
Northern Gas Networks Specification

Bulk Earthworks for the Infilling of Gas Holder Tank Voids and
Associated Structures

May 2017

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0 Summary - Governing Overall Specification

This specification has been prepared for the purposes of bulk filling works and granular hardcore and sub-base deposition in relation to gas holder tank voids and associated structures.

The guiding overall specification for all aspects of bulk earthworks filling works shall be the Specification for Highway Works (SHW), current edition, from the Highways England Design Manual for Roads & Bridges suite. In particular, the requirements of the 600 Series clauses from that document together with the published Appendices thereto shall form the basis of this specification.

The general requirements and sections for filling that follow below are issued for general guidance and to assist in clarification and direction for the specific items described. Where there is any conflict with the SHW/DMRB documentation the Contractor shall refer to Northern Gas Networks (NGN) for final direction.

Notwithstanding the above, the whole of the filling and compaction works will need to comply with NGN specification for chemical composition and contamination limits of all materials incorporated into the works.

The term 'Contractor' used in this document is equivalent to *Main Works Contractor* within the project contract documentation.

All laboratory testing required under this specification is required to be completed by a UKAS accredited laboratory and be less than six months old.

General requirements

1 General Requirements

1.1 Surplus material

All unsuitable material and excavated material not required for filling of gas holder tank voids and associated structures shall be removed from site.

1.2 Work adjacent to Existing Buildings

Necessary permanent works (such as underpinning or concrete back-fill) will be specified by Northern Gas Networks (NGN).

It is the Contractor's responsibility to take whatever other precautions are necessary when working adjacent to existing buildings such as:-

- a) Checking existing foundation depths at an early stage.
- b) Shoring excavations and walls where necessary.
- c) Guarding against excessive vibration adjacent to existing properties.

The Contractor shall submit his proposals for temporary works and method of work adjacent to existing buildings to Northern Gas Networks (NGN) for approval before commencing the works.

1.3 Work around Existing Drains and Services

Before commencing any excavation the Contractor shall ascertain wherever possible the positions of existing drains and utilities. These shall be carefully exposed, temporarily supported and worked around, or diverted by agreement with NGN and the service authority concerned.

Unless directed otherwise by NGN, backfill around existing drains or services shall be carefully compacted by hand ramming.

1.4 Building Regulations

The Contractor shall comply with the requirements of the Local Authority Building Control Department.

1.5 Mud, Debris and Dust on the Highway

Highways in the vicinity of the works must be kept free from mud, debris and dust falling from vehicles or the wheels of vehicles connected with the Works to the satisfaction of NGN.

1.6 Samples of Materials

General requirements

Samples of materials shall be made available in good time for approval. NGN must be provided with at least five working days to review and approve material samples and test results.

1.7 Safety

All backfilling works are to be undertaken in accordance with a safe system of work to the satisfaction of NGN.

1.8 Method Statements

Before the work commences, the Contractor shall submit to NGN for comment method statements for all significant earthwork operations, to include considerations of safety.

Nothing in this specification should be taken as an instruction to adopt working methods which contravene the CDM Regulations, and all Contractors/sub-contractors are responsible for ensuring safe procedures which comply with the Regulations.

Excavations

2.1 Excavation Generally

Excavations are not normally necessary as the demolition works undertaken prior to the contract to which this specification relates will have exposed the gas holder tank voids and any associated structures (such as valve pits) that require filling. No substantial excavation works are anticipated to be required.

Filling of Gas Holder Tank Voids and Associated Structures

3.1 Placing fill generally

Bulk filling works shall generally be undertaken to comply with the principles of the SHW 600 series clauses and the Appendices thereto in relation to plant, compaction and layer thickness requirements, suitability and moisture conditions, protection of intermediate formations, placing of any interstitial or formation level drainage or geogrids/ membranes or to the specific requirements of Northern Gas Networks (NGN).

Areas to be filled (gas holder tank voids and associated structures) should be free from loose soil, rubbish and water and shall generally comply with the cleanliness, weather, temperature and suitability requirements of the SHW series documents. Fill shall not be placed on frozen ground. Any disposal of water from the site must be undertaken in a manner pre-approved by NGN.

All necessary precautions shall be taken to ensure stability of adjacent structures. Fill shall be placed and compacted against structures, membranes or buried services in a sequence and manner which ensure stability and avoid damage.

Plant employed for the transporting, laying and compacting must be suited to the type of material.

Differing materials shall be laid separately so that only one type of material occurs in each layer.

3.2 Benching of Fill

Where, during the progress of the work, the difference in level between adjacent areas of filling exceeds 600mm, the Contractor shall cut into the edge of the higher filling to form benches having a minimum width of 600mm and a height equivalent to the depth of a layer of compacted filling. New filling shall be spread and compacted to ensure maximum continuity with the previous filling.

3.3 Types of Fill

The fill material to be used must be demonstrated to comply with the NGN Backfill Material Chemical Validation Criteria and must be one of the materials in the schedule below;-

- i) Acceptable excavated sub-soil material as defined in Highways England Specification for Highway Works Clause 601. The largest pieces shall have a maximum dimension not exceeding 100mm.
- ii) Imported general bulk fill material compliant with SHW 600 series Class 1 (granular) or Class 2A, 2B or 2C (cohesive/ stony cohesive variants), complete with testing and certification for the grading and geotechnical properties appropriate to the material classification under SHW series 600 and the Northern Gas Networks (NGN) Backfill Material Chemical Validation Criteria. The grading and geotechnical testing is to be a minimum of one test per 5000m³ of material, with at least three tests per material source (unless agreed differently by NGN).

Filling of Gas Holder Tank Voids and Associated Structures

- iii) Imported granular filling material shall be clean and inert, **evenly graded**, 75mm to dust, crushed or broken rock such as granite, sandstone or limestone or weathered upper rock, rock overburden or sand/gravel. Such evenly graded granular filling material may be further specified to the SHW specific requirements for type 6F1, 6F2, & 6F5 material and shall have the required grading and testing certificates as required by the SHW from the supplier or source.
- iv) Type 1 or Type 2 sub-base material to Specification for Highway Works. Clauses 803 or 804 respectively, (and also the low fines content Type 3 stone to the 800 series clauses, where specified for water filtration/ percolation properties) shall comply with all grading, chemical properties, hardness and quality criteria embodied in these clauses and shall have full certification supplied from the supplier or source.

3.3.1 Clay Cap to Gas Holder Tank Footprint

Infilled gas holder tanks are required to include a sealing layer of clay over the overall diameter of the tank. The Contractor is required to demonstrate that the proposed material is a clay by means of particle size distribution testing by sedimentation, with a minimum of three test results per material source provided.

3.4 Unacceptable Material

Unacceptable material Class U1 or U2 as defined in the DMRB Specification for Highway Works Clause 601 shall not be used in the Permanent Works. Materials not complying with the NGN Backfill Material Chemical Validation Criteria will also be deemed unacceptable unless otherwise agreed by Northern Gas Networks.

3.5 Spreading and Compaction of Fill other than in Gas Holder Tank Voids and Associated Structures

3.5.1 Gas Holder Tank Voids – Filling Below the Surface of the Gas Holder Dumping (Where Present)

Soil or granular filling materials placed below the dumping upper surface level (where present), i.e. between the dumping surface level and the base of the gas holder tank, shall be compacted in layers not greater than 600mm thick after compaction.

Fill materials placed at this location shall be well compacted in a method appropriate to the working environment and achieving the filling and compaction objectives outlined in Section 3.7. The proposed compaction methodology is to be presented to NGN in writing in advance for approval (detailing the plant, machinery and methodology to be employed), with no compaction to proceed without written NGN approval.

3.5.2 Gas Holder Tank Voids – Filling From Dumping Upper Surface Level (Where Present) to Finished Fill Level

Soil or granular filling materials placed between the dumping upper surface level (where present) and finished fill level (excluding the clay cap, reference Section 3.5.3) shall be fully compacted in

Filling of Gas Holder Tank Voids and Associated Structures

layers not greater than 250mm thick after compaction. Where no dumping is present, this requirement applies from the gas holder tank base to the finished fill level.

In order to achieve the filling and compaction objectives outlined in Section 3.7, fill materials placed at this location shall be compacted in a method in general accordance with, or demonstrably equivalent to, the principles of the SHW 600 series (with reference to method and plant to be employed). The proposed compaction methodology is to be presented to NGN in writing in advance for approval (detailing the plant, machinery and methodology to be employed), with no compaction to proceed without written NGN approval.

3.5.3 Gas Holder Clay Cap

Overlying the final compacted fill layer the overall diameter of the tank is to be sealed with a minimum thickness of 300mm of clay (reference Section 3.3.1) and capped with the final 250mm of suitable backfill material rolled to produce a 'dome' finish at ground level but to overlap the tank wall to ensure any water run off flows to land rather than back into the holder tank bund

3.5.4 Associated Structures Requiring Infilling

The requirements for the infilling of structures associated with gas holder tank voids, such as valve pits, are as included in Section 3.5.2 (above) unless otherwise agreed with NGN.

3.6 Excavation supports

Excavation supports shall be carefully removed as filling proceeds (except where such support is required to be left in position) but stability of the gas holder tank/excavation sides and adjacent ground must be maintained. The space left by the withdrawal of support shall be filled in the manner of the main fill.

3.7 Acceptability of Fill

The objective of the filling of a gas holder tank void is to produce a well compacted surface which will undergo no significant settlement post-completion of the filling works and not preclude or significantly restrict the site from future redevelopment with respect to ground stability issues. The compacted fill within each filled structure should have a bearing capacity and stability at least equal to that of the adjacent undisturbed sub-grade (outwith the gas holder tank structure). It is of note that the bearing capacity and stability of the sub-grade outside the gas holder tanks has not been established by NGN. Completion of such testing is the responsibility of the Contractor at their own expense.

Where settlement, deterioration, inspection or test results indicate that the fill is not equal to the adjacent sub-grade such additional work necessary to produce a final reinstatement equal in capacity, performance and condition to that required shall be carried out to the satisfaction of Northern Gas Networks (NGN) at no extra cost to the Contract. The Contractor is to maintain records of fill materials and the size of plant/number of passes used to compact it.

Filling of Gas Holder Tank Voids and Associated Structures

3.8 Field Compaction Testing

As a minimum NGN require that certified field compaction tests (such as plate load tests, nuclear density gauge testing or other appropriate method) in accordance with the SHW and BS1377 are required to confirm adequate compaction (as per Section 3.7 above). As a minimum, these must be undertaken as follows (with prior agreement with NGN of testing location, horizon and method): finished filling level (before placement of clay cap and dome); finished fill level minus 3m; finished fill level minus 6m; and finished fill level minus 9m or 1m above tank base (to be agreed with NGN). A minimum of three test positions are required to be completed per horizon per holder. The certified field density tests are required to be completed by a trained, accredited and certified testing provider. The results of this testing are to be provided to NGN for approval within 1 working day of completion.

In addition to the above, the Contractor is also responsible for the completion and recording of in-situ field compaction testing in accordance with BS1377 part 9 (using an Impact Soil Tester (such as a Clegg Hammer), penetrometer or similar) on every completed layer (reference Section 3.5 above for post-compaction layer thicknesses). Two tests are required per quadrant on each layer completed within each holder (total of eight tests per completed layer per holder). The results and locations of this testing are to be recorded by the Contractor and presented to NGN within 1 working day for approval in a format agreed with NGN (an example is included in Appendix A of this specification). The in-situ field compaction testing is required to provide a field measurement/indication of compaction performance (equivalent to California Bearing Ratio or similar). The purpose of this testing is to provide field indications of compaction performance and achievement of compaction objectives (reference Section 3.7). It is anticipated that this testing will be calibrated against the results of the certified field density tests to be undertaken at 3m intervals.

The Contractor is responsible for recording the co-ordinates and elevations of all compaction tests undertaken to a local datum (as a minimum).

The Contractor is responsible for the costs of the required testing (including equipment, personnel and sub-contractors), and surveying of test positions. All compaction testing is required to be undertaken by competent, trained individuals with evidence of competence made available to NGN.

If the results of the compaction tests show the state of compaction to be inadequate with reference to the requirements of Section 3.7, the Contractor shall carry out at his expense such testing as may be required to prove the level of compaction achieved by use of Nuclear Density Gauge testing or other appropriate method.

Where a Clegg Hammer is used for in-situ field compaction testing, the following table ('Table B') will be referenced with respect to determining whether adequate compaction has been achieved.

Filling of Gas Holder Tank Voids and Associated Structures

TABLE B

REINSTATEMENT LEVEL	FOURTH DROP IMPACT VALUE		
	Target Value	Typical Range	Highest Likely
Trench Bed	7	7 - 8	30
Top of Fine Fill	10	10 - 17	-
Top of Back Fill	18*	17# - 27	-
Top of Sub-base	22	24 - 27	-
Top of Road Base	30	32 - 34	38

*Minimum IV for re-used materials
#Minimum IV for imported materials

3.9 Filling against Vertical and Steeply Sloping Hard Edges in Tank Voids

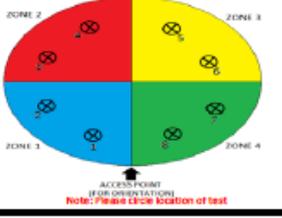
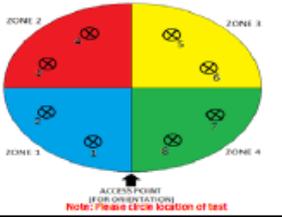
Where fill is to be placed and compacted against existing retained hard edges, such as gas holder tank walls and dumplings, care is to be taken to ensure that compaction plant is able to pass close enough to the edge to compact the full depth of the layer. Where this requires smaller plant, the number of passes required to achieve compaction must be increased accordingly. If this exceeds the allowable limits in the Specification for Highway Works, the Contractor must prove the compaction achieved by testing or propose an alternative method or material. Alternative methods and/or materials and testing to prove acceptability are to be at the Contractors expense.

3.10 Soluble sulphate content (SO₃)

All imported fill materials to be incorporated into the works must comply with the requirements of this specification and the Northern Gas Networks Backfill Material Chemical Validation Criteria.

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APPENDIX A – EXAMPLE FIELD COMPACTION RECORD SHEET (EXAMPLE FOR A CLEGG HAMMER)

SOIL COMPACTION TEST RESULTS - RECORD SHEET					
Tester Name:		Site Name:		Holder Number:	
Date:		Test Number:		Layer Number:	
ZONE No.	DROP NUMBER	IV READING	LOWER LIMIT	UPPER LIMIT	
	1			NO UPPER LIMIT ON THE FIRST FOUR DROPS	
CBR	2				
	3				
Critical Impact Value	4				
	5				
Tester Signature:		PASS	FAIL	Verified by:	Signature:
Tester Name:		Site Name:		Holder Number:	
Date:		Test Number:		Layer Number:	
ZONE No.	DROP NUMBER	IV READING	LOWER LIMIT	UPPER LIMIT	
	1			NO UPPER LIMIT ON THE FIRST FOUR DROPS	
CBR	2				
	3				
Critical Impact Value	4				
	5				
Tester Signature:		PASS	FAIL	Verified by:	Signature:
Tester Name:		Site Name:		Holder Number:	
Date:		Test Number:		Layer Number:	
ZONE No.	DROP NUMBER	IV READING	LOWER LIMIT	UPPER LIMIT	
	1			NO UPPER LIMIT ON THE FIRST FOUR DROPS	
CBR	2				
	3				
Critical Impact Value	4				
	5				
Tester Signature:		PASS	FAIL	Verified by:	Signature: