand-guided compaction is used and not exceeding 200 mm (in loose state) where heavy equipment or rollers are used.

For granular fill material, grain size distribution and mechanical characterizations are described below. The grain shape shall be edged only slightly rounded to ensure a sufficient cohesion by mechanical interlocking of the grains. The material used for structural fill shall be treated such way that it will ultimately be of homogeneous character.

Table 2: Sieve curve for structural back fill or fill

Sieve opening [mm]	Percentage Passing [%]
100	100
63	75 – 100
31,5	50 – 100
16,0	35 – 95
8,0	25 – 90
4,0	15 – 75
2,0	10 – 50
0,075	0 – 10

15.2.4 Engineering back fill and fill

This type of material is applicable for road construction, foundation of structures etc.

Engineering back fill shall be laid in layers not exceeding 200 mm (in loose state).

For granular fill material, grain size distribution and mechanical characterizations are described below. The grain shape shall be sharp edged or only slightly rounded to ensure a sufficient cohesion by mechanical interlocking of the grains. The material used for structural fill shall be treated such way that it will ultimately be of homogeneous character.

Table 3: Sieve curve for engineering back fill or fill

Sieve opening [mm]	Percentage Passing [%]
31,5	100
16,0	55 – 95
8,0	35 – 65
4,0	22 – 50
2,0	12 – 35
0,5	5 – 25
0,075	2 – 10

15.2.5 Non-bearing back fill

This type of material is applicable for back fill which will not be exposed to any loads, for instance back fill around structures foundation or for instance site levelling in areas where no load will be exerted to a ground surface.

Non-bearing back fill shall be laid in layers not exceeding 300 mm.

For non-loaded areas the materials shall have the following characteristics:

1. Naturally occurred and free from organic impurities and other deleterious substances.
2. Not contains stone fragments larger than 100 mm nominal size.
3. Max. 35 % passing sieve opening 0,075 mm
4. The plasticity index of the materials passing sieve opening 0,425 mm shall not exceed 10 % and liquid limit not more than 40 %.

In general, the material which will be excavated from the site can be used for the common back fill with exception clayey soil materials (classes F5 ML or MI, F6 CI, F7 MH, MV or ME and F8 CH, CV or CE according to classification of ČSN 73 6133).

The backfill material should be thoroughly mixed before placing it.

15.3 Back Fill and Filling Special Requirements

15.3.1 New Paved Areas

Roads, parking areas and sidewalks will require the furnishing and placing of backfill and fill as required to construct them to the cross sections and elevations indicated on the drawings.

In areas where pavements will be placed over and/or adjacent to structures, or trenches, the backfill shall be placed in layers not exceeding 200 mm in thickness measured before compaction and shall be compacted at least to 95 % as determined by the standard Proctor test. The upper most layer (subgrade) shall be compacted at least to 98 % of PS.

Where the existing grade is above the required sub base elevation, the material shall be excavated to allow placement of the required thickness of sub base.

15.3.2 Common Back Fill and Fill

Backfill and fill required against exterior walls and under structures for grading and not under pavement shall be placed and compacted to finished grades indicated on the drawings (refer to Section for backfill under pavements).

No backfill shall be placed against walls until them and their supporting slabs, if applicable, have attained sufficient strength.

Fill required for site grading shall be deposited within the lines and to the grades shown on the drawings or as directed by the Client, making due allowance for settlement of fill and existing subgrade.

Fill shall be placed only on surface which have been inspected and approved by the Client. No fill shall be placed until the subgrade has been inspected and approved by the Client.

If fill material is too wet or dry to meet the compaction requirement, the Contractor will be required to alter the water content in such a way that uniform acceptable compaction (in accordance with ČSN 72 1006 and ČSN EN 13286-2) can be obtained.

The Contractor shall dewater areas to be filled and shall perform the work in such a manner which will preserve the undisturbed state of the subgrade material.

16 COMPACTION OF BACK FILL AND FILL MATERIAL

16.1 General Requirements

Material shall be compacted in layers to a stable condition as soon as practicable after deposition and in a manner appropriate to the location, to the material compacted and the compaction equipment used. The earthmoving plant will not be accepted as compaction equipment under this clause.

Material shall be tested after each layer is compacted and before the next layer is deposited. Verification of each compacted layer needs to be in accordance with ČSN 72 1006, ČSN 72 1018 and ČSN EN 13286-2.

Material shall have optimum moisture content during compaction in accordance with ČSN 72 1006 and ČSN EN 13286-2.

The tolerance with regard to the optimum moisture content shall be $\pm 3 \%$, provided that the fill material is still capable of being compacted in accordance with the specified requirements. All necessary measures shall be taken to achieve and maintain the specified moisture content.

Material shall be compacted in such a manner that structures or utilities are not disturbed or damaged.

Materials which fail to meet the compaction density or become uncompacted prior to placement of the next layer shall be moisture conditioned and recompacted to the specified density. If the specified density is still not achieved the material shall be excavated and disposed of as unsuitable material.

16.2 Compaction Requirements

Following minimum compaction requirements within stations unless otherwise required by the Client shall be achieved:

Table 4: Compaction requirements within stations

Type of structure, type of fill (soil)	Required degree of compaction [%]
Compaction of subsoil (ground) within stations (in general)	95 % PS (max. density) *
Soil in natural state below buildings and structures foundation	95 % PS (max. density) *
Back fill or fill below buildings and structures foundation	98 % PS (max. density) *
Top of first granular sub base layer under roads	98 % PS (max. density) * $E_{def,2} \geq 60 \text{ MPa}$ $E_{def,2} / E_{def,1} \geq 2,5$ *** CBR > 30 % **
Top of second granular sub base layer under roads	100 % PS (max. density) *

Type of structure, type of fill (soil)	Required degree of compaction [%]
Sand bedding of pipes (near road)	95 ÷ 100 % PS (max. density) *
Sand bedding and backfill layer below pipes and up to its centreline (valid also for main pipeline 20 m from foundation edge for both sides)	98 % PS (max. density) *
Top of back fill or fill below compressors (station equipment)	98 % PS (max. density) *
Top of engineering back fill or fill under rotary equipment and below pumps	$E_{def,2} \geq 175 \text{ MPa}$ $E_{def,2} / E_{def,1} = 2,25$ ***

* Verification of compaction requirements needs to be in accordance with ČSN 721006, ČSN 72 1018 and also ČSN EN 13286-2.

** Value of CBR needs to be checked through the test methods described at ČSN 73 6186 and ČSN EN 13286-47.

*** Testing is performed according to ASTM D1195: Standard Test Method for Repetitive Static Plate Load Tests of Soils and Flexible Pavement Components, for Use in Evaluation and Design of Airport and Highway Pavements (09/2015). Then evaluation of these plate tests is performed according to DIN 18134. Minimum required diameter of the bearing plate ≥ 0.3 m. Determining of the deformation and strength characteristics of soils by the plate loading test shall be used for calculation of $E_{def,1}$ and $E_{def,2}$.

Minimum compaction requirements used for pipe trenches within stations are also specified in the document “Typical Drawing – Excavation, Backfill and Compaction for Station Pipeline and Piping” (no. C4G-HPPL-ILF-GENER-STA-VYK-010 – the last valid revision).

Minimum compaction requirements used for the pipeline trenches outside stations are specified in the document “Typical Drawing – Pipeline Ditch” (no. C4G-HPPL-ILF-GENER-LIN-VYK-005 – the last valid revision). During earthworks and installation of the pipeline these principles shall to be observed by the Contractor.

In the stations areas the padding and backfilling of the pipeline shall be compacted to with the same parameters as compacting for the road crossings to eliminate settlement of the other facilities. Rules for compaction filling of technology within stations

(objects) are specified in the document "Pipeline – Construction Specification" (no. C4G-HPPL-ILF-GENER-STR-SPC-802 – the last valid revision).

16.3 Testing

Earthworks testing shall be carried out by competent experienced personnel.

A series of tests shall be carried out on the fill material and the frequency of such tests shall be as shown in the table below. Additional tests will be carried out if initial tests do not meet the specified requirements. Additional tests shall not count towards the frequencies.

Table 5: Testing requirements

Test	Frequency
Plate load test according to ASTM D1195	1 test per 200 m ³ with not less than one test per layer
Particle Size, Distribution, Liquid Limit and Plasticity Index	1 test per 500 m ³
Sulphate Content (only adjacent to structures)	1 test per 500 m ³
Proctor Standard test according to ČSN 72 1006 and ČSN EN 13286-2	min. 3 soil specimens for one soil stratum (layer)

Testing shall be conducted in accordance with the table above and equivalent standards (refer to chapter “Codes and Standards”).

A batch of fill material is any quantity of fill material of the same type and with similar properties throughout. For the purpose of testing for moisture content and relative compaction a batch shall, in addition to the above, be fill material which is deposited in a single layer in any area of fill presented by the Contractor for testing on one occasion.

Each sample of fill material shall consist of at least four increments taken from different parts of the batch. The increments shall be combined and thoroughly mixed and shall then be divided by quartering or by using a riffle box to obtain specimens of an appropriate size to carry out the individual tests.

The size of samples of fill material shall be in accordance with the applicable standards (refer to chapter “Codes and Standards”).

17 SOIL REPLACEMENT

In case that ground density is not corresponding to compaction at least 97 % PS (measured on the top of natural soil) underneath the structures, then soil replacement shall be provided in minimum thickness of 500 mm.

Requirements for soil replacement material are as the same as engineering back fill (refer to chapter “Backfill and Fill”).

Verification of replacement compacted soil layer (i.e. min. required degree of compaction) needs to be in accordance with ČSN 72 1006, ČSN 72 1018 and ČSN EN 13286-2.

18 COMPACTION EQUIPMENT

The contractor shall provide compaction equipment suited for compaction of the various materials specified. In all cases, the efficiency and acceptability of compaction equipment shall be subject to approval.

19 TOLERANCES

The surface of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the drawings, and no soft spots or uncompacted areas will be allowed in the work.

20 DISPOSAL OF EXCAVATED MATERIAL

When the Client approves the stockpiling of excavated material at the site, the material shall be neatly piled so as to inconvenience, as little as possible, the work and the public and adjoining property Clients.

Excavated material meant for use as fill or backfill are to be stored on the site. Those excavated materials which are not needed or are unsuitable (unusable) for use as fill or backfill are to be removed from the site to an approved dump site. Unsuitable excavation materials are in general classes F5 ML or MI, F6 CI, F7 MH, MV or ME and F8 CH, CV or CE according to classification of ČSN 73 6133, then organic soils, arable land, clayey silts, rubble material, loess soils etc.

No usable excavated material other than surplus not required to satisfy the conditions described in the contract is to be removed from the site except when such removal is ordered or approved. A surplus of useable material can only be removed from site after approval of the Client. If the Contractor removes usable material from the construction site and fill or backfill is needed he is obliged to deliver material of the same quality up to the amount which was removed.

21 PLACING OF TOP SOIL AND RECULTIVATION

The arable land (top soil) shall be removed from the whole area of the site and storage areas, including the area for the construction site equipment in a thickness recommended by Pedological Survey. Removed top soil will be deposited on a construction site temporarily. After completion of the construction of the new HP Gas Pipeline DN 1400, the arable land shall be used for reclamation of green areas within the site and shall be spread out at the site of the working strip of the VTL pipeline during rehabilitation works.

The arable land shall be hidden in such a way that it does not mix with the subgrade (at the site of mechanization, pipe trenches, excavation etc.). Hidden arable land shall be recovered as part of reclamation.

The final ground level shall respect the original terrain as much as possible. Due to the sloping terrain, landscaping needs to be done at the site to ensure access to heavy handling equipment for objects, technologies and machinery.