

Test report no.: 229366

Client: MODUS PLASTİK METAL AŞ.
İMES 4 Street No. 13
ÇERKEŞLİ O.S.B. MAH
Dilovası/ Kocaeli
TURKEY

Order: Initial type test on 3-layer PE-Xa heating pipes
with oxygen barrier layer, DG 1, acc. to SKZ HR 3.2:2022-10

Production plant: IMES 4 Street No. 13
ÇERKEŞLİ O.S.B. MAH
Dilovası/ Kocaeli
TURKEY

Brand name: MODUSPE-XA
Material: PE-Xa (LG SL188)

Letter of: 2023-03-14

Reference: MAIL BY MR. SOLMAZ

Receipt of samples: 2023-10-31

Sampling: ---

Test period: 2024-01-16 to 2025-02-26

This test report comprises 7 pages.

Würzburg, 17 March 2025
Enj/we

i. V. 

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Head of Testing Laboratory



i. A. 

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Project Manager Pipe Systems

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The results refer to the products tested. The scope of accreditation is available on the Internet at www.skz.de.

1 Test material

SKZ – Testing GmbH had no influence on the selection of samples and received the following test material from the client.

Sample no.	Designation	DN/OD [mm]	Application class / design pressure	Colour	Quantity	Date of sampling	Date of delivery
1	Granulate	---	---	natural coloured	200 g	---	2023-10-31
2	Pipe	16 x 2.0	Class 1,2,4 / 10 bar Class 5 / 6 bar	natural coloured / orange	25 m coil	---	2023-10-31
3	pipe	20 x 2.0	Class 1,2,4 / 10 bar Class 5 / 6 bar	natural coloured / orange	25 m coil	---	2023-10-31

The markings of the samples read as follows:

Sample no.	Marking
2	no marking available
3	<i>The following minimum marking data are missing: Trademark, Material, Dimension, Application class including design pressure, opacity, oxygen permeability, production date or -period, Machine no.</i>

According to the customer's information the pipes were made of the following materials:

Sample no.	Component	Material	Type	Manufacturer	Colour
2	Inner layer	PE-Xa	SL188	LG Chem Ltd.	natural coloured
	Adhesive inner layer	PE-LLD	Modic M702E	Mitsubishi Chemicals Europe GmbH	natural coloured
	with masterbatch		Granül formunda TURUNCU masterbatch	Senkroma Boyar Madde A.S.	orange
	Oxygen barrier layer	EVOH	EVASIN-2904F	Chang Chung Petrochemicals Co, Ltd.	natural coloured
3	Inner layer	PE-Xa	SL188	LG Chem Ltd.	natural coloured
	Adhesive inner layer	PE-LLD	Modic M702E	Mitsubishi Chemicals Europe GmbH	natural coloured
	with masterbatch		Granül formunda TURUNCU masterbatch	Senkroma Boyar Madde A.S.	orange
	Oxygen barrier layer	EVOH	EVASIN-2904F	Chang Chung Petrochemicals Co, Ltd.	natural coloured

2 Test procedure

Usually, we carry out tests according to standards for which we have an accreditation. The list of all standards for which we are accredited can be viewed as an annex to the accreditation certificate on the homepage at <https://www.skz.de/en/testing/products>. In case of non-accredited procedures, they are marked with *. If it is only a matter of deviating test conditions of an accredited standard, this is marked with #.

In case that a conformity assessment is issued, the general decision rule is as follows: The measurement uncertainty and the standard deviation are not taken into account. Deviations from this rule are only made at the client's request, in the case of standard specifications or other specifications about which the client is informed in each individual case.

Unless otherwise noted all tests were carried out at standard atmosphere 23/50, according to DIN EN ISO 291:2008-08 "Plastics – Standard atmospheres for conditioning and testing", class 2.

The tests were carried out according to SKZ Specification for Tests and Inspection HR 3.2:2022-10 "Heating Pipes made of crosslinked Polyethylene PE-X".

The following tests were carried out:

Section	Test	Requirements acc. to	Test acc. to
3.1	Material	SKZ HR 3.2:2022-10	---
3.2	Marking	SKZ HR 3.2:2022-10	---
3.3	State of delivery and appearance	SKZ HR 3.2:2022-10	Visual assessment
3.4	Dimensions	SKZ HR 3.2:2022-10	DIN EN ISO 3126:2005-05
3.5	Longitudinal reversion	SKZ HR 3.2:2022-10	DIN EN ISO 2505:2005-08
3.6	Long-term hydrostatic pressure behaviour	SKZ HR 3.2:2022-10	DIN EN ISO 1167-1:2006.05 DIN EN ISO 1167-2:2006-05
3.7	Degree of crosslinking	SKZ HR 3.2:2022-10	DIN EN ISO 10147:2013-03
3.8	Homogeneity	SKZ HR 3.2:2022-10	SKZ HR 3.2:2022-10

3 Test results

3.1 Material

3.1.1 Material analysis on granulate

For identifying used material, the granulate of the inner layer material (sample no. 1) was analysed by means of infrared (IR) spectroscopy. The IR-spectrum was filed at SKZ-Testing GmbH for documentation purposes.

3.1.2 Material of inner and outer layer

A test report (ELEMENT P-19/90-v2, dated 2019-09-13, of ELEMENT Materials Technology, Plastic Pipes, SE-611 99 Tystberga, Sweden) on regression analysis according to EN ISO 9080 of the natural PEX pipe grade PE-Xa SL188 for the client LG Chem, was presented.

3.2 Marking

The pipes had no marking. **The following minimum marking data were missing: Trademark, Material, Dimension, Application class including design pressure, opacity, oxygen permeability, production date or -period, Machine no. (see section 1).**

3.3 State of delivery, appearance, colour, surface condition

Pipes were delivered as coil. The ends of the pipes were cleanly cut and perpendicular to their axis. The internal and external surfaces of the pipes were smooth and clean. No scoring, cavities and other surface defects were observed.

The pipes were delivered as 3-layer-pipes. Pipes were natural coloured with an orange-coloured outer layer.

3.4 Dimensions of pipes acc. to DIN EN ISO 3126:2005-05

Sample no.	Designation		Actual value [mm]		Set value ¹⁾ [mm]	
			Minimum	Maximum	Minimum	Maximum
2	Outside diameter total pipe	d ₁	16.2	16.3	16.0	16.3
	Wall thickness total pipe	S	2.2	2.3	2.0	2.4
	Outside diameter base pipe	d _i	15.8	15.8	15.7	16.0
	Wall thickness inner layer ^{2) 3)}	s ₃	1.9	2.1	1.9	2.1
4	Outside diameter total pipe	d ₁	20.2	20.2	20.0	20.3
	Wall thickness total pipe	S	2.1	2.4	2.09	2.4
	Outside diameter base pipe	d _i	19.8	19.8	19.7	20.0
	Wall thickness inner layer ^{2) 3)}	s ₃	2.0	2.2	2.0	2.2

¹⁾ Set values acc. to customer data sheet "OXY PE-XA PIPE DIMENSIONS AND TOLERANCES"

²⁾ Actual measurement without adhesive.

³⁾ Set value without adhesive thickness.

3.5 Longitudinal reversion acc. to DIN EN ISO 2505:2005-08

Test medium: Air

Sample no.	Test temperature [°C]	Test duration [min]	Longitudinal reversion [%]		Surface condition during and after heat aging
			Mean value	Set value	
2	120	60	0.8	≤ 3.0	No noticeable change
3	120	60	0.9	≤ 3.0	No noticeable change

3.6 Internal pressure test acc. to DIN EN ISO 1167-1:2006-05 and DIN EN ISO 1167-2:2006-05

Free length: 450 mm

End cap: type A

Conditioning duration: > 1 h

Test medium: water-in-water (20 °C and 95 °C), water-in-air (110 °C)

Number of samples: 3

Sample no.	Test temperature [°C]	Hoop stress [MPa]	Test pressure [bar]	Time-to-failure [h]	
				Actual value	Set value
2	20	12.0	32.8	> 1 ¹⁾	≥ 1
	95	4.8	13.1	> 1 ¹⁾	≥ 1
	95	4.7	12.9	> 22 ¹⁾	≥ 22
	95	4.6	12.6	> 165 ¹⁾	≥ 165
	95	4.4	12.0	> 1000 ¹⁾	≥ 1000
	110	2.5	6.8	> 8760 ¹⁾	≥ 8760
3	20	12.0	27.0	> 1 ¹⁾	≥ 1
	95	4.8	10.8	> 1 ¹⁾	≥ 1
	95	4.7	10.6	> 22 ¹⁾	≥ 22
	95	4.6	10.3	> 165 ¹⁾	≥ 165
	95	4.4	9.9	> 1000 ¹⁾	≥ 1000

¹⁾ No failure during test duration. Test was stopped.

3.7 Degree of crosslinking, acc. to DIN EN ISO 10147:2013-03

Sample no.	Degree of crosslinking [%]	
	Mean value	Set value
2	95	≥ 70
3	95	≥ 70

3.8 Homogeneity, acc. to SKZ HR 3.2:2022-10

Sample no.	Cross-sectional area of inhomogeneities [mm ²]	
	Actual value	Set value
2	< 0.01	≤ 0.02
3	< 0.01	≤ 0.02

4 Initial inspection of production site

The initial inspection of the production site MODUS PLASTİK METAL AŞ., IMES 4 Street No. 13, ÇERKEŞLİ O.S.B. MAH, Dilovası/ Kocaeli, TURKEY, was carried out on 18 December 2024 by Ms. Gizem Kahyalar of SKZ – Testing GmbH. The assessment of the laboratory staff and device equipment were found to be without objection.

All requirements of SKZ HR 3.2 concerning the factory production control were met, except for the testing of homogeneity acc. to clause 4.2.8 of SKZ HR 3.2. The test was not carried out by the time of initial inspection.

The company sent revised quality plans, dated 20 December 2024, “Kalite Kontrol Programi-PE-Xa Borular”, KKP-001, including homogeneity testing. The implementation of the test in factory production control needs to be controlled during the first surveillance audit.

5 Summary of test results

The presented test material met the requirements of SKZ HR 3.2 within the tested scope.

The deviation in marking (section 3.2) is not relevant to safety and function. The pipes need to receive a proper marking after certification.