



شرکت ملی گاز ایران

مدیریت پژوهش و فناوری

امور تدوین استانداردها

IGS

مشخصات فنی خرید

سیستم غلاف انقباضی حرارتی برای دمای تا ۵۰ درجه سانتیگراد

Heat Shrinkable Sleeve system (Mastic Adhesive) for
Service Temperature up to 50 C.



تاریخ: ۱۳۹۵/۳/۱۲
شماره: ۱۷۴۸۱-۹۳/۰-۱



شرکت ملی گاز ایران



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ابلاغ مصوبه هیات مدیره



مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۶۸۶ مورخ ۱۳۹۵/۳/۲۳ هیات مدیره، نامه شماره ۳۵۹۸۸/۰۰۰/۹۵ مورخ ۹۵/۰۲/۱۹ مدیر پژوهش و فناوری در مورد تصویب نهایی استانداردها به شرح زیر مطرح و مورد تصویب قرار گرفت:

۱. دستورالعمل سیستم غلاف انقباضی حرارتی برای دمای تا ۵۰ درجه سانتیگراد

IGS-M-TP-014-7 (1)

۲. دستورالعمل سیستم غلاف انقباضی حرارتی برای دمای تا ۶۰ درجه سانتیگراد

IGS-M-TP-014-6 (1)

۳. دستورالعمل سیستم غلاف انقباضی حرارتی برای دمای تا ۸۰ درجه سانتیگراد

IGS-M-TP-014-3 (2)

این مصوبه در حکم مصوبه مجمع عمومی شرکت‌های تابعه محسوب و برای کلیه شرکت‌های تابعه لازم الاجرا می‌باشد.

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امور عمومی استاندارد
شماره ۴۹۲۴۳
تاریخ ۹۵/۳/۱۳



FOREWORD

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

Iranian gas standards (IGS) are prepared , reviewed and amended by technical standard committees within NIGC Standardization division and submitted to the NIGC's "STANDARDS COUNCIL" for approval .

IGS Standards are subject to revision , amendment or withdrawal , if required , thus the latest edition of IGS shall be checked/inquired by NIGC users .

This standard must not be modified or altered by the end users within NIGC and her contractors . Any deviation from normative references and/or well known manufacturers specifications must be reported to Standardization division .

Any comments from concerned parties on NIGC distributed IGS are welcome to technical standards committees and will receive serious attention and consideration should a revision to standards is recommended .

GENERAL DEFINITIONS :

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 mentioned div.

2- "COMPANY" : refers to national Iranian gas company .

3- "SUPPLIER" : 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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1. SCOPE

This standard specification covers the minimum requirements of mastic type heat shrinkable sleeve used for external corrosion protection on the field girth weld areas of linepipes that has been mainly factory coated with three layer extruded polyethylene coating system .

Notes :

1 : The mastic type heat shrinkable sleeve shall be used for the pipeline projects with :

- Maximum operating temperature of up to 50 °C .
- The O.D up to 20 inches .

2 : The materials for field repair of main coating (melt stick , filler mastic and repair patch) are covered in Annex A .

3 : For use on other types of pipe coating systems compatibility shall be verified accordance to relevant engineering codes and standards .

2. REFERENCES

Throughout this standard specification , the following standards and codes are referred to , the edition of them , that are in effect at the time of issue of this standard specification (2008) shall , to the extent specified herein , form part of this standard specification . The applicability of changes in standards and codes that occur after the date of standards that referred , shall be mutually agreed upon by the purchaser and manufacturer or supplier .

2.1 Normative References

BS EN 12068 (1999) "Cathodic protection-External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection-Tapes and shrinkable materials"

ASTM D 570 (1998) " Test method for water absorption of plastics"

ASTM D 638 (2002) "Test method for tensile properties of plastics"

ASTM D 870 (2002) "Practice for testing water resistance of coatings using water immersion"

ASTM D 1000 (1999) "Test method for pressure-sensitive adhesive-coated tapes used for electrical and electronic applications"

ASTM D 1044 (1999) "Test method for resistance of transparent plastics to surface abrasion"

ASTM D 2240 (2002) "Test method for rubber property-durometer hardness"

ASTM D 2671 (2000) "Test method for heat shrinkable tubing for electrical use"

ASTM E 28 (2002) "Test method for softening point of resins derived from naval stores by Ring-and-Ball apparatus"

ISO 1183 (1999) "Plastics-Methods for determining the density of non-cellular plastics-Part 3: Gas pykno meter method supersedes method A and B of BS 2782-6: Method 6 "

ISO 21809-3 (2006) "Materials equipment and offshore structures for petroleum, petrochemical and natural gas industries "

2.2. Informative References

NACE RP0303 (2003) "Field-applied heat-shrinkable sleeves for pipelines : Application , and quality control"

3. TERMS AND DEFINITIONS

Heat shrinkable sleeve

Coating that will reduce in dimensions from an expanded size to a predetermined size by the application of heat .

Mastic adhesive

A family of adhesive based on butyl-rubber , poly isobutylene , synthetic rubber and asphalt , with amorphous structure .

Coating repair material

Pre-manufactured patches fillers , etc. , compatible with and made from similar materials as the heat shrinkable sleeve .

Coating system

The complete number and types of coats applied to a substrate in a predetermined order .

Filler Material

Compatible material used under a heat shrinkable sleeve or repair patch to fill voids if any .

Factory coating (mill coating)

Coating applied to pipe length in a factory or yard before delivery .

4. GENERAL CHARACTERISTICS

The mastic type heat shrinkable sleeve shall consist of a mastic type adhesive coated wraparound sleeve .

The backing layer of the heat shrinkable sleeve shall be UV resistant irradiation (electron beam) cross linked high density poly ethylene .

The thickness of the system shall be measured at four positions around the circumference of the pipe , with 4 measurements taken at each position , and shall be an average of 2.5 mm .

The polyethylene backing of the heat shrinkable sleeve shall be supplied with a quality assurance indicator system that changes when heated to a sufficient temperature during installation .

This type of heat shrinkable coating system shall compose of a heat shrinkable sleeve and a closure patch .

The mastic type heat shrinkable sleeve shall meet the requirements of Table 1 .

The closure patch shall consist of irradiation cross linked high density polyethylene and proven to prevent the more than 1 cm of slippage between the two sides of heat shrinkable sleeve during application .

The outer layer shall be UV-resistant .

4.1 Accessories

The following accessories shall be ordered with the heat shrinkable sleeves in accordance with the manufacturer installation instructions :

Digital thermometer with probs hand roller

Table 1 – Mastic base heat shrinkable sleeve properties

| ITEMS | ELEMENTS | REQUIREMENTS | UNITS | TEST METHODS | QUALIFICATION TESTS | MANUFACTURING QC TESTS |
|-------|---|---|-------------------|---------------------|---------------------|------------------------|
| 1 | Backing thickness (as supplied) , min | 0.9 | mm | ASTM D 1000 | yes | yes |
| 2 | Adhesive thickness (as supplied), min | 1.3 | mm | ASTM D 1000 | yes | yes |
| 3 | Total thickness (as installed) , min | 2.5 | mm | ASTM D 1000 | yes | yes |
| 4 | Hardness at 23 °C , min | 50 | Shore D | ASTM D 2240 | yes | yes |
| 5 | Ring and ball softening point of adhesive , min | 100 | °C | ASTM E 28 | yes | yes |
| 6 | Impact resistance at 23 °C , min | 15 | J | EN 12068 Annex H | yes | yes |
| 7 | Peel strength to pipe surface and to factory coating , min - at 23 °C - at 50 °C | 1.5 0.3 | N/mm N/mm | EN 12068 Annex C | yes | yes |
| 8 | Peel strength @ 10 mm/min to pipe surface and to factory coating after 28 days hot water soak test at 50 °C , min | 2.5 | N/mm | ISO 21809-3 Annex I | yes | yes |
| 9 | Cathodic disbondment resistance , max - at 23 °C - at 50 °C | 8 15 | mm mm | EN 12068 Annex K | yes* | --- |
| 10 | Lap shear strength to pipe surface and factory coating at 50 °C , min | 0.05 | N/mm ² | EN 12068 Annex D | yes | yes |
| 11 | Specific electrical insulation resistance , RS100 , min | 10 ¹⁰ | Ω.mm ² | EN 12068 Annex J | yes* | --- |
| 12 | Ultimate elongation , min | 400 | % | ASTM D 638 | yes | --- |
| 13 | Heat aging , ratio of elongation at break , 21 days at 150 °C , min | 200 | % | ASTM D 638 | yes* | --- |
| 14 | Thermal ageing 100 days at 100 °C followed by - Elongation to break - Peel strength to pipe surface | 1.25≥E ₁₀₀ /E ₀ ≥0.75 , E ₁₀₀ /E ₇₀ ≥0.8 A ₁₀₀ /A _T ≥0.75 , A ₁₀₀ /A ₇₀ ≥0.8 | --- --- | EN 12068 Annex E | yes* | --- |

| | | | | | | |
|----|---|--------------------------------|---|----------------------|------|-----|
| 15 | Heat shock , 4 hours at 225 °C | No cracking , flow or dripping | --- | ASTM D 2671 | yes* | --- |
| 16 | Indentation resistance pressure (test condition) - at 23 °C - at 50 °C Holiday detection or residual thickness , min | 10.0 10.0 pass 0.6 | N/mm ² N/mm ² --- mm | EN 12068 Annex G | yes | --- |
| 17 | Soil stress creep resistance , 24 hours at 50 °C , max | 2.5 | mm | TP 206 (see Annex B) | yes* | --- |
| 18 | Ultraviolet resistance ratio of elongation at break | $1.25 \geq E_x/E_0 \geq 0.5$ | --- | EN 12068 Annex F | yes* | --- |

***Note :** The qualification test may be waved , provided that the results of the tests carried out by an internationally well known institute/laboratory on the same material , not exceeding two years from the date of the tests , to be submitted by the manufacturer/supplier .

5. DOCUMENTATION

The manufacturer/supplier shall provide sufficient information to identify the coating system and shall supply as a minimum requirement , the technical information of the coating components as follows :

A : ISO 9001: 2000 " CERTIFICATION" for "Design , Manufacturing and Quality control" of offered coating system for "pipeline corrosion protection" issued by an internationally recognized body .

B : Certificate and approval test report from an internationally well known certifying body (i.e. DVGW (Germany) and ADVANTICA (UK)) for the offered coating system as stress class C UV and maximum operating temperature of up to 80 °C and the compatibility with this standard specification .

Note : Other certificates from recognized certifying body shall be approved by Technical & Industrial Research Laboratories of NIGC .

C : Original technical catalogues , manufacturing product data sheet and application procedure recommendation and guidelines (installation instructions) for all of the items to be offered .

D : Material Safety Data Sheet (MSDS) .

E : Filled , signed and stamped data sheets stating in Annex C and Annex D .

6. QUALITY ASSURANCE

Manufacturer shall operate an effective , documented quality system based on the relevant part of the BS EN ISO 9001:2000 and maintain records identifying the product , date of manufacturing , batch numbers and all results of inspection and testing .

7. INSPECTION AND TESTING

The manufacturer shall set up and maintain such quality and inspection system as to ensure the material supplied, comply with all aspect of the requirements of this standard specification.

The manufacturer shall furnish the purchaser or its nominated inspector an overall compliance certificate accompanied with all in-production quality control test results for review. These documents and test results shall be traceable with regard to the batch number of each item.

The purchaser or his nominated inspector may inspect a part or the whole of the materials at the manufacturer's works during manufacture and prior to packing and may witness any inspections and tests as called for, by this standard specification.

Purchaser's inspector shall have free access to the manufacturer's works at any time during manufacturing.

The manufacturer shall provide all means necessary for carrying out all inspections and tests as required by this standard specification.

Random sampling proportional to the quantity of each item and frequency of inspections and tests as required by this standard specification shall be at the discretion of the inspector.

If a sample is rejected in any inspection or test, double sampling shall be carried out, in case of any rejection in new samples, all materials represented by such sampling shall be rejected.

Inspection or tests carried out by the purchaser's inspector, in no way relieves the manufacturer/supplier of his responsibilities and liabilities under the conditions, terms and specification of this standard specification.

8. PACKAGING

The heat shrinkable sleeve and accessories shall be packaged in strong cartons then located on heavy wooden pallet with a light plate on top of the steel drums and carton; tightly on sides with plastic cover and finally put them into a 20/40 ft³ standard container that ensure acceptance and safe delivery to their destination.

8.1 The weight of each container with the consigns should not be more than 22 M/T.

8.2 Each heat shrinkable coating item shall be packaged to prevent adherence to the packaging material or the container.

8.3 Each container of coating material shall contain application instruction.

9. MARKING

The carton packaging shall be plainly marked with the following information .

| | |
|---------------------------------------|--------------------------------------|
| Name | : Mastic type heat shrinkable sleeve |
| Specification | : IGS-M-TP-014-7(0) |
| Order No. | : |
| MESC No. | : |
| Type and trade name of material | : |
| Dimensions (Expanded and Recovered) | : |
| Maximum temperature resistance , °C | : |
| Application temperature , °C | : |
| Storage conditions | : |
| Color | : |
| Batch No. | : |
| Stock No. | : |
| Date of manufacture | : |
| Shelf life | : |
| Quantity of material in container | : |
| Information and warning , if required | : |
| Manufacturer name and address | : |

" ANNEX A " Repair Materials

The repair materials consist of the following components :

A) Repair patch

The repair patch shall be an irradiated (electron beam) cross linked high density polyethylene backing coated internally with a high temperature , high melting point semi crystalline thermoplastic adhesive , which is applied over the filler mastic covering the damaged area .

The backing layer of repair patch shall be thermally stabilized and ultra violet resistance.

The repair patch shall meet the requirements mentioned in Table A-1 .

B) Filler mastic

The filler mastic shall be a rubber extended semi crystalline adhesive in according with the following physical properties :

- Peel strength at 23 °C , min : 3 N/mm (EN 12068 Annex C)
- Lap shear strength at 23 °C , min : 0.25 N/mm² (EN 12068 Annex D)
- Softening point , min : 100°C (ASTM E 28)

C) PE melt stick

The melt stick shall be from the same hot melt adhesive used for manufacturing of heat shrinkable sleeves .

Table A_1 – Physical properties of repair patch material

| | PROPERTIES | REQUIREMENTS | UNITS | TEST METHODS |
|-----------------|---|-----------------------------------|-------------------|---------------------|
| ADHESIVE | Thickness (as supplied) , min | 0.65 | mm | ASTM D 1000 |
| | Softening point , min | 100 | °C | ASTM E 28 |
| | Lap shear at 50 °C , min | 150 | N/mm ² | EN 12068 Annex D |
| BACKING | Thickness (as supplied) , min | 0.75 | mm | ASTM D 1000 |
| | Tensile strength , min | 17 | mPa | ASTM D 638 |
| | Elongation at break , min | 400 | % | ASTM D 638 |
| | Hardness , min | 50 | Shore D | ASTM D 2240 |
| | Abrasion resistance (CS 17/500 gr/5000 cycle) , max | 50 | mg | ASTM D 1044 |
| PATCH | Impact resistance at 23 °C , min | 15 | J | EN 12068 Annex H |
| | Indentation resistance at 50 °C | 10 | N/mm ² | EN 12068 Annex G |
| | Peel strength to pipe surface and to factory coating , min - at 23 °C - at 50 °C | 4 0.2 | N/mm N/mm | EN 12068 Annex C |
| | Water absorption , max | 0.05 | % | ASTM D 570 |
| | Peel strength @ 10 mm/min to pipe surface and to factory coating after 28 days hot water soak test at 50 °C , min | 2.5 | N/mm | ISO 21809-3 Annex I |
| | Heat shock on the backing , 4 hours , at 225 °C | No dripping , flowing or cracking | Visual | ASTM D 2671 |

" ANNEX B " (TP 206)

ALEYSKA SHEAR STRESS TEST

4.1.1 The purpose of this test is to determine if the sleeve has adequate resistance to shear stresses that might result from friction between the coating and the ground during pipe movement . The normal and shear loads simulate the forces experienced actual operation due to back-fill and to pipe movement .

4.1.2 The test set-up is shown schematically in figure 1 .

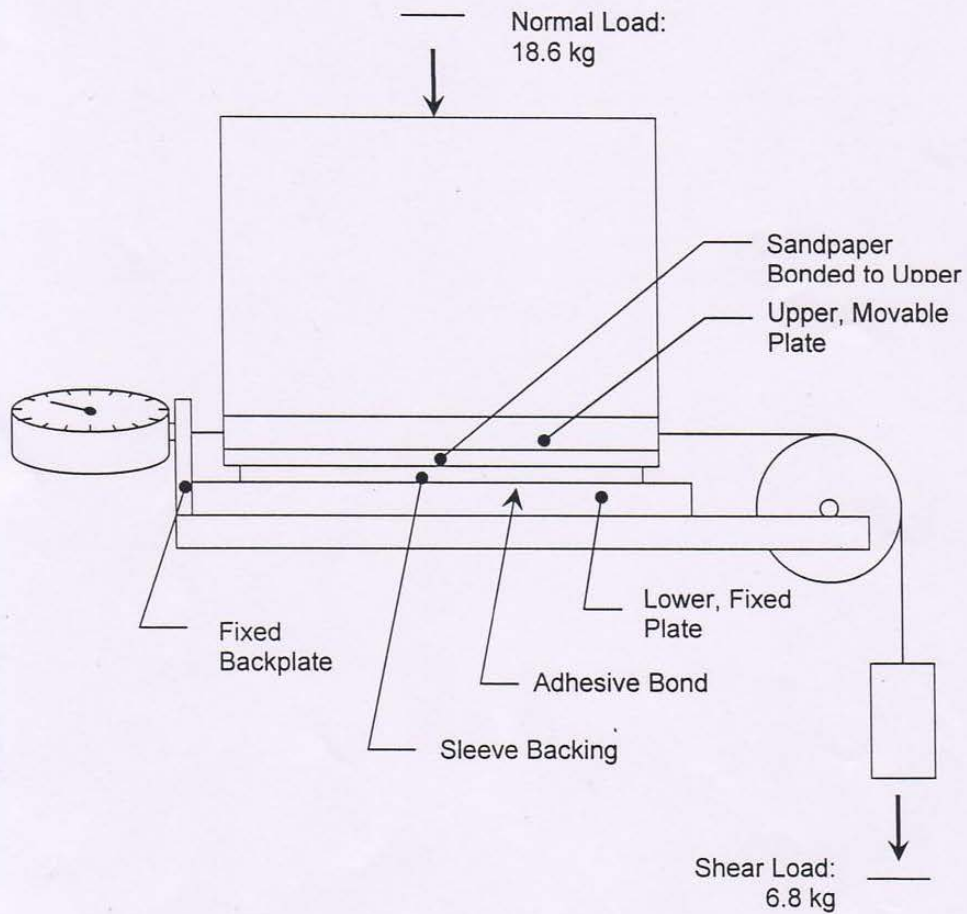
4.1.3 A strip cut from a heat shrink sleeve is bonded to a degreased steel plate by applying a load of approximately 34 kPa (5 psi) and placing in an oven at the vendor-recommended application temperature (typically about 150°C) for a minimum of 4 hours . After removal from the oven , the joint shall remain at room temperature for one day before testing . The 34 kPa load shall remain on the test joint during cool down . The bonded strip of heat shrink sleeve shall be trimmed to a final size of 15.2 (6.0 inch) long by 3.1 cm (1.2 inch) wide . The test fixture , the coated plate , and the weights are then conditioned in an oven at the test temperature for 5 hours prior to testing .

4.1.4 The coating plate is fixed in place on the text fixture . The 18.6 kg normal load and the 6.8 kg shear load are applied (**Note:** the 18.6 kg weight has coarse sandpaper (120 grit) bonded to it , rough side exposed , so that is will not slip on the coating during the test) .

4.1.5 A dial indicator , reading to the nearest 0.025 mm (0.001 inch) is set in contact with the upper , moveable weight and zeroed . Readings are taken after 18 hours , 25 hours , and 50 hours and reported to the nearest 0.025 mm .

4.1.6 The test report shall include the dimensions of the coating strip , weights used , test temperature (including tolerance) , surface preparation of the steel panels , amount of movement after the time intervals given in paragraph 4.1.5 , and the time to complete failure (if complete failure occurs within the 50 hour test period) .

Figure 1 – Test setup for TP-206 – Alyeska Shear Stress test



" ANNEX C "

Data Sheet for Mastic Base Heat Shrinkable Sleeve

| | |
|---------------------------------|--|
| Manufacturer's name and address | |
| Product | |
| Product designation | |

| ITEMS | ELEMENTS | ACTUAL AND REPRODUCIBLE DATA | UNITS | TEST METHODS | REMARK |
|-------|---|------------------------------|-------|--------------|--------|
| 1 | Backing thickness (as supplied) | | | | |
| 2 | Adhesive thickness (as supplied) | | | | |
| 3 | Total thickness (as installed) | | | | |
| 4 | Hardness at 23 °C | | | | |
| 5 | Ring and ball softening point of adhesive | | | | |
| 6 | Impact resistance at 23 °C | | | | |
| 7 | Peel strength to pipe surface and to factory coating - at 23 °C - at 50 °C | | | | |
| 8 | Peel strength @ 10 mm/min to pipe surface and to factory coating after 28 days hot water soak test at 50 °C | | | | |
| 9 | Cathodic disbondment resistance - at 23 °C - at 50 °C | | | | |
| 10 | Lap shear strength to pipe surface and factory coating at 50 °C | | | | |
| 11 | Specific electrical insulation resistance , RS100 | | | | |
| 12 | Ultimate elongation | | | | |
| 13 | Heat aging , 21 days at 150 °C - Elongation | | | | |
| 14 | Thermal ageing 100 days at 100 °C followed by - Elongation at break - Peel strength to pipe surface | | | | |
| 15 | Heat shock , 4 hours at 225 °C | | | | |
| 16 | Indentation resistance pressure (test condition) - at 23 °C - at 50 °C Holiday detection or residual thickness | | | | |
| 17 | Soil stress creep resistance , 24 hours at 50 °C | | | | |
| 18 | Ultraviolet irradiation resistance ratio of elongation at break | | | | |

NOTES:

1. This data sheet shall be filled , signed , and stamped by manufacturer/supplier .
2. Any deviation from this standard specification shall clearly be specified by manufacturer/supplier .

" ANNEX D "**Data Sheet for Repair Patch Material**

| | |
|---------------------------------|--|
| Manufacturer's name and address | |
| Product | |
| Product designation | |

| PROPERTIES | | ACTUAL AND REPRODUCIBLE DATA | UNITS | TEST METHODS | REMARK |
|-----------------|---|------------------------------|-------|--------------|--------|
| ADHESIVE | Thickness (as supplied) | | | | |
| | Softening point | | | | |
| | Lap shear at 50 °C | | | | |
| BACKING | Thickness (as supplied) | | | | |
| | Tensile strength | | | | |
| | Elongation at break | | | | |
| | Hardness | | | | |
| | Abrasion resistance (CS 17/500 gr/5000 cycle) | | | | |
| PATCH | Impact resistance at 23 °C | | | | |
| | Indentation resistance at 50 °C | | | | |
| | Peel strength to pipe surface and to factory coating - at 23 °C - at 50 °C | | | | |
| | Water absorption | | | | |
| | Peel strength @ 10 mm/min to pipe surface and to factory coating after 28 days hot water soak test at 50 °C | | | | |
| | Heat shock on the backing , 4 hours , at 225 °C | | | | |

NOTES:

1. This data sheet shall be filled , signed , and stamped by manufacturer/supplier .
2. Any deviation from this standard specification shall clearly be specified by manufacturer/supplier .

