INSTALLATION GUIDELINES AND INSPECTION CHECKLIST FOR UNDERGROUND PIPING

Receiving, Hauling and Storage

1. Care shall be exercised in all loading, unloading, hauling and stringing operations so as to avoid damage to the pipe ends and coatings.

2. Handling hooks shall be protected or of soft metal type so as not to cause out of round or deformed bevels.

3. Inspect yard storage of pipe, valves, and coating materials for proper protection. Ensure large diameter pipe is not stacked too high (with suitable soft packing if pre-wrapped) to avoid deformation and to reduce accident risk.

4. Where special coatings have been applied, ensure that transport carriers are properly buffeted to prevent damage.

5. Check bevel and coating cutback.

Trenching

1. Check that the trench width and depth is not less than the minimum specified.

2. Check for proper clearance between the pipeline and any other underground pipelines or structures.

3. Ensure drainage ditches are provided when necessary.

4. Check that bottom of the trench is graded as specified. (As a minimum, it must provide a uniform support for each joint of pipe).

5. Where rock is encountered, check that the trench depth and width is sufficient to provide at least the minimum of "earth padding" specified.

6. If "earth padding" is not available, check that rock shields are used when specified.

7. Where drainage tiles are used, check for proper clearance between the pipe and the tiles.

8. Ensure the proper construction technique at roads, railways, ditches, canals, and river crossings are in accordance with design documents.

9. If casing is used, check that the joints are sealed.

10. In general, pipe is strung end-to-end along the right-of-way. In some cases, it may be stacked for welding or coating. Monitor these activities to ensure correct procedure is followed to alleviate damage.

11. Valves, casing and other materials may be hauled and strung along the right-of-way. Monitor these activities to ensure against loss or damage.

12. Monitor, to ensure that small material, or materials easily lost or damaged are properly stored.

13. All welding is done in accordance with specification requirements.

14. Check interior of pipe for foreign matter prior to aligning for welding. Swab clean if necessary.

15. Check that the open ends of lines are securely closed at the end of each day's work to prevent the entrance of small animals or introduction of foreign matter. Do not re-open until work is resumed.

Bending

1. Where seam-welded pipe is used, check that:

   a) The longitudinal seam is at right angles to the plan on the bend
   b) The seams on adjacent pipe lengths are offset so as not to be in line with each other.
   c) The pipe bends are free from buckling, out of round, cracks, thinning of pipe wall or any other evidence or mechanical damage.
   d) The bent pipe conforms to the profile of the bottom of the completed trench or bedding.
   e) Cold-pipe-bends are smooth and uniform.
   f) The maximum permanent deflection of a pipe bend depends on the pipe diameter and wall thickness, the particular code in use and Design-Document. Ensure that the maximum deflection specified is not exceeded – this shall be checked by pulling a gauging plate through the bend prior to stringing in the line.
   g) The difference between the maximum and minimum diameter at a pipe bend does not exceed the specified amount.
   h) Bending does not occur within the minimum distance specified from a joint.
   i) Suitable precautions are taken to prevent deformation at the end of the pipe joint due to bending activities and pipe handling.
   j) Where the pipe is double-jointed prior to bending, ensure that the weld is not placed within the bending shoe. In no case shall a bend occur at the circumferential weld, nor shall a completed weld come in contact with the surface of the bending or holding shoe, or the clamp of the machine.

Pipe Priming, Coating and Wrapping

1. Material storage:

   Ensure correct storage of priming, coating and wrapping materials. Follow the manufactures recommendations. Materials that show evidence of deterioration or damage shall not be used.

2. Priming:

   Prior to commencement of priming, coating and wrapping activities, ensure the following, where applicable:

   a) All leak testing and non-destructive testing has been performed and recorded.
   b) Final checking and punch listing has been completed.
   c) The surface has been properly cleaned and is free of moisture.
   d) Check that the primer is of the required type, composition, condition and temperature.
   e) Check that the primer coat is uniform and free of “floods” or “runs”.
   f) When more than one pass of the cleaning and priming is required, check that the “cutback primer” or other solvent and the time lapse between passes are in accordance with design documents and/or manufacturer’s specifications.

g) Where the primed surface is supported by skids or earthen berms etc., ensure that the primed surface is adequately protected.

h) Where the surface has been pre-primed, check the integrity of the primer coating and make any repairs necessary.

3. Coating and Wrapping:

a) Check that the primed surface is free of any foreign matter prior to application of the coating, and that it is not moist.

b) Ensure that weather and temperature conditions are suitable for application of the coating and wrapping materials according to design documents and manufacturer's recommendations.

c) Ensure that the application of the coating and wrapping materials is in accordance with the manufacturer's directions or compatible with the existing coating and requirements of the design documents e.g.:

- Correct number of laps or plies.
- Temperature and humidity during application.
- Uniformity of application of fluid coatings.
- When spiral weld pipe is used, extra care must be used to see that the raised weld seams are properly coated to prevent voids under the tape coating.
- Ensure that all valves or fittings are coated as required by design documents.
- Ensure that electrical holiday testing is carried out as required and measurements are recorded.
- Check that repairs are made in accordance with design document requirements and re-tests are recorded.

4. Inspection:

Coating and wrapping shall be visually inspected prior to testing with an electrical holiday detector. Minimum testing voltage shall be as defined by design output documents. In cases where shop applied coatings have been holiday tested with documentation provided, the field shall limit final testing to:

- suspect areas
- shop applied coating which have not been properly documented
- areas in which the shop applied coating has been repaired in the field.

5. Records:

Coating and wrapping inspections shall be documented on the coated and wrapped pipe inspection report, (CFN-1002).

6. Lowering of Pipe into the Trench:

a) Ensure proper lowering sequence and procedure.

b) Side bends and sag bends shall be lowered first and weighted to serve as anchorage.

c) Side bends shall be made to bear on the outside wall of the trench.

d) Sag bends shall bear firmly on the bottom of the trench.

e) Check that overbends have at least the minimum specified space between the bottom of the pipe and the bottom of the trench.

f) Ensure that if the pipe is cradled-in, it is done in such a manner as to secure proper slack and does not injure the pipe coating, and that the minimum radius of bending is observed.

g) Check that cooling of the pipes with a wetting agent is carried out when necessary during hot weather cradling-in operation.

h) Check for damage to coating by bumping or scuffing during lowering in operation. Initiate any repairs necessary and check that they are performed in accordance with Design Documents.

7. Mechanical Jointed Pipe:

a) Ensure pipe is free from cracks (including lining if applicable).
b) Ensure gasket or seal lubricants are kept in dirt free condition.
c) Ensure offsets at joints do not exceed the angle stipulated by the manufacturer.
d) Check that gaskets or seals are the correct specification (especially in sour systems).
e) Normally jointed pipe is installed with bell end facing up the slope when used on gravity drainage systems utilizing slopes.
f) At flanged connections (especially on cast and ductile iron systems) ensure that mating flanges of valves and/or equipment are compatible. (Normally flat faced) to avoid risk or fracture during bolt up.
g) Ensure, during pressure tests, that anchors, stops or sufficient backfill has been placed. Care shall be exercised on partial tests to ensure temporary plugs, caps or flanged connections are adequately shored and braced.
h) Any sand bags used for installation expediency shall be burst prior to compaction and testing activities. Use of temporary wood cribbing in trenches shall be avoided since there is a tendency for these to be buried and not removed.

Note: Where epoxy cements are used in bell and spigot pipe to afford zero leakage, the joint manufacturer's recommendation regarding cleanliness, mixing and placement must have rigid compliance.

i) Ductile Iron Piping with a weld ring / wedge joint system may have unique requirements affecting the installation. Follow manufacturer's instructions and request management review if deviations from this procedure are suggested. Obtain vendor training when needed.

8. General:

a) Verify that anchor weights and thrust blocks are installed where specified.
b) Check that the concrete mix and pouring procedures for any blocks, weights, foundations, valve boxes, supports and anchors are in accordance with design documents.
c) Check that all necessary drips, valves, farm taps, tie-ins, and other connections are properly installed.
d) Check that any damaged or removed drain tile is replaced with the correct material.
e) Check that troughs or conduits are placed so as to adequately support the drainage tile, e.g. they shall penetrate sufficient solid ground to ensure that alignment and correct grade are maintained when backfill settles.
f) Check that cleaning and blowing activities are carried out in accordance with design document requirements.
g) Ensure that cathodic protection is installed correctly, when required (welded attachments to pressure boundary piping shall be complete prior to leak testing.)
h) Verify pipe penetrations in manholes, valve boxes, etc. are installed with proper clearances and link seals or other specified materials between the pipe and sleeve.

9. Backfilling:
   a) Utilize a release for backfill assuring that piping work is complete. Partial backfill may be necessary for stability prior to testing. Holiday testing shall be completed on coated piping, including repaired areas, prior to release for backfill. Stub-ups requiring electrical heat tracing shall be heat traced prior to release for backfill.
   b) Monitor backfilling operations to ensure that they are carried out in accordance with design document requirements.
   c) Monitor backfilling operations to ensure that the pipe's protective coating or fittings are not damaged.
   d) Where rock is the backfill material, check that rock shields are installed where required.
   e) Where backfilling is omitted due to installation of boxes, farm taps, tie-ins, foundations, etc., ensure it is completed after such installations have been approved.
   f) Ensure adequate compaction of open-cut highway or railway crossings. Where the pipe is not cased, check that rock-shields are installed if required and proper permits have been secured. Ensure proper inspection and completion notices have been distributed.
   g) Inspect cathodic protection installation prior to backfilling.
   h) Ensure that tracer tape or other marking tape is placed in accordance with project requirements.

Piping:

   a) Verify fit-up is acceptable; vertical lines are plumb; and horizontal lines are level, except where slope is indicated on the design drawings.
   b) Ensure slopes are as indicated on P & ID's, orthographic and isometrics drawings.
   c) Check that pipe size, schedule and type of material are correct.
   d) Check that flange ratings are correct.
   e) Confirm routing and tie-ins of lines are in the correct location.
   f) Ensure that the correct type of reducers (eccentric or concentric and correct schedule) are located and orientated per specification, standards and design installation drawing.
   g) Confirm that branch lines are located correctly on headers.
   h) Verify that reinforcing pads with weep holes, tees, sockolets, weldolets, or welding saddles are used as specified for branch connections.
   i) Verify that temporary supports are provided, if required, to avoid pipe damage.
   j) Ensure that vents are installed at high points and drains at low points.
   k) Check that vents and drains are installed/welded after hydro as required by specifications. Including valve removal if specified.
   l) Verify that no carbon steel is able to contact stainless steel components.
      Note: Check specification and vendor information as carbon steel bolting materials maybe be specified in stainless steel underground piping systems.
   m) Check that piping is free of tape, wire, slings and other installation tools and materials.
   n) Verify internal pipe cleanliness during installation process. Monitor HDPE work and ensure shavings and debris are removed prior to joint fusion.
   o) Internal cleanliness shall be verified during in-process inspection and documented in accordance with Y17-95-64-835, *UPF Piping System Cleaning.*

Valves

a) Check that globe and control valves are installed with flow in correct direction as indicated on the P & ID.
b) Verify that the manufacturer's nametag description agrees with stock code number, (if used) description and trim. (Do not rely on warehouse tag). Check casting stamp also.
c) Confirm that special packings are installed as required and if repacking is required, a tagging or color code system is used to identify repacked valves.
d) Check that drains or flushing connections to valve bodies are installed as required.
e) Check that by-passes around valves are installed as required.
f) Verify that valves remain internally clean.
g) Confirm valves have been tested and calibrated prior to installation, if specified
h) Verify that valve stems are not installed lower than horizontal unless specifically approved, (especially stem locations for cryogenic valves).
i) Check that valves with special bolting requirements (i.e. tapped flanged bolt holes) are installed as required. These materials must be identified on the design drawings and BOMs.

Bolts and Studs

a) Check that bolts and studs are not interchanged.
b) Confirm that bolting is appropriate length, diameter, and material.
c) Verify the thread pitch for 1 inch (25mm) and larger bolting materials.
d) Check for thread lubricant if required. (Take extra caution with stainless steel materials).
e) Verify types of bolts to be used on high pressure, high temperature flanges or on cryogenic lines. Verification shall include a spot check with a magnet for non-magnetic materials.
f) All bolts or studs shall be installed and tight. Studs shall be at least flush with nuts and/or have equal projection beyond nuts per project specifications (normal is two exposed threads).
g) Consider the use of torque limiting bolting for mechanical joints, mega-lug, and other underground restraint bolting.
h) Verify that bolts and studs are properly coated to prevent corrosion.

Gaskets

a) Confirm gaskets are installed and are the correct type, style, material, size and rating. Establish a color code system that can be edge inspection verified.
b) Verify specification changes at equipment block valves are carefully checked for correct gaskets.
c) Ensure all gaskets on blind flanges are checked and verified.

NOTE: Temporary gaskets may be used at temporary blinds, and then line specification gaskets are installed after pulling temporary blinds. The punchlist shall specify the right gasket. High-pressure ring gaskets shall be verified oval or hex and material as installed.

Small Bore Piping

a) The gap in socket weld fittings shall be checked as work progresses.
b) Ensure that vendor supplied trim material used meets design and job specifications or has been an agreed substitution approved by Engineering.
c) Monitor welding, bonding/jointing and NDE per specification.
d) Check stress relieving requirements.

Pipe Supports and Expansion Joints

Ensure line is supported properly inside manholes, valve boxes, etc. Drawings must be checked to confirm that major supports are installed; small lines are most often field supported.

Seal Welding

a) Check that seal welding is complete as required.
b) Ensure exposed threads are covered by seal weld.
c) Check that no pipe thread sealant or tape has been used in screwed joints to be seal welded.

Insulated Lines

Ensure hot and cold insulation on underground piping is installed properly to prevent water infiltration.

Alloy Lines

a) Check that stress relieving is complete, witnessed as required, and documentation has been distributed.
b) Ensure that materials are the correct type – especially stainless steels - 304, 304L, 310, 316 and 316L.
c) Valves and gaskets shall be checked carefully; validate stock code description against valve nameplate data and, if necessary to determine valve is correct, against manufacturers catalog number.

NOTE: Never weld galvanized or zinc rich attachments to stainless steel lines.

Miscellaneous Items

a) Check that spectacle blinds, blinds, and spacers are installed as required and are the correct thickness.
b) Check that piping specifications are carried to the point specified before the instrument details take over.

NOTE: Usually the block valves must be per piping specifications.

c) Verify that clearance exists for removal of equipment and valves inside manholes and valve boxes.
d) Check that instruments, (i.e. level glass, pressure and temperature gauges, thermowells, etc) are accessible for operation and maintenance.
e) Inspect lines at valves, pumps, and other equipment carefully after backfilling for undue stresses on flanges. Verify that removal does not require cutting the pipe.

UPF INSPECTION RECORD FOR UNDERGROUND PIPING

DMC NUMBER:			**DATE:**
PROJECT NUMBER:		**PROJECT NAME:**	
QUALITY LEVEL: ☐ **Q** ☐ **RS** ☐ **CC**			
BLDG / AREA:	**PIPING SYSTEM:**	**ASME** ☐ **Yes** ☐ **No**	
DESCRIPTION:			
REFERENCE DOCUMENT NUMBER:	**REV NUMBER:**	**REMARKS:**	

ITEM	INSP. TYPE	N/A	FE/DATE	QCE/DATE
PIPING				
1. Fit-up is acceptable; vertical lines are plumb; and horizontal lines are level, except where slope is indicated on the design drawings				
2. Slopes are as indicated on P & ID's and isometrics drawings				
3. Pipe size, schedule and type of material is correct				
4. Flange ratings are correct				
5. Routing and tie-ins of lines are in the correct location				
6. Correct type reducers (eccentric or concentric and correct schedule) are located and orientated per specification, standards and design installation drawing				
7. Branch lines are located correctly on headers				
8. Reinforcing pads with weep holes, tees, sockolets, weldolets, or welding saddles are used as specified for branch connections				
9. Temporary supports provided, if required, to avoid pipe damage				
10. Vents are installed at high points and drains at low points				
11. Vents and Drains installed/welded after hydro as required by specifications				
12. No carbon steel contact with stainless steel components. Note: Check specification and vendor information as carbon steel bolting materials maybe be specified in stainless steel piping systems				
13. Welding and NDE is in compliance with codes and project specification				
14. Pipe coating is protected from damage during all handling, transportation or installation operation. Special care should be given to paint system which damage easily to prevent scratching, marring or damage				
15. Verify internal pipe cleanliness and hand clean pipe during installation process				

FIELD ENGINEER:	**DATE:**
QUALITY CONTROL ENGINEER:	**DATE:**

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BLDG / AREA:	**PIPING SYSTEM:**	**ASME** ☐ **Yes** ☐ **No**	
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	ITEM	INSP. TYPE	N/A	FE/DATE	QCE/DATE
	VALVES				
1.	Check, globe and control valves are installed with flow in correct direction as indicated on P&ID				
2.	Manufacturer's nametag description agrees with stock code number, (if used) description and trim. (Do not rely on warehouse tag). Check casting stamp also				
3.	Valves are accessible and operable and chain wheels or extensions are installed and operable, as required				
4.	Control Valve Positioners and accessories are accessible				
5.	Rising stem valves are free of obstructions and protectors are installed as required				
6.	Special packings are installed as required and if repacking is required, a tagging or color code system is used to identify repacked valves				
7.	Drains or flushing connections to valve bodies are installed, accessible and operable, as required				
8.	By-passes around valves are installed and operable, as required				
9.	Valves are internally clean				
10.	Temporary Supports provided, if required				
11.	Valves have been tested and calibrated prior to installation, if specified				
12.	Valve stems are not lower than horizontal unless specifically approved. (Especially stem locations for cryogenic valves)				
13.	Lubrication fittings on valves are installed as required				
14.	Valve lubrication sticks have been installed if required				
15.	Valves with special bolting requirements (i.e. tapped flanged bolt holes) are installed as required. These materials must be identified on the design drawings and BOM's				

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BOLTS AND STUDS				
1. Bolts and studs are not interchanged				
2. Bolting is appropriate length, diameter, and material				
3. Verify the thread pitch for 1 inch (25mm) and larger bolting materials				
4. Thread lubricant is used if required. Take extra caution with stainless steel materials				
5. Verify types of bolts to be used on high pressure, high temperature flanges or on cryogenic lines. Verification should include a spot check with a magnet for non-magnetic materials				
6. All bolts or studs are installed and tight or torqued/tensioned, as required. Studs have minimum one thread past nuts and have equal projection beyond nuts per project specifications (normal is 1-3 exposed threads), unless otherwise specified by project specification				
GASKETS				
1. Gaskets are installed and are the correct type, style, material, size and rating				
2. Specification changes at equipment block valves are carefully checked for correct gaskets				
3. All gaskets on blind flanges are checked and verified				
4. Temporary gaskets may be used at temporary blinds, then line specification gaskets are installed after pulling temporary blinds. Punch list should specify the right gasket. High pressure ring gaskets should be verified oval or hex material as installed				

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BLDG / AREA:	**PIPING SYSTEM:**	**ASME** ☐ **Yes** ☐ **No**	
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ITEM	INSP. TYPE	N/A	FE/DATE	QCE/DATE
SMALL PIPING, INCLUDING SMALL PIPE AT PUMPS AND OTHER EQUIPMENT				
1. Screwed and socket weld fittings of the correct weight and type material are used (watch out for malleable iron vs. forged steel fittings)				
2. Specified pipe thread sealant is used with adequate temperature capability				
3. The gap in socket weld fittings should be checked as work progresses				
4. If a vendor supplies the trim material, ensure the material used meets design and job specifications or there has been an agreed substitution approved by design engineering				
5. Monitor welding and NDE per specification				
6. Check stress relieving requirements				
PIPE SUPPORTS AND EXPANSION JOINTS				
1. Line is supported properly. Drawings must be checked to confirm that major supports are installed; small lines are most often field supported				
2. Particular lines, but especially steam and high temperature lines may require anchors, guides, and longer shoes to allow for expansion				
3. Remove all temporary supports - wire, wooden blocks, chain falls etc				
4. Check all supports for conformance with support detail drawings or standards				
5. Alloy lines must be checked carefully for material compatibility. Any additional welded supports or temporary welds may require stress relieving. Clamp types may be used if specifications permit.				
SEAL WELDING				
1. Seal welding is complete as required				
2. Exposed threads are covered by seal weld				
3. No pipe thread sealant or tape is to be used in screwed joints to be seal welded				
4. Specifications are checked for seal welding to equipment. (Some require it and some do not allow it).				

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ITEM	INSP. TYPE	N/A	FE/DATE	QCE/DATE
ALLOY LINES				
1. Stress relieving is complete, witnessed as required and documentation has been distributed				
2. Materials are the correct type. (Watch for substitutions of various alloys, especially stainless steels - 304, 304L, 310, 316 and 316L).				
3. Valves and gaskets are checked carefully. Stock code description is checked against valve nameplate data and, if necessary to determine valve is correct, against manufacturers catalog number.				
4. Never weld galvanized or zinc rich painted supports to stainless steel lines				
5. Records are available, signed by the client and/or fabricators, indicating orifice flanges have been internally ground smooth at butt welds (if required)				
6. Field installed orifice flanges should be checked to verify that inside diameter has been ground smooth				
MISCELLANEOUS ITEMS				
1. Relief valves and pressure gauges have been checked in calibration shop if required by specifications. These are tagged and calibrated as early as possible prior to installation, for pressure gauges, and in line with start up schedule for PSVs, and a list of these items is prepared for control, including set pressure, date checked and signature of checker. Ensure relief valves are calibrated in line with start up schedule and within the correct number days of start up as stated in the specification				
2. Spectacle blinds, blinds, and spacers are installed as required and are correct thickness				
3. Piping specifications are carried to the point specified before the instrument details take over. Usually the block valves must be per piping specifications				
4. Clearance exists for removal of equipment such as deep well type pumps, motors, tube bundles, basket strainers, thermowells, etc., and that spare equipment can be removed without a total plant shut down				
5. Instruments, i.e. level glass, pressure and temperature gauges, thermowells, etc. are accessible for operation and maintenance				

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