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Research and Technology Management

Iranian Gas Standards

امور تدوین استانداردها

Standardization Division

Specification for :

مشخصات فنی :

Amendment to 3 Layer Polyethylene Coating System Parts (1 & 2)

اصلاحیه استاندارد پوشش ۳ لایه پلی اتیلن خطوط لوله

APPROVED

FOREWORD

This standard is intended to be mainly used by **NIGC** and contractors and has been prepared on interpretation of recognized standards , technical documents , knowledge ,backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Standards (**IGS**) are prepared , reviewed and ammended by technical standard committees within NIGC Standardization Div. and submitted to the **NIGC**'s "**STANDARDS COUNCIL**" for approval .

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Throughout this standard the following definitions , where applicable , should be followed :

1- "**STANDARDIZATION DIV.**" has been organized to deal with all aspects of industrial standards in NIGC . Therefore , all queries for clarification or amendments are requested to be directed to the mentioned div.

2- "**COMPANY** " : refers to national iranian gas company .

3- "**SUPLIER**" : refers to a firm who will supply the service , equipment or material to igs specification whether as the prime producer or manufacturer or a trading firm .

4-"**SHALL**" : is used where a provision is mandatory.

5-"**SHOULD**" : is used where a provision is advised only.

6-"**MAY**" : is used where a provision is completely discretionary.

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پیشگفتار

۱- این استاندارد/دستورالعمل بمنظور استفاده اختصاصی در شرکت ملّی گاز ایران و شرکتهای فرعی وابسته تهیه شده است.

۲- شرکت ملّی گاز ایران در مورد نیازهای عمومی از استانداردهای وزارت نفت (IPS)و در موردنیازهای اختصاصی از استانداردهای اختصاصی خود(IGS) استفاده می نماید.

۳- استانداردهای شرکت ملّی گازایران (IGS) توسط کمیته های تخصصی استاندارد متشکل از کارشناسان بخش های مختلف و یا مشاور تهیه می شود و توسط شورای استاندارد (منتخب هیئت مدیره شرکت ملی گازایران) به تصویب میرسند.

۴- در تنظیم متن استانداردهای(IGS) از کلیه منابع شناخته شده استانداردی، اطلاعات فنی- تخصصی مربوط به صنایع گاز دنیا،مشخصات فنی تولیدات سازندگان معتبرجهانی ونیزاز نتیجه تحقیقات و تجربیات کارشناسان ومتخصصان داخلی بر حسب مورد استفاده می شود. همچنین بمنظوراستفاده هرچه بیشترازتولیدات داخلی قابلیت های سازندگان داخلی نیزمورد توجه قرارمیگیرد.

۵- استانداردها از طریق پایگاه اینترنتی شرکت*ویالوح فشرده (CD) در اختیار واحدها و کاربران قرار می گیرد .

۶- استانداردها بطور متوسط هر ۵ سال یکبار و یادرصورت ضرورت زودتر،مورد بازنگری وبروزرسانی قرار میگیرند. بنابراین کاربران باید همیشه آخرین نگارش را مورد استفاده قرار دهند.

۷- هرگونه نظر و یا پیشنهاد اصلاح در مورد استانداردها مورداستقبال وبررسی قرار خواهد گرفت و در صورت تأئید، استانداردمربوطه نیزموردتجدیدنظرقرارخواهدگرفت .

تعاریف عمومی

درمتن استانداردهای (IGS)ازتعاریف واصطلاحات زیراستفاده مشود.

۱- "شرکت"(COMPANY): منظورازشرکت "شرکت ملی گازایران"ویاشرکتهای فرعی وابسته میباشد.

۲- "فروشنده"(SUPPLIER/VENDOR): به فردیاموسسه ای اطلاق میگرددکه تعهدی رانسبت به شرکت تقبل نموده است.

۳- "خریدار"(PURCHASER): منظورازخریدار"شرکت ملی گازایران"ویاشرکتهای فرعی وابسته میباشد.

۴- "SHALL" : درمواردی بکاربرده میشودکه انجام خواسته موردنظراجباری است

۵- "SHOULD" : درمواردی بکاربرده میشودکه انجام خواسته موردنظرترجیحی و درعین حال اختیاری است

۶- "MAY" : درمواردی بکاربرده میشودکه انجام کاربه شکل موردبحث نیز قابل قبول میباشد

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*آدرس پایگاه اینترنتی(http://igs.nigc.ir) ، آدرس الکترونیکی(nigcigs@nigc.ir)

IGS-TP-010(0) - 1994

Foreword

This standard specification (Part 1 & 2) has been revised and amended on the basis of draft ISO 21809-1 : 2006 edition, Z245.21-2002 edition (Canadian Standard) and the outcome of a research project executed in the Research and Technology Directory under supervision of the Standard Council of NIGC.

The amendments is summarized as follows:

IGS-TP-010(0): Part 1

KEY CHANGES

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IGS-TP-010(0): Part 2

KEY CHANGES

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	Liquid epoxy thickness:	Added	2	5
CLAUSE 7.2	Blast profile and methods:	Modified	6	5
CLAUSE 7.7	Chemical pretreatment requirement:	Added	---	5
TABLE 3	Coating requirements :	Modified	18	6
TABLE 4	Inspection of surface preparation requirements:	Added	---	8
TABLE 5	Inspection and testing of applied coating requirements:	Added	---	9

TABLE 1 – Liquid Epoxy Properties

Item	Property	Unit	Requirement	Test Method
1	Density	g/cm^3	Base resin:1.17 ± 0.05 Activator:1.15 ± 0.05	JIS K-5400
2	Viscosity	Poise	Base resin: 200 – 600 (20^oC) Activator: 250 – 450 (25^oC)	JIS K-5400 B type viscosity meter
3	*Pot life, - at 25^oC - at 40^oC - at 60^oC	minute	 17 7 2.5	---

* Mixing ratio : Base resin / Activator = 100/45-50

TABLE ۲ – Raw Epoxy Powder Properties

Item	Property	Unit	Requirement	Test Method
1	Gloss at 60 ^{O} angle	%	65±5	DIN 67530
2	Gel time	%	±20/ manufacturer's specification	Annex J ISO 8130-2 or 3
3	Density at 23±2^{o}C, min	g/cm^{3}	1.5	ISO 8130-2
4	Particle size	%	90 , between 10 to 80 µ	CSA Z 245.20-02
5	Moisture content, max	% by mass	0.5	Annex K ISO 21809-1
6	Shelf life at 35^{O} C & 60% humidity, min	month	12 after delivery	---
7	Theoritical coverage	gr/m^{2}	90 gr (for 60 microns (DFT))	Acceptable method to NIGC
8	Dry film thickness, min	µm	150	Annex A ISO 21809-1
9	Glass transition temperature (DSC), min	^{O}C	95	Annex D ISO 21809-1

TABLE 3 – Adhesive Properties

Item	Property	Unit	Requirement	Test Method
1	Density at 23±2°C	gr/cm^3	0.900-0.950	ISO 1183
2	Melting index (2.16 kg/190 ° C)	gr/10minutes	5-8	ISO 1133
3	Elongation at break at 23 ° ± 2 ° C , min	%	600	ISO 527
4	Melting point (DSC), min	° C	95	ISO 3146
5	Vicat softening temperature A/50 (9.8N) , min	° C	85	ISO 306
6	Tensile strength, at 23±2°C, min	MPa	8	ISO 527
7	Water content , max	Weight %	0.1	ISO 15512

TABLE 4 –Black Polyethylene Properties

Item	Property	Unit	Requirement	Test Method
1	Density at 23±2°C (base material), min	gr/cm^3	0.933	ISO 1183
2	Melting index (2.16 kg/190°C)	gr/10minute	0.3-0.8	ISO 1133
3	Elongation at break at 23±2° C , min	%	600	ISO 527
4	Yield strength at 23±2° C , min	MPa	15	ISO 527
5	Hardness Shore D	---	55	ISO 868
6	Vicat softening temperature A/50 (9.8N), min	°C	115	ISO 306
7	Melting point (DSC) , min	°C	125	ISO 1133
8	Low temperature brittleness	°C	-70 no fracture	ASTM D 746
9	Stress cracking resistance (methyl-ethyl-ceton) , min	Hour	1000	ASTM D 1693
10	Carbon black content, min	% by mass	2.5	ASTM D 1603
11	Water content , max	weight %	0.05	ISO 15512
12	Oxidation – Induction time , at 210 °C , min	minute	30	ISO 11357
13	*UV resistance and thermal aging	%	△MFR≤35	Annex G ISO 21809-1

* 2mm thick compression moulded sheet, specimen ISO 527-2, strained at 50 mm/min.

TABLE 2 – Minimum Coating Thickness

Pipe Diameter, mm(in)	Liquid Epoxy (1^{st} layer), mm (µm)	Powder Epoxy Resin (1^{st}layer), mm (µm)	Adhesive (2^{nd} layer), mm (µm)	Total Thickness mm
Up to DN 250(10)	0.025 (25)	0.150 (150)	0.150 (150)	2.0
DN 250 (10) up to DN 500 (20)	0.025 (25)	0.150 (150)	0.150 (150)	2.5
DN500(20) up to DN 900 (36)	0.025 (25)	0.150 (150)	0.150 (150)	3
>DN900 (36)	0.025 (25)	0.150 (150)	0.150 (150)	3.5

7.2 Pipes shall be blast cleaned to Sa 2½ as a minimum (SIS 055900). The blast profile shall be between 60µm and 100µm height, measured by an Talysurf instrument or Replica method. The blast cleaning medium used shall be agreed with NIGC.

7.7 Chemical Pretreatment

After blast cleaning and before application of the epoxy primer, linepipe shall be subject to chemical pretreatment using an approved phosphoric acid solution.

The surface to be coated shall be heated to a temperature of 45^{o}- 65^{o} C and treated with a low pressure (0.5 – 0.2 bar) spray application of a max. 10% v/v solution of an approved acid washing material and process. A uniform PH of 1 or less shall be maintained over the entire surface of treated area. The acid washed pipe surface shall remain wetted for 15-30 seconds and then rinsed with clean water before its starts to dry out.

High-pressure water rinses at 700-1000 psi (50-70bar) shall be used to remove any treatment residue. The wetted surface of the rinsed pipe shall meet the following requirements:

Chlorides shall not exceed 10 ppm, sulfates shall not exceed 40 ppm, and nitrates shall not exceed 10 ppm. The total of these salts shall not exceed 60 ppm. The water shall not be reused. Soluble salts (Chloride contamination) on the steel surface shall be checked using an approved salt detector instrument measuring conductivity SCM400 or equivalent. Soluble salt content shall not exceed 2 micrograms/cm^2.

TABLE 3 – Coating Requirements and Test Methods for Coating Procedure Approval Tests

Item	Property	unit	Requirement	Test method
1	Surface preparation	---	As specified in 7.2	Visual inspection
2	Coating thickness	---	As specified in Table 2	Electro-magnetic thickness gauge. The gauge shall be calibrated daily with the standard calibrated plates. Annex A ISO 21809-1
3	Porosity , max	kV	25 *	DIN 30670
4	Peel strength (Adhesion), min: - at 23±2 ^{o} C - at 80±3 ^{o} C	 N/mm N/mm	 15 3	Annex C ISO 21809-1
5	Impact resistance,at 23±2^{o}C,min	J/mm	7	Annex E ISO 21809-1
6	Elongation at break at 23±2^{o}C, min	%	400	ISO 527
7	Indentation(hardness), max: - at 23±2 ^{o} C - at maximum operation temperature	 mm mm	 0.2 0.4	Annex F ISO 21809
8	Thermal cycle resistance	---	No crack	Cycle : -30^{O}C 1hour +60 ^{O}C 1 hour No. of cycles:100

* 5 kV per mm

Continued

Item	Property	Unit	Requirement	Test Method
9	Product stability during extrusion of the PE top layer process	%	△MFR≤20	ISO1133
10	Specific electrical (coating resistivity), min	Ωm^2	10^8	DIN 30670
11	*Cathodic disbondment , max: - at 23 ± 2^{O}C /28 days,-1.5 V - maximum operation temperature/28 days/-1.5V	 mm mm	 5 12	Annex H ISO 21809-1
12	Hot water soak test	---	No loss of adhesion	Annex J ISO 21809-1:2005
13	Degree of cure of the epoxy as first layer	^{O}C	△ Tg≤ +3 for FBE Scratch test for liquid epoxy	Annex D ISO 21809-1
14	Flexibility at 0^{o} C± 3 ^{O}C	%	No cracking at 2.0 angle per pipe diameter length	Annex I ISO 21809-1

* The hole diameter shall be equal to 3 × total coating thickness.

TABLE 4 –Requirements for inspection of surface preparation

Item	Properties	Unit	Test Method	Requirements	Frequency Qualification	Frequency production
1	Bare pipe	---	Visual inspection	Free from dent, porosity, corroded debris	each pipe	each pipe
2	Surface condition before blasting	---	Visual inspection	Free of contaminations	each pipe	each pipe
3	Surface condition after blasting , max	mg/m^2	Conductive measurement, ISO 8502-9	salt content 20	each pipe	5 pipes at start of production and 1 pipe/shift
4	Humidity	---	Calculation	as determined at time of measurement	once	every 4h
5	Pipe temperature before blasting , min	^{O}C	thermocouple	3above the dew point	Once	every 4h
6	Size , shape and properties of abrasive	---	Visual + certification ISO 11124 resp. ISO 11126	Conformity to certificate, compliance to manufacturing/working procedures	Once	1 shift
7	Water soluble contamination of abrasives , max	mS/cm	ASTM 4940	Conductivity60	Once	every 4h
8	Surface roughness of blasted surface (R_z): - liquid - powder	---	ISO 8503-4	 40 µm to 100µm 60µm to 100µm	10 pipes	every 1h
9	Visual inspection of blasted surface	---	ISO 8501-1	grade Sa2½	each pipe	each pipe
10	Presence of dust after dust removal, max	---	ISO 8502-3	class 2	10 pipes	every 1h
11	Pipe condition prior to coating	^{O}C	monitoring	no rust, pipe temperature at least 3 above the dew point	Continuously	continuously
12	Temperature of extruded adhesive and polyethylene	---	thermometer	compliance to APS	Once	every 1/h
13	Preheating temperature before coating	---	thermometer	compliance to APS	each pipe	every 5^{th} pipe

TABLE 5 – Requirements for inspection and testing of applied coating

Item	Properties	Unit	Test Method	Requirements	Frequency Qualification	Frequency production
1	Epoxy thickness, min	µm	ISO 2808	FBE:150 Liquid epoxy :25	2 pipe	each shift
2	Adhesive thickness, min	µm	ISO 2808	150 on pipe body	at start up	each start up
3	Degree of cure	°C	Annex D ISO 11357-2	$\triangle T_g \leq +3$ for FBE Scratch test for liquid epoxy	1 pipe	each shift
4	Appearance and continuity	---	Visual Annex B ISO 21809-1	Uniform color, free of defects and discontinuities, Delamination , separations and holidays.	Continuously	Continuously
5	*Total thickness of coating	mm	Annex A ISO 21809-1	Table 2	5 pipe	every 10 pipes
6	Impact resistance	J/mm	Annex E ISO 21809-1	Table 3	3 pipe	once per batch
7	Peel strength (Adhesion)	Kg/cm	Annex C ISO 21809-1	Table 3	5 pipe	every 4 h
8	Indentation	mm	Annex F ISO 21809-1	Table 3	Once	each batch
9	Elongation at break	%	ISO 527	Table 3	Once	each batch
10	Cathodic disbondment	mm	Annex H ISO 21809-1	Table 3	Once	1/week
11	Flexibility	%	Annex I ISO 21809-1	Table 3	Once	---
12	In process degradation of polyethylene	%	ISO 1133	$\triangle$MFR ≤ 20 for PE between raw and extruded material	Once	each batch
13	Cutback	mm	Measuring	100 ±7 up to 20" 150 ±10 for ≥ 20"	each pipe	each pipe
14	Hot water soak	---	Annex J ISO 21809-1:2005	No loss of adhesion	2 pipes	each shift

* The total thickness may be reduced by a maximum of 10% on the weld seam for SAW welded pipes.

Note: Retest

In case of failure of any required test, the Coater shall test two additional linepipes, one linepipe before and one after the failed one. If the follow – up tests are successful, all coated linepipes since the last acceptable test shall be considered satisfactory, except for the failed linepipes that will be rejected .

If the follow – up tests also fail to meet the requirements of this specification, all coated linepipes since the last acceptable test shall be rejected .