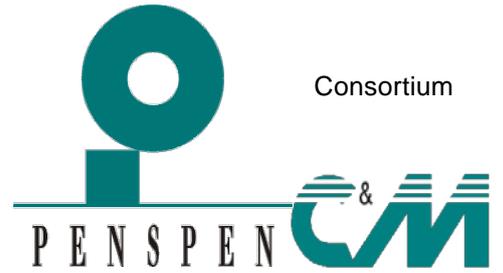


# “ICGB” AD

## ***FEED & EIA for Natural Gas Interconnector Greece – Bulgaria (IGB) Project***

### ***Specification for Internal Lining of Line Pipe***



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## 1. **Introduction**

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ICGB AD is a company set up and existing under Bulgarian law and hereafter known as the CONTRACTING ENTITY. The CONTRACTING ENTITY awarded the consortium of Penspen Ltd and C&M Engineering SA, known hereafter as the CONTRACTOR with the Front End Engineering Design (FEED) and Environmental Impact Assessment (EIA) for a proposed 32” diameter high pressure gas pipeline, called the “Gas Interconnector, Greece – Bulgaria” (IGB).

The IGB buried pipeline will transport natural gas over the border between Greece and Bulgaria, connecting the existing Komotini Facility in Greece with an existing gas pipeline near the Bulgarian town of Stara Zagora. The proposed pipeline will measure a total distance of approximately 181.3kms, (30.5kms in Greece and 150.8kms in Bulgaria).

The design of this bi-directional pipeline system shall be in accordance with the internationally recognised codes of practice: EN1594 and ASME B31.8, and also in conjunction with Bulgarian Ordinances, for the safe transportation of 3bcm/yr of gas initially, with the provision for the future expansion up to a maximum technical capacity of 5bcm/yr. The project also includes the construction of the associated Above Ground Installations (AGIs).

### 1.1 **Purpose of Document**

This specification describes the requirements for the internal two-pack epoxy resin, solvent-based coating which is specifically designed for friction reduction in pipelines carrying non-corrosive gases.

All coating materials shall be applied in accordance with the SUPPLIER'S recommendations and the CONTRACTING ENTITY shall ensure that copies of such recommendations are available to the CONTRACTING ENTITY and those of the APPLICATOR'S personnel involved in this work.

### 1.2 **Abbreviation**

AGI	Above Ground Installation
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ATEX	Atmosphere Explosive
BS	British Standard
DBM	Design Basis Memorandum
DN	Diameter Nominal
EPC	Engineering, Procurement, Construction
FEED	Front End Engineering Design
IGB	Interconnector Greece-Bulgaria

ISO	International Standards Organisation
ITP	Inspection and Test Plan
PQT	Procedure Qualification Trial
VOC	Volatile Organic Compounds
MFR	Melt Mass-Flow Rate
MVR	Melt Volume-Flow Rate
PE	Polyethylene
PP	Polypropylene
PQT	Pre-Production Qualification Test
SOW	Scope of Work
3LPE	Three Layer Polyethylene
3LPO	Three Layer Polyolefin
3LPP	Three Layer Polypropylene

## 2. **Definitions and Abbreviations**

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CONTRACTING ENTITY is ICGB AD;

CONTRACTING ENTITY REPRESENTATIVE Entity appointed by the CONTRACTING ENTITY and advised to the Contractor, to carry out defined duties on behalf of the CONTRACTING ENTITY.

APPLICATOR Coating Applicator

SUPPLIER SUPPLIER of Equipment or Materials

Throughout this document the following terminology is used:

“must”: signifies a legal or statutory requirement

“shall”: signifies a requirement made mandatory by this specification

“may”: signifies a feature, which is discretionary in the context in which it is applied

“will”: signifies a feature which the SUPPLIER / APPLICATOR may assume to be already present.

**3. Appropriate Codes and Standards**

Only the latest issues of the relevant standards, codes, statutory regulations and specifications referenced shall be applied to the work being performed unless specifically stated otherwise.

API RP 5L2	Recommended practice for Internal Coating of Line Pipe for Non-Corrosive Gas Transmission Service
ASTM 4940	Standard Test method for Conductimetric Analysis of Water Soluble Contamination of Blasting Abrasives
Council Directive 1999/13/EC	On the limitations of volatile organic compounds due to the use of organic solvents in certain activities and installations
EN 10208-2	Steel pipes for pipelines for combustible fluids – Technical delivery conditions – Part 2: Pipes of requirement class B.
European Parliament and Council Directive 2004/42/CE	On the limitations of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC
ISO 2409	Paints and varnishes. Cross-cut test
ISO 2431	Paints and varnishes. Determination of flow time by use of flow cups.
ISO 2808	Paints and varnishes. Determination of film thickness
ISO 2811-All parts	Paints and varnishes. Determination of density.
ISO 2812 – 2	Paints and varnishes. Determination of resistance to liquids. Water immersion method.
ISO 2815	Paints and varnishes. Buchholz indentation test.
ISO 3233	Methods of test for paints. Tests on liquid paints (excluding chemical tests). Determination of percentage volume of non-volatile matter by measurement of the density of a dried coating.

ISO 3251	Paints, varnishes and plastics. Determination of non-volatile-matter content.
ISO 6743-4	Lubricants, industrial oils and related products (class L). Classification. Family H (hydraulic systems).
ISO 6860	Paints and varnishes. Bend test (Conical mandrel).
ISO 7253	Paints and varnishes. Determination of Resistance to neutral salt spray (fog).
ISO 8501-All parts	Preparation of Steel Substrates before Application of Paints and Related Products - Visual assessment of surface cleanliness
ISO 8502-2	Preparation of Steel Substrates before Application of Paints and Related Products – Test for the assessment of surface cleanliness. Laboratory determination of chlorides on cleaned surfaces
ISO 8502-3	Preparation of Steel Substrates before Application of Paints and Related Products - Test for the assessment of surface cleanliness. Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 8502-9	Preparation of Steel Substrates before Application of Paints and Related Products - Test for the assessment of surface cleanliness. Field method for the conductometric determination of water soluble salts
ISO 8503-All parts	Preparation of Steel Substrates before Application of Paints and Related Products - Surface roughness characteristics of blast cleaned steel substrates
ISO 8504-2	Preparation of Steel Substrates before Application of Paints and Related Products - Surface preparation methods. Abrasive blast cleaning

ISO 9001	Quality management systems. Requirements
ISO 11124-All parts	Specification for metallic blast-cleaning abrasives
ISO 15741	Paints and varnishes. Friction-reduction coatings for the interior of on- and offshore steel pipelines for non-corrosive gases
ISO 2431	Paint and Varnishes – Determination of Flow Time by Use of Flow Cup

**4. Reference Material**

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10760-SPC-PL-P0-003	Specification for Linepipe
10760-PHL-EN-00-001	Design Basis Memorandum

**5. Technical Requirements**

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**5.1 Pipeline Details**

Details of the linepipe to be coated and service conditions are shown in Specification of Linepipe, refer to above.

**5.2 Coating System**

The coating system is provided for friction reduction (flow coat). A flow coat provides the following benefits:

- It reduces internal roughness of the linepipe and hence reduces friction.
- It improves flow efficiency and hence reduces compressor head for the same volume of gas throughput.
- The reduction in head means a reduction in power consumption and hence savings in energy costs and reduction in emissions of greenhouse gases from the compressor stations.
- It eliminates atmospheric corrosion of the lined sections of pipe (note that the final 20 mm at pipe ends are not lined) during transportation, storage and construction
- It provides a clean smooth surface for pipeline cleaning and inspection
- A cleaner pipe translates to reduced effort and hence cost of cleaning the pipeline after hydro test.

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- Reduction in corrosion products translates to less waste disposal and easier approval for test water disposal.
- More rapid drying and hence less time on site for expensive hot air or vacuum driers.
- Less problems in commissioning of compressor stations due to minimal dust blow through.
- Decreased block valve and compressor station maintenance on valves and filters due to minimal dust in the line after drying and commissioning.
- Significantly reduces the danger of pyrophoric combustion from ferrous deposit build up.

To realise these benefits the pipe will be lined. The internal coating shall be a two-pack epoxy resin, low solvent based, high solids material designed for friction reduction in pipelines carrying non-corrosive gases.

The coating shall be applied by airless spray to a minimum dry film thickness of 75 microns. If lower thicknesses are proved by the APPLICATOR as satisfactory for blast profile coverage and final hydraulic smoothness then this will be considered for approval by the CONTRACTING ENTITY, down to an absolute minimum of 60 microns.

The coating shall not contain any substances which will be released from the paint film after it has been cured and are proven to be detrimental to the operation of the pipeline and the quality of the gas or be released into the hydrostatic test water.

Paint batch samples shall be kept for a minimum period of 12 months from application for verification purposes required by the CONTRACTING ENTITY.

### 5.3

#### General

The APPLICATOR shall maintain a quality assurance system which complies with ISO 9001 to ensure that all requirements of this specification and contract documents are met.

The APPLICATOR shall submit written procedures for all activities required by this specification for review and must receive approval from the CONTRACTING ENTITY prior to commencement of any coating operations.

All certification, test results, reports and any other documentation submitted shall be in English.

**5.4 Procedure Qualification Trial (PQT)**

Prior to commencement of any coating operations, the APPLICATOR shall submit to the CONTRACTING ENTITY all necessary details of the proposed coating materials and procedures for qualification and approval.

Where the CONTRACTING ENTITY considers that the APPLICATOR has not satisfactorily demonstrated that the proposed coating materials and procedures will meet the requirements of this specification, the APPLICATOR shall undertake a PQT meeting the requirements detailed in Appendix.A.

The PQT shall be witnessed by the CONTRACTING ENTITY. The results from the PQT shall be recorded by the APPLICATOR and submitted to the CONTRACTING ENTITY for approval.

**5.5 Pipe Receipt and Storage**

Receiving and storage procedures of bare pipe shall ensure the pipe is maintained in a fully satisfactory condition, with no detriment to the subsequent coating system. Procedures shall be fully in accordance with relevant project specifications.

**5.6 Materials**

All materials shall be totally suitable for the coating system specified and the pipeline usage advised by the CONTRACTING ENTITY. The APPLICATOR shall ensure all details of the coating to be applied are available for review and approval prior to commencing coating production. These details shall as a minimum include those identified in Appendix.A.

Materials for pipe coating shall be unloaded in a manner to prevent damage or loss and shall be stored in a manner to preserve their condition, prevent loss and permit easy access for checking. Materials shall not be used after their expiry date.

**5.7 Factory Conditions**

All preparation and internal coating of linepipe shall be carried out in a fully enclosed weatherproof building which will permit the necessary control of environmental conditions and all application procedures required for satisfactory coating system application.

Safety conditions for application and for venting of VOC's to atmosphere shall meet all current EU directives and regulations if the coating is applied at a plant in Europe. If the coating is applied in a country outside the EU then the regulations of that country shall apply.

**5.8 Surface Preparation**

Pipe surface preparation shall meet the testing and inspection requirements detailed in Appendix A.2.

Before abrasive blast cleaning, pipe surfaces shall be free of all surface contamination. Oil, grease or similar contaminants shall be removed with a solvent or detergent. Salt contamination, chemical cleaning agents and remaining detergents shall be washed off with fresh, potable water. Any water used for such purposes shall have a pH within the range 6.5 to 7.5. Pipes shall be dry before abrasive blast cleaning.

The pipes shall be cleaned by automatic rotary blast cleaning. Only dry abrasive materials shall be employed and the abrasive shall be maintained free from dust, salts and other impurities. The preferred blasting medium shall be steel grit. Any surface which in the opinion of the CONTRACTING ENTITY is unsatisfactory shall be re-blasted.

After blast cleaning, any remaining chloride contamination on pipes shall meet the requirements detailed in Appendix A.2. Where chloride contamination on pipes is identified, the CONTRACTING ENTITY reserves the right to specify additional testing on bare or coated pipe, to reject such coated pipe, and to invoke additional measures to avoid such contamination.

The condition of the pipe shall be visually examined for manufacturing and handling defects during cleaning. Defects detrimental to the coating process shall be removed by grinding. Any grinding shall not violate EN 10208-2 or relevant project specifications.

Elapsed time between abrasive blast cleaning and coating shall not exceed the following time/humidity values:

Relative Humidity (RH)	Maximum Elapsed Time
$80\% < RH \leq 85\%$	2 hours
$70\% < RH \leq 80\%$	3 hours
$RH \leq 70\%$	4 hours

Any pipe which has not been processed within the maximum elapsed time or before visible re-rusting occurs shall be re-blasted.

Immediately before the application of the coating the internal surfaces to be coated shall be rendered free of dust and grit by blowing off the surface with clean dry air or by vacuum extraction.

**5.9 Coating Application**

The pipe shall be coated strictly in accordance with the material SUPPLIER'S application procedures. Application procedures shall meet the requirements detailed in Appendix A.2.

Each batch of material shall be used up completely in the sequence in which it has been manufactured.

The ambient temperature, relative humidity and the temperature of the steel surface during application and subsequent drying/curing shall be in accordance with material SUPPLIER'S recommendations and agreed

procedures. Temperatures shall be continuously monitored and recorded. Any pipes coated during temperature deviations shall be marked and subject to additional testing to the satisfaction of the CONTRACTING ENTITY.

Paint shall be applied by continuous airless spray to achieve a uniform dry film thickness over the whole surface. Dry film coating thickness shall be in accordance with Section 5.2 of this specification.

#### **5.10 Coating Cut-back**

The pipe ends shall be maintained free of coating for a length of 20mm + 5 mm (cut-back length). Bevelled ends shall be free of coating and any coating materials deposited in the cut-back section shall be removed immediately by solvent wiping.

#### **5.11 Coating Repairs**

Minor defects in the coating or small areas of insufficient dry film thickness shall not require repair. If such defects or areas constitute a total area greater than 1% of the overall coated area, then the pipe joint may be rejected by the CONTRACTING ENTITY and the pipe shall then be re-blast cleaned and re-lined.

#### **5.12 Inspection and Testing Plan (ITP) and Daily Log**

The APPLICATOR shall develop and agree with the CONTRACTING ENTITY an ITP which identifies all pipe preparation, coating application and quality control activities in a consecutive order, including process parameters that are relevant to each activity. Reference shall be made to the applicable standards or APPLICATOR'S procedures, frequencies and acceptance criteria that shall apply for each process control and inspection/testing activity and actions in case of non-conformities.

A Daily Log shall be used to record all inspection and testing data, process parameters and calibration of equipment for quality control.

The ITP and Daily Log shall meet the requirements detailed in Appendix A.2.

#### **5.13 Pipe Identification/Numbering**

All pipes will be allocated a unique serial number at the pipe mill. This number will be stencilled on the inside of the pipe at each end.

The APPLICATOR shall maintain comprehensive tallies of the serial numbers of the pipes received, pipes taken for coating, pipes accepted or rejected at the pre-coating inspection stage, pipes accepted after coating and pipes which have been rejected during the coating stage and put aside or recirculated through the process.

All such tallies shall be maintained strictly in the correct sequence and the date and time of recording shall be included wherever relevant and/or required by the CONTRACTING ENTITY.

Pipe serial numbers shall not be die-stamped. Where the original stencilled serial numbers cannot be maintained and protected the APPLICATOR shall propose a procedure for the re-application of the serial numbers.

#### **5.14 Reporting**

Reports shall be kept of all relevant data for each individual pipe joint. This shall include, but not be limited to, the following:

1. Material batch numbers and certificates detailing all the information required for each batch as defined in this specification.
2. Daily Log.
3. Details of repairs to manufacturing and handling defects exposed during cleaning and the repair techniques used.
4. Details of repairs to coating defects exposed during testing and the repair techniques used.
5. Details of rejected pipe, with reasons for failure.
6. Information on pipe which, after rejection, requires complete recycling.

Such information shall be submitted daily by the APPLICATOR to the CONTRACTING ENTITY.

Coated pipe which is submitted to the CONTRACTING ENTITY for approval shall not be accepted unless accompanied by the above information. Failure to supply such information shall be cause for rejection.

#### **5.15 Handling, Storage and Delivery of Pipe**

The greatest care is to be taken at all times to avoid damage to the pipe, the prepared welding end or the anti-corrosion coating. Pipes may be stacked in tiers such that no damage is or could be caused to the pipe, or its coating.

The maximum height of stacked pipe shall be supported by calculations and be subject to Approval by the CONTRACTING ENTITY.

Pipe shall be carefully lowered to limit impact effects and stacked in such a way, that water and mud cannot accumulate within the pipe.

The APPLICATOR shall store the pipe by laying out on prepared sand rows having a covering of polyethylene sheeting. Sand rows shall be kept clean and clear of vegetation, large and injurious aggregates, or any other deleterious substances.

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The bottom layer of pipes, as a minimum, shall be secured with wedges or clips to prevent the collapse of the stockpile.

If the pipe is delivered to the APPLICATOR with bevel protectors and/or end caps, these are to be carefully removed and replaced after coating is complete and after the ends have been inspected by the CONTRACTING ENTITY for damage. Damage bevel protectors and end caps are to be replaced to the satisfaction of the CONTRACTING ENTITY.

Any damage or defects noted shall be recorded by the APPLICATOR and reported in writing to the CONTRACTING ENTITY within 3 working days. Damage or defects shall be marked using a suitable marking system. Pipes which are out of specification or have an identification anomaly shall be clearly marked with the word 'HOLD' on the outer surface of the pipe.

**Appendix.A Materials Certificates and Inspection and Testing**

**A.1 Materials**

A.1.1 Acceptable Materials

The coating shall be a low solvent, high solids epoxy. It shall have a VOC content of 225g/l or less and shall have a demonstrable successful track record for use as a flow coat for friction reduction in pipelines carrying non-corrosive gases.

A.1.2 Certification

Each batch of material supplied to the APPLICATOR shall be accompanied by a certificate stating that all the tests required have been carried out on every batch and that the results are in accordance with this Specification.

The APPLICATOR shall issue the CONTRACTING ENTITY with copies of all certificates related prior to using the material for coating pipe. Material for which no satisfactory test certificates have been received shall not be used for coating pipe.

Batch certificates shall contain the following information with test methods and acceptance criteria.

- Identification of SUPPLIER
- Product identification
- Batch identification
- Date & place of manufacturing
- Expiry date for use
- Non volatile matter by mass – base component
- Non volatile matter by mass – curing agent component
- Viscosity - base component
- Viscosity – curing agent component
- Density – base component
- Density – curing agent component
- Ash – base component
- Ash curing agent component (if pigmented)
- Infrared spectrogram (on request)

A.1.3 Approved Materials

The APPLICATOR shall ensure that the material SUPPLIER submits data sheets for the qualification and approval of material, together with recommendations for storage and coating application procedures, which will ensure that the pipes when coated will meet all the requirements of this Specification.

Data sheets submitted by the SUPPLIER shall include acceptable values for the following properties,

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- Identification of SUPPLIER
- Product identification
- Batch identification
- Date & place of manufacturing
- Expiry date for use

Test Method

- |   |              |
|---|--------------|
| - Non volatile matter by mass (components and mixed material) | ISO 3251     |
| - Ash (components)  | ISO 15741    |
| - Viscosity   | ISO 2431     |
| - Buchholz hardness   | ISO 2409     |
| - Resistance to neutral salt spray                            | ISO 7253     |
| - Resistance to artificial ageing                             | ISO 15741    |
| - Bend Test (conical mandrel)                                 | ISO 6860     |
| - Resistance to gas pressure variations                       | ISO 15741    |
| - Resistance to water immersion                               | ISO 2812-2   |
| - Resistance to chemicals                                     | ISO 2812-1   |
| - cyclohexane   |              |
| - 95% by vol. diethylene glycol soln. in water                |              |
| - hexane  |              |
| - methanol  |              |
| - toluene   |              |
| - lubricating oil   |              |
| - Resistance to hydraulic blistering                          | to be agreed |

**A.2 Inspection and Testing**

Inspection and testing shall be carried out in accordance with the agreed procedures and shall meet the requirements of the following tables A, B and C.

**Table A – Requirements for inspection of surface preparation**

Properties	Test Method	Requirements	Frequency
Surface condition before blasting	Visual inspection	free of contaminations	each pipe
Environmental conditions	instrumental	relative humidity < 85% ambient temperature dew point	every 4 h
Pipe temperature before blasting	thermocouple	min 3 °C above the dew point	every 4 h
Size, shape and properties of abrasive	visual + certification ISO 11124	conformity to certificate compliance to manufacturing/ working procedures	1/day
Water soluble contamination of abrasives	ASTM 4940	conductivity max. 60 mS/cm	1/shift
Surface roughness of blasted surface (Rz/Ry5)	ISO 8503-4	30 to 60 microns	every 1 h
Visual inspection of blasted surface	ISO 8501-1	Grade Sa 2½	each pipe
Presence of dust after dust removal	ISO 8502-3	max. class 2	every 1 h
Surface condition after blasting	conductive measurement ISO 8502-9	salt content max. 20 mg/m <sup>2</sup>	5 pipes at start of production and 1 pipe/shift
Pipe condition prior to coating	monitoring	no rust, pipe temperature at least 3 °C above dew point	continuously

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**Table B – Requirements for inspection and testing of applied coating**

Properties	Test Method	Requirements	Frequency
Wet paint (mixed) viscosity & temperature	ISO 2431	in accordance with SUPPLIERS criteria	each new mix and at painting interruptions
Appearance of film	visual	uniform, continuous, smooth, freedom from runs and holidays, defects do not exceed 1% of coated area	every 5 <sup>th</sup> pipe
Minimum dry film thickness	ISO 2808	min 75 µm See Note 1	every 5 <sup>th</sup> pipe
Cutback	measuring	20 mm± 5 mm	each pipe

Note 1. Measurement procedure in accordance with ISO 15741 Annex B.

**Table C – Requirements for testing of applied coating on test panels**

Properties	Test Method	Requirements	Frequency
Cross cut adhesion	ISO 2409	classification ≤ 1	twice / shift
Bend test	ISO 6860	cracking ≤ 13 mm no loss of adhesion	twice / shift
Buchholz hardness	ISO 2815	≥ 94	twice / shift
Cure	solvent wipe	no softening wrinkling or blistering	twice / shift
Porosity	to be agreed	≤ 5 pinholes/panel	twice / shift