SPECIFICATION FOR
EXTERNAL LIQUID POLYURETHANE FOR STEEL PIPES

COMMON REQUIREMENTS

Reference: TS-C4Gas-COAT2 V1.0
Date:

Approved by:
C4Gas
Name: Odile CAZENAVE Date: 12 October 2021

REVISION TABLE:

Revision	Date	Content
1.0		1st issue

TABLE OF CONTENTS

Foreword

This specification is an addendum to “EN 10290:2002”, referred to in this document as “EN 10290”.

This specification applies to the (semi-)manual coating done in the applicator's workshop of pipes and cold or hot-bent pipes. The coating materials, coating system and workshop shall be qualified as stated in this specification.

Copies of this engineering document can be obtained from the C4Gas website. C4Gas documents are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition by referring to the C4Gas Register of Engineering Documents available on the C4Gas website.

All additional or mandatory requirements, changes and contradictions mentioned in this specification take precedence over the EN 10290 requirements.

No changes may be made in this specification without the prior approval of all of the BUYERS. However, individual BUYERS may change or add to their own company specific requirements within the document without the prior approval of the other BUYERS. Any such changes shall be promptly notified to the C4Gas nominated document controller.

General Requirements

References to “manufacturer” and “purchaser” shall be synonymous respectively to the SELLER and the BUYER unless the context otherwise requires.

The Authorized Inspection Organization's name, hereinafter referred to as AIO, shall be mentioned in the purchase order.

The requirements of the BUYER’s procedure qualification shall be fully complied with prior to pipe coatings.

Any interpretation and deviation to this specification, by the SELLER, shall be requested in writing with detailed justification and approved by the BUYER and the AIO before an order is placed with the SELLER. The latter is responsible and shall indemnify the BUYER for any damage resulting from the non-respect of this obligation.

For any control, test or examination required under the supervision of the BUYER or the AIO (Inspection and Test Plan interventions points included), the SELLER shall inform the BUYER and if required shall send an inspection notification to the AIO ten (10) working days in advance about place and time by mail or by fax.

Before starting any coating operation, the COATER shall be in possession of the approved Inspection and Test Plan, filled in with all the intervention points. If the COATER is not in possession of this document, the SELLER shall send for approval, twenty (20) working days before coating operation, an Inspection and Test Plan to the AIO and the BUYER.

An approval of document(s) shall not be considered as an acceptance of deviations or relaxations of the prescribed requirements. **A deviation is only possible after a specific request to the BUYER.** No deviation shall be accepted without an official acceptance of deviation signed by the BUYER or by the AIO.

Compliance with this engineering document does not confer immunity from prosecution for breach of statutory or other legal obligations.

Coated pipes, even released by the AIO or by the BUYER and in which injurious defects are found after delivery, shall be rejected. The SELLER shall be notified and the material replaced: all costs involved, including wages and travel expenses of the AIO’s representative, shall be borne by the SELLER.

Disclaimer

This engineering document is provided for use by C4Gas and BUYER'S and such of their contractors as are obliged by the terms and conditions of their contracts to comply with this engineering document. Where this engineering document is used by any other party it is the responsibility of that party to ensure that the engineering document is correctly applied.

MANDATORY AND NON-MANDATORY REQUIREMENTS

To establish compliance with a C4Gas engineering document, it is necessary to be able to identify those provisions that are to be satisfied and those which give freedom of choice. C4Gas engineering documents express these in the following manner:

- **Shall:** Indicates a mandatory C4Gas requirement.
- **Should:** Indicates best practice and is the preferred option. If an alternative method is used, then a suitable and sufficient risk assessment shall be completed to show that the alternative method delivers the same or better level of protection.

1. Scope

Replace paragraph with:

This document specifies the requirements of liquid applied external coating, polyurethane (PUR) and polyurethane-modified (PUR-MOD), for the corrosion protection of steel pipes used in natural gas pipelines and utilities.

The coating in this standard can be applied to longitudinally or spirally welded and to seamless steel tubes used for the construction of pipelines for conveying liquids or gases.

Coated tubes should be used within a year after coating application.

In accordance with the elongation properties, if the component is cold bent, the coating shall be applied after bending unless otherwise approved by the purchaser.

The coating shall consist normally of one layer of liquid product, applied by an airless spray technique.

Other application methods can be recommended by the product manufacturer, in accordance with the kind of product (brush, spatula, injection, spreading, etc.).

This coating can be used for the protection of buried or submerged steel tubes for service at the following temperatures -20°C to +80 °C.

For GRTgaz, the temperature range of the station pipes is -29°C to 80°C.

Other temperatures can be agreed; in this case, tests shall be carried out at the required temperature.

2. Normative references

Replace the following references:

ISO 4892:2006	with	EN ISO 4892-2
ISO 8501-1:2007	with	EN ISO 8501-1

Add at the end of this clause:

EN ISO 8502-3
EN ISO 8503-4
EN ISO 8503-5
EN ISO 4624
EN ISO 11124
EN ISO 11126
ASTM D4940
BUYER's specifications
SG-C-235 – GRTgaz specification for handling, transportation and storage
TS-C4Gas-PIP0 – C4Gas specification for steel pipes for pipelines – common requirements
TS-C4Gas-PIP2 – C4Gas specification for steel pipes for pipelines – FLUXYS specific requirements
TS-C4Gas-PIP3 – C4Gas specification for steel pipes for pipelines – GRDF and GRTgaz requirements

3. Terms, definitions, and symbols

Add at the end of this clause:

3.28
Authorised Inspection Organisation
AIO
Recognised inspection body specified in the purchase order

3.29
BUYER
C4Gas Customer

3.30
SELLER
Manufacturer

4. Coating materials

Add at the end of this clause:

4.5 Qualification

4.5.1 General – Qualification Scheme

The qualification process as per this document includes the following:

4.5.1.1 Coating material qualification, by the manufacturer

Each coating material shall be qualified by the manufacturer in accordance with the requirement of Table 4. The manufacturer shall carry out and report the coating material qualification in accordance with the requirements of Table 1 and 4 where applicable. The test report issued by the manufacturer may be also certified by a certification organization.

4.5.1.2 Workshop qualification, by the applicator

The production facility are evaluated to verify the ability to supply coatings in compliance with the BUYER's requirements.

Each coating system shall be qualified by the applicator.

The applicator shall prepare a Coating Technical File (CTF), related to the qualification of the specific coating system.

4.5.1.3 Coating System Qualification, by the applicator (Clause 10)

A system is qualified for one production facility. If another production facility shall be used to apply the coating system, a new qualification shall be necessary.

The applicator shall carry out and report the coating qualification (a third-party laboratory or a third-party inspection shall be selected by mutual agreement with the BUYER) in accordance with the requirements of Table 4.

4.5.1.4 Coating Technical File

The CTF consists of:

- the APS (see 4.5.2);
- the ITP (see 4.5.3)
- the qualification report containing the qualification test results and technical data.
- and shall be prepared for each pair “production facility / coating system”, in accordance with the document “C4Gas Coating Technical File – External Coating”.

4.5.1.5 Coating System Data sheet

Following technical approval of a CTF by C4Gas, a Coating System Datasheet (CSD) issued that contains the main data relating to the qualified coating system / production line.

4.5.2 Application procedure specification

Prior to the qualification process, the applicator shall prepare an APS, including:

- Incoming inspection of pipes and pipe tracking,
- Manufacturer’s specification (data sheets) for coating materials, including any materials used for coating repairs,
- Manufacturer’s specification (data sheets) for abrasive blasting materials,
- Certification, receipt, handling and storage of materials for coating and abrasive blasting,
- Cleaning procedure for all application equipment,
- Preparation of the steel surface including monitoring of environmental parameters, methods and tools for inspection, grinding of pipe surface defects and testing of surface preparation,
- Coating application, including tools/equipment for control of process parameters essential for the quality of the coating,
- Methods and tools/equipment for inspection and testing of the applied coating,
- Repairs of coating defects and any associated inspection and testing,
- Preparation of coating cutback areas,
- Marking and traceability,
- Handling and storage of pipes,
- Any special conditions for dispatch of coated pipes, including protection of pipe ends,
- Documentation.

The APS shall cover all items associated with quality control as defined in this document and any agreed amendments. It shall be available to the BUYER on request at any time during production.

The APS, including any revisions, shall be approved by the BUYER prior to the start of qualification and production.

4.5.3 Inspection and test plan (ITP)

The applicator shall prepare an ITP and a daily log to record quality control data.

An ITP shall be prepared for any requested qualification and production acceptance testing.

Inspection frequencies shall be as per Tables 8 and 9.

The ITP contents shall reflect all the process items, the items to be inspected and tested as described by the APS and related frequencies.

As a minimum the following shall be recorded:

- Description of the activities,
- Coating system,
- Inspection points for each of the activities,
- Applicable reference documents,
- Applicable check procedures and methods / instruments,
- Acceptance criteria,
- Test frequency,
- Remedial actions,
- Persons required to be present,
- Reporting.

If specified, a daily log shall be used to record all inspection and testing data, process parameters and calibrations of equipment for quality control.

5. Information supplied by the purchaser

5.1 Mandatory

5.2 Options to be indicated by the purchaser

6. Application of the coating

6.1 Surface preparation

Replace this clause with:

The abrasives used in the coating workshop shall be in accordance with the respective requirements of EN ISO 11124 or EN ISO 11126. The abrasives (including recycled materials) shall be maintained clean, dry and free from contaminants in accordance with ASTM D4940 so as not to contaminate the substrate.

All pipes shall be dry prior to start surface preparation. The pipe temperature shall be at least 3°C above the dew point immediately prior to abrasive cleaning.

For the purpose of the grit blasting operation, the supplier shall take all measures to ensure protection of the cold marking of the bare pipes (order number, pipe number…).

After blasting, the surface condition and dust contamination near the weld seam shall be equivalent to those found on the pipe wall.

Components shall be abrasive blast cleaned. The degree of cleanliness shall be Sa 2 ½ minimum in accordance with EN ISO 8501-1.

The blast cleaned surface shall have of roughness R_z between 50 µm and 100 µm, as measured in accordance with EN ISO 8503-4 (stylus method) or ISO 8503-5 (replica tape method).

6.1.5

Replace this clause with:

The dust level shall be measured in accordance with the requirements of EN ISO 8502-3. The maximum dust quantity rating shall be 2 and the maximum dust size class shall be 2.

Chemical treatment of the steel may be used in addition to abrasive blast cleaning, by agreement between the purchaser and the coater.

Testing for the presence of soluble salts on the pipe shall be undertaken in accordance with the requirements of EN ISO 8502-6 and EN ISO 8502-9. The maximum allowable level shall be 20 mg/m² after blasting. If level above 20 mg/m² of soluble salts are measured, a surface pre-treatment cleaning process shall be agreed upon by the applicator and the purchaser.

6.2 Composition of the coating

6.2.1 General
6.2.2 Mixing
6.2.3 General application procedure
6.2.4 Field and shop application procedure

7. Requirements of the applied coating

7.1 General

7.2 Minimum dry thickness of the coating system

Replace this clause with:

Coating thickness shall be measured in accordance with the method defined in annex A.

The minimum dry thickness of the coating system at any point shall correspond to the following value depending on the pipe diameter.

1000 µm	DN < 80
1500 µm	80≤ DN ≤ 600
2000 µm	DN > 600

7.3 Hardness Shore “D”

7.4 Appearance and continuity

7.5 Cut-backs

Add at the end of this clause:

To avoid corrosion linked to environment the BUYER requires bare ends of coated pipes to be coated with weldable varnish up to the cutback. The type of varnish shall be proposed for approval to the BUYER.

7.6 Holiday detection

7.7 Impact resistance

Replace this clause with

The maximum impact energy, in Joules, which does not give rise to perforation when detected in accordance with the method described in annex B, shall be determined in accordance with the method defined in annex C. The minimum impact energy, in Joules, shall correspond to the following value depending on the pipe diameter.

Diameter	(23 ± 2) °C	(- 5 ± 3) °C
DN ≤ 600	7.5 J	4.5 J
DN > 600	10 J	6 J

7.8 Adhesion test – Resistance to removal

Replace this clause with:

Adhesion is only measured using the pull off method

7.9 Adhesion test – Pull off method

Replace this clause with:

The minimum pull-off adhesion shall be determined in accordance with the method defined in EN ISO 4624 and shall correspond to 10 MPa at (23 ± 2) °C.

An adhesive rupture at the interface steel-coating shall be considered a failure.

Results shall be given for information at the maximum service temperature.

7.10 Cathodic disbondment

7.11 Specific electrical insulation resistance

7.12 Adhesion test immersion in tap water

7.13 Indentation resistance

7.14 Thermal ageing

7.15 Flexibility

7.16 Infra-red scan

7.17 Elongation

7.18 Hot Water Immersion Test

Replace table 4 with:

Properties	Requirements		Subclause
Dry thickness of the coating system	1000 µm DN < 80 1500 µm 80≤ DN ≤ 600 2000 µm DN > 600		7.2
Hardness “Shore D”	Specified by the manufacturer		7.3
Appearance and continuity	Uniform colour, smooth appearance and free from defect		7.4
Cut-Back	(150 ± 20) mm		7.5
Holiday	Free from holiday		7.6
Impact resistance	(23 ± 2) °C	(- 5 ± 3) °C	7.7
	DN ≤ 600: 7.5 J DN > 600: 10 J	DN ≤ 600: 4.5J DN > 600: 6J	
Adhesion test Pull off method	(23 ± 2) °C	(60 ± 2) °C	7.9
	10 Mpa	Result for information	
Cathodic disbondment	Average	Maximum	7.10
	≤ 8 mm	≤ 10 mm	
Specific electrical insulation resistance	Minimum Rs after set number of days at constant temperature		7.11
Adhesion test after immersion in tap water	7 Mpa		7.12
Indentation resistance	(23 ± 2) °C	(60 ± 2) °C	7.13
	≤ 0,2 mm	≤ 30 % of initial measured thickness	
Thermal ageing	Results for information		7.14
Flexibility	Pass		7.15
Infra-red scan	Acceptable comparison with reference scan		7.16
Elongation	≥ 10 %		7.17

8. Inspection

8.1 General

Replace this clause with:

Inspection and testing shall be carried out in accordance with the APS, and ITP as applicable, and meet the requirements of Table 5.

The applicator is required to submit to the BUYER's representative and AIO a specific Inspection Test Plan and planning twenty working days before each production run for each item.

The BUYER and/or AIO's representative shall have free access to the manufacturing plant and laboratories to perform inspections as defined in the Inspection and Test Plan.

All inspections and tests during production, shall be approved by the QC or/and the BUYER's representative and shall be recorded in the technical file.

If necessary, the BUYER can specify additional or other properties during the tender process and the ordering process.

During production the ITP, the production ranges, the procedures or production orders may be inspected by the AIO or BUYER's representative.

The SELLER shall undertake any corrective action identified in non-conformance raised by the AIO or BUYER's representative. A non-conformity report shall be made by the seller.

8.2 Documents

8.2.1 Standard

Replace this clause with:

The SELLER shall provide to the BUYER a complete end-of-manufacture file that includes as a minimum:

- The reference of the coating system,
- The corresponding CSD number,
- The list of delivered coated pipes,
- The numbers of all raw material batches used,
- All batch certificates of the raw material used,
- All results of the production tests,
- A list of all repairs that were carried out (pipe number, type of repair, etc…),
- All the non-conformity sheets established during the production process,
- An inspection certificate of type 3.1 according to EN10204: 2004 or ISO 10474,
- For FLUXYS only, the end-of-manufacture file shall also contain the quality release note (QRN) delivered by the AIO's delegate or upon final approval of the coating.

The archiving of the complete end-of-manufacture file shall be established by the applicator and shall be kept for 12 years by the SELLER.

The SELLER shall provide copies of the complete end-of-manufacture file as follows:

- GRTgaz & GRDF: 2 hard copies + 1 CD-ROM or USB KEY (on the specific website for GRDF)
- FLUXYS: 2 hard copies (after final approval by the AIO's delegate of all the documentation)

The end-of-manufacture file shall be drawn up in the following languages:

BUYER	Language
GRDF & GRTgaz	French
FLUXYS	English

8.2.2 Special

8.3 Sampling

8.4 Nature and frequency of testing and control

Replace the table with:

Table 5 – Nature and frequency of testing and control

Properties	Subclause	Test Method	Requirements	Minimum production control	System and applicator approval
Surface condition before blast cleaning	6.1	Visual	Free of contaminations	Every component	3 Components
Environmental conditions	6.1	-	As determined at time of measurement	Every 4 h	Once
Pipe temperature before blasting	6.1	-	Minimum 3°C above the dew point	Every component	Once
Dimension, shape, and properties of blast cleaning products and checking of the blast cleaning process	6.1	Certification respective requirements ISO 11124 / ISO 11126	Conformity to certificate and compliance with manufacturing/working procedures	Twice per shift c	3 Components
Roughness of the blast cleaned surface	6.1	ISO 8501-1	50 to 100 µm	Once per shift c	3 Components
Dust contamination	6.1	ISO 8501-2	Class (2,2)	Once per shift c	3 Components
Soluble salt content after blasting	6.1	ISO 8502-6 or ISO 8502-9	Salt content (as NaCl) max. 20 mg/m²	Once per shift c	3 Components
Visual inspection of the blasted surface	6.1	ISO 8501-1	Sa 2 ½	Every component	3 Components
Temperature of pre-heating before coating, if necessary	6.2	-	Within manufacturer's specification	Continuously c	3 Components
Temperature of post-heating before coating, if necessary	6.2	-	Within manufacturer's specification	Continuously c	3 Components
Wet thickness of the coating system	6.2	ISO 2808	Within manufacturer's specification	d	3 Components
Dry thickness of the coating system	7.2	Annex A	Table 4	4 per shift c	3 Components

Properties	Subclause	Test Method	Requirements	Minimum production control	System and applicator approval
Hardness Shore “D”	7.3	EN ISO 868	Within manufacturer’s specification	4 per shift	3 Components
Appearance and continuity	7.4	Visual	Uniform color, smooth appearance and free from defect	Every component	3 Components
Cut-Back	7.5	Visual	Table 4	Every component	3 Components
Holiday detection	7.6	Annex B	Table 4	Every component	3 Components
Impact resistance at (- 5 ± 3) °C and at (23 ± 2) °C	7.7	Annex C	Table 4	-	3 Samples
Adhesion Test - Pull-off method f	7.9	EN ISO 4624	Table 4	Once per shift c	3 Samples
Cathodic disbondment f h	7.10	Annex E	Table 4	g i	3 Components
Specific electrical insulation resistance	7.11	Annex E	Table 4	g i	3 Tubes
Adhesion test after immersion in tap water	7.12	Annex G	Table 4	g	3 Components
Indentation resistance	7.13	Annex H	Table 4	g i	3 Tubes
Thermal ageing	7.14	Annex J	Table 4	g i	3 Tubes
Flexibility	7.15	Annex K	Table 4	g	3 Samples
Infrared scan	7.16	-	Table 4	g	3 Components
Elongation	7.17	ISO 527	Table 4	g	3 Samples

a All tests detailed shall be undertaken at least every 3 years for the same system, material and significant technical process. The system and applicator approval may be combined with a coating production run.
b Option 12
Other scheme of procedure qualification may be requested by the purchaser.
c If the process is discontinuous this test shall be carried out on every component.
d The test shall be carried out as follows:
automatic plant : 1 tube every 5;
manual application : 3 times per component.
e Any component from the beginning to the end of production may be used for this test.
f Option to be indicated by the purchaser.
g The test and their frequency shall be defined at the time of the inquire and order.
h The delivery of tubes can be undertaken prior to the completion of the test.
i By agreement the test can be carried out on panels or samples coated at the same time and in the same way as production. This is permissible if qualification trials have been carried out both on panels and components.

8.5 Retests

9. Repairs

10. Marking

Replace this clause with:

10.1 General

Coated pipe shall be marked in accordance with the requirements of 14.2, 14.3 and 14.4. The identification marking shall be easily readable. The marking method shall ensure the legibility of the information for 2 years.

10.2 External identification marking

The following marking shall be placed on the external coating:

<table>
<tr><th colspan="2">GRTgaz and GRDF</th></tr>
<tr><th>Position</th><th>Markings</th></tr>
<tr><td>near pipe end
It shall be positioned, so as to leave a free space of at least 20 cm and at most 50 cm, between the end of the coating and the extremity of the marking.</td><td>All information required by steel pipe reference documents:
- Pipe identification,
- Pipe length (in meters and cm) [a],
- Outside diameter (mm),
- Wall thickness of the pipe (mm),
- Maximum Operating Pressure (MOP),
- For GRDF in Bar
- For GRTgaz in MPa
- Heat number,
All information relative to coatings:
- Trademark and, as possible, the production facility
- Reference to this specification,
- Coating thickness,
- CSD number</td></tr>
<tr><th colspan="2">Fluxys</th></tr>
<tr><th>Position</th><th>Markings</th></tr>
<tr><td>continuous paint marking</td><td>For all coated pipes:
- Steel grade,
- Outside diameter (mm),
- Wall thickness of the pipe (mm).
- The following symbol: “PUR”
Supplementary requirement for sour gas service pipes:
- The words “SOUR GAS”</td></tr>
<tr><td colspan="2">a Pipe length marking must be revised in case of cutting of a pup for CD test.</td></tr>
</table>

Any deviation from these instructions shall need to be covered by a waiver from the BUYER.

Mark shall be carried out using a method such as stencil painting or printing to ensure legible and indelible identification, with characters of minimum 20mm.

Cold marking realized by the pipe manufacturer shall be protected with transparent varnish or equivalent, in order to guarantee the identification in addition to the marking by stencil painting or printing.

(Such a cold marking shall be perfectly legible prior to application of the protection).

Supplementary sticker marking may be applied upon agreement with the BUYER.

10.3 Internal identification marking

An internal identification marking is required for pipes DN ≥ 80 mm. This identification marking shall be placed opposite to the external marking.

GRTgaz and GRDF	Fluxys
All information required by steel pipe reference documents	NO MARKING REQUIRED
- Pipe identification, - Pipe length [a] (in m an cm)	
[a] Pipe length marking has to be updated in case of cutting of a pup for CD test.	

The internal identification marking shall be easily legible from the outside.

10.4 Special Marking

Special marking is defined in the steel pipe specification. Certain pipes are marked with a ring painted at each end. Unless otherwise indicated, the standard colors are the following:

10.4.1 Requirements for FLUXYS according to TS-C4Gas-PIP2

For HFW pipes the weld shall be marked with a white line of approximately 10 cm long, painted at both ends on the inside of the pipe
SAWH pipes with strip end weld (when qualified) shall be additionally marked with 2 light green rings, painted on each end of the strip end weld
If requested for pipes D > 508 mm, the middle of the pipe shall also marked with a white ring for 3LPE or black ring for 3LPP, painted on the coating

10.4.2 Requirements for GRTgaz and GRDF according to TS-C4Gas-PIP3

GRDF	
Pipe for distribution (MPC)	Brown ring
Pipes for distribution CI/CM	No ring ; Yellow coating to be applied
For HFW pipes the weld shall be marked with a white line painted at both ends on the inside of the pipe	
GRTgaz	
Category A pipes	Without color ring
Category B pipes	Red ring
Category C pipes	Yellow ring
Category T (safety over thickness) pipes	Double yellow ring
Pipes with special characteristics for collection networks	Purple ring
For HFW pipes the weld shall be marked with a white line painted at both ends on the inside of the pipe	
SAWH pipes with strip end weld (when qualified) shall be additionally marked with 2 green rings, painted on each end of the strip end weld	
If requested for pipes D > 508 mm, the middle of the pipe shall also marked with a white ring for 3LPE or black ring for 3LPP, painted on the coating	

11. Handling, transportation and storage

Add at the end the following clause:

11.5 Buyer specific requirements

11.5.1 Requirements for GRTgaz and GRDF

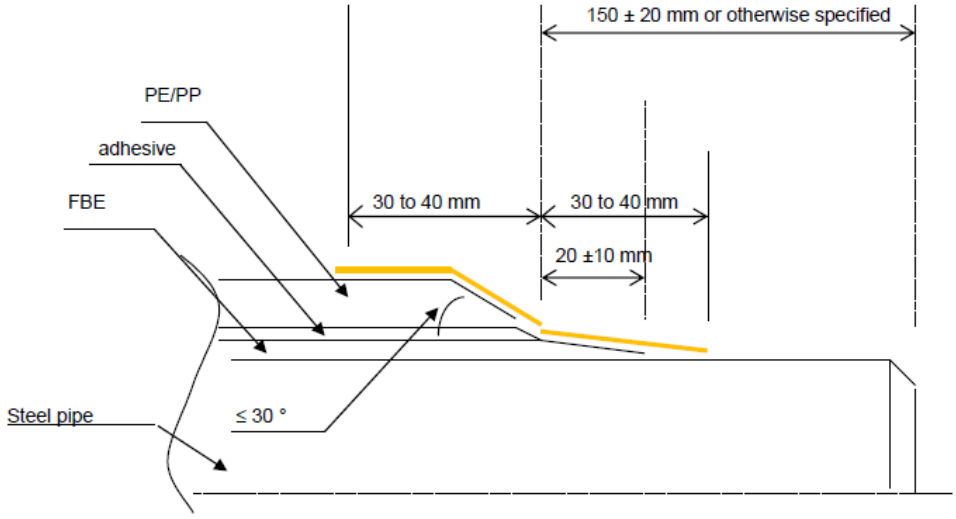
The SELLER shall take all appropriate measures to ensure that the pipe or its coating will not be damaged during production, handling and storage at its manufacturing plant. These requirements apply to transportation also and delivery which are part and parcel of the SELLER's liability.

Rules relative to unloading and the storage of pipes at the BUYER's various sites are defined in the specification SG-C-235.

Supplementary rules concerning a specific worksite may be defined in the logbook concerning this site.

GRDF: For limiting the internal corrosion and to facilitate stock management, each pipe end shall be closed with a pipe cap with an 8mm drilled hole, displaying the pipe number.

A protective varnish shall be applied onto the top coat beveled edge (see diagram in section 11.4 of TS-C4Gas-COAT0). The applied product shall be approved by the BUYER. The product shall be easily removed on site during the surface preparation by brushing or grit blasting. The product shall be systematically applied, except with a contrary indication by the BUYER.



11.5.2 Requirements for FLUXYS

The SELLER shall take all appropriate measures to ensure that the pipe or its coating will not be damaged during production, handling and storage at its manufacturing plant. These requirements apply also to transportation and delivery which are part and parcel of the SELLER's liability.

At least 1 month before delivery, the SELLER shall provide following documents:

- A copy of its procedure for shipping, handling & storage including pipe transportation to the final delivery location.
- For pipes with ratio OD/WT > 50 or NPS ≥ 24, a calculation of short term & long term (> 6 months) storage, including the number and spacing of bearing/separator strips and the number of layers.

Handling & storage

Unless otherwise specified, pipes will be stored at the permanent FLUXYS depot.

Pipes NPS < 36 are, unless otherwise stated at the time of quotation request or order, unloaded & handled with hooks.
Pipes NPS ≥ 36 shall not be handled with hooks after beveling.

The loading and handling methods (vacuum lifting, etc.) shall be described in the offer and shall be in conformity with abovementioned principles.

In case pipes are to be stored at another site supplementary rules for handling & storage will be defined and specified in the order

Transportation

Single and bundled pipes shall be secured adequately during transport. Padding shall be positioned between the means of restraint and the pipe coating and between all points of contact between the vehicle and the pipes. Chocks or contoured bearing/separator strips shall be used to prevent pipes from rolling.

During transportation the weld of longitudinally welded pipes shall be positioned as such to avoid direct contact with adjacent pipes, separator strips and/or bearing strips.

- Nested stacks – except for the bottom layer: Pipes shall be positioned with the weld seam vertically down (in other words, 6 o'clock position)
- Parallel rectangular stacks with separators strips and bottom layers of nested stacks: Pipes shall be positioned with the weld seam at 20 ° ± 5 ° from vertically down, depending on the chocks or bearing type used.

For spirally welded pipes sufficient padding shall be positioned between adjacent pipes and all points of contact between pipes and the vehicle.

➢ Road transportation

Trailers shall be suitable for crane unloading (no fixed roof , box or tarpaulin vehicle).

Sufficient padding shall be placed between the pipes to separate them, to prevent chafing and to facilitate unloading.

➢ Railroad transportation

Railroad transportation shall be performed in accordance with API RP 5L1.

Sufficient padding shall be placed between the pipes to separate them, to prevent chafing and to facilitate unloading

➢ Marine and inland waterways transportation

Transportation on barges and marine vessels shall be performed in accordance with API RP 5LW.

A calculation of the acceptable stack heights shall be made by the SELLER and provided for approval to the BUYER at least 1 month before delivery.

The SELLER shall inform the BUYER in case the pipes are carried as deck cargo at least 1 month before delivery.