ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

HCR OPPOTUNITIES IN AUTOMOTIVE INDUSTRY

DR. GÖKÇE BAKİLER

BURGAHUSEN, APRIL 2024

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

CONTENT

ERENLI
KAUÇUK & PLASTİK SANAYİ A.Ş.

ERENLI COMPANY INFORMATION

FOUNDED
1959

EMPLOYEES
+450

TURNOVER
25 Mio. EUR

R&D CERTIFIED
SINCE 2016

RECIPE &
MIXING INHOUSE

ISO 9001,
IATF 16949,
ISO 14001

ERENLI COMPANY INFORMATION

HEADQUARTERS & PRODUCTION PLANTS

- 2 Production Plant in **Izmir, TR**

GERMANY OFFICE

- Sales & Engineering Team
  Braunschweig, DE

PRODUCTION PLANT

- *In Leskovac, SRB*

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

ERENLI COMPANY INFORMATION

PRODUCTION

100 % Automotive

- SAP Controlled Automated System
- Extrusion
- Vulcanisation
- Rubber Molded Parts
- Plastic Injection
- Thermoforming Plastic Tubes
- Quick Connector Production
- Toolshops
- Mixing

PC controlled autoclaves. Monitoring of all parameters such as curing conditions are stored and processed on servers in order to avoid any curing problems.

MIXING

Producing Elastomers.

- Full Automated
- 50L Intermesh Mixer for FKM Recipes
- 140L Mixer for all other recipes:

- EPDM-s
- EPDM-per
- NBR
- NBR/PVC
- CM
- CR
- CSM
- AEM
- HNBR
- ACM
- HT-ACM
- HT-AEM
- FKM
- ECO
- VMQ (outsource)
- FVMQ (outsource)

R&D + TESTING

Analyzing is our job.

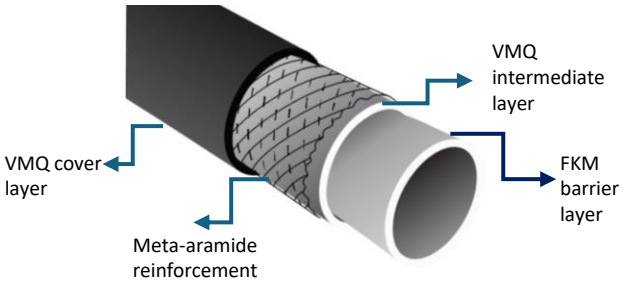
- Certified R&D Center
- All OEM relevant test requirements inhouse laboratory
- Endurance Tests
- Rubber formulation devolopment and Reverse Engineering inhouse
- Mechatronics Engineering
- Partnerships with research institutes and Universities

ERENLI
KAUÇUK & PLASTİK SANAYİ A.Ş.

ERENLI COMPANY INFORMATION

DPF HOSES- TECHNICAL INFORMATION

- Construction is FKM/ VMQ / M-aramide/ VMQ

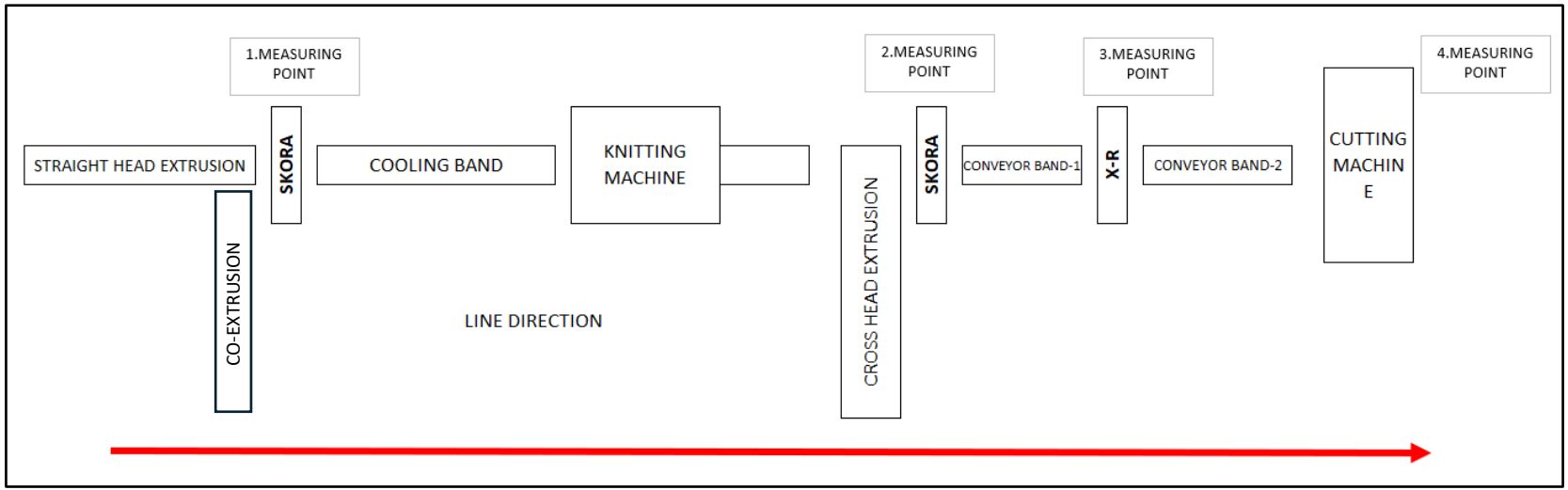


- Connects the DPF unit to a DPF pressure sensor. This allows the sensors to accurately measure the inlet and outlet pressures of the DPF.

- Temperatures of fluid flowing inside:
  -30; +220 °C continuous
  -40; +250 °C peak
  Outside hose temperature:
  180°C continuous, 200 °C peak
- Resistance to pressure: 60 kPa (rel.) under 200 °C

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

DPF HOSES- PRODUCTION TECHNOLOGY



- Multi componenet hoses for the automotive industry can be produced in co-extrusion lines.
- Special barrel and screw geometry are needed to process silicone rubbers in extrusion.

DPF HOSES- PRODUCTION TECHNOLOGY

- Extruded hoses are cured in pressurized caps called autoclaves.
- Saturated steam is the heat source of autoclaves.
- At a defined period and a specific pressure rubber hoses are cured.

POST CURING

FINISHED AND ASSEMBLED HOSE

ERENLİ KAUÇUK & PLASTİK SANAYİ A.Ş.

DPF HOSES- TEST RESULTS

Acc. to Renault 30-00-118 Annex A.3.14

INNER LAYER

Standards	Characteristics	Units	Requier[ts]	Values
	Rubber compound identification		**Erenli Rubber And Plastic FKM RUBBER**	
ISO 1629 03-10-100	Nature of elastomer		**FKM**	
	Classification		**Fluorocarbon**	
	Initial properties			
ISO 48 /N	Hardness IRHD	pts	**≤ 85**	73
ISO 7619-1	Hardness SHORE A	pts	**report**	74
ISO 37 type 2 500 mm/min	Tensile Stress at break	MPa	**≥ 10**	12,9
	Tensile Elongation at break	%	**≥ 150**	323
	Tensile Stress for elongation 20%	MPa	**report**	1,2
	Tensile Stress for elongation 100%	MPa	**report**	3,5
ISO 34-2	Tear strength DELFT	kN/m	**≥ 6**	13,8
ISO 22768	Glass transition	°C	**report**	-22,8
ISO 1431-1 §7.2, §10.3	Resistance to ozone (20%, 40°C) 2 cm^3/m^3	h	**≥ 16**	nc
ISO 815-1 met. A, typ. A	Compression set 72 h at 250 °C	%	**≤ 60**	59,7
ISO 188	**700 h at 220°C + 70 h at 250°C in AIR**			
ISO 48 /N	Hardness IRHD	pts	**≤ 85**	68
	(Change)	pts	**-5 to + 10**	*(-5)*
ISO 37 type 2 500 mm/min	Tensile stress at break	MPa	**report**	8,5
	(Change)	%	**≥ -40**	*(-34,3)*
	Tensile elongation at break	%	**≥ 100**	426
	(Change)	%	**≥ -50**	*(+31,8)*
	Tensile Stress for elongation 20%	MPa	**report**	1,57
	Tensile Stress for elongation 100%	MPa	**report**	3,06

Standards	Characteristics	Units	Requier[ts]	Values
	Rubber compound identification		**Erenli Rubber And Plastic FKM RUBBER**	
ISO 1629 03-10-100	Nature of elastomer		**FKM**	
	Classification		**Fluorocarbon**	
D47 5270 type B	**168 h at 80 °C in acid solution in vapor phase**			
	• Without drying			
ISO 1817	Volume change	%	**0 to + 35**	+28,5
	• After drying 22 h at 100°C			
ISO 48 /N	Hardness IRHD	pts	**≤ 85**	70
	(Change)	pts	**-5 to + 10**	*(-3)*
ISO 37 type 2 500 mm/min	Tensile stress at break	MPa	**report**	11,2
	(Change)	%	**≥ -30**	*(-13,2)*
	Tensile elongation at break	%	**≥ 100**	270
	(Change)	%	**≥ -40**	*(-16,3)*
	Tensile Stress for elongation 20%	MPa	**report**	1,7
	Tensile Stress for elongation 100%	MPa	**report**	4,6
ISO 1817	Volume change	%	**-5 to + 15**	+6,9

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

DPF HOSES- TEST RESULTS

Acc. to Renault 30-00-118 Annex A.3.14

OUTER LAYER

Standards	Characteristics	Units	Requier[ts]	Values
	Rubber compound identification		**Erenli Rubber and Plastic VMQ RUBBER**	
ISO 1629	Nature of elastomer		**VMQ**	
03-10-100	Classification		**Silicon**	
	Initial properties			
ISO 48 /N	Hardness IRHD	pts	**≤ 85**	76
ISO 7619-1	Hardness SHORE A	pts	**report**	70
ISO 37 type 2 500 mm/min	Tensile Stress at break	MPa	**≥ 10**	9,3
	Tensile Elongation at break	%	**≥ 150**	440
	Tensile Stress for elongation 20%	MPa	**report**	5,6
	Tensile Stress for elongation 100%	MPa	**report**	2,3
ISO 34-2	Tear strength DELFT	kN/m	**≥ 6**	10,6
ISO 22768	Glass transition	°C	**report**	-69
ISO 1431-1 §7.2, §10.3	Resistance to ozone (20%, 40°C) 2 cm^3/m^3	h	**≥ 16**	70
ISO 815-1 met. A, typ. A	Compression set 72 h at 200 °C	%	**≤ 60**	60
ISO 188	**700 h at 180°C + 70 h at 200°C in AIR**			
ISO 48 /N	Hardness IRHD	pts	**≤ 85**	81
	(Change)	pts	**-5 to + 10**	*(+5)*
ISO 37 type 2 500 mm/min	Tensile stress at break	MPa	**report**	7,2
	(Change)	%	**≥ -40**	*(-23,1)*
	Tensile elongation at break	%	**≥ 100**	360
	(Change)	%	**≥ -50**	*(-18,1)*
	Tensile Stress for elongation 20%	MPa	**report**	1,8
	Tensile Stress for elongation 100%	MPa	**report**	2,82

Necessities of Improvement in Automotive Design

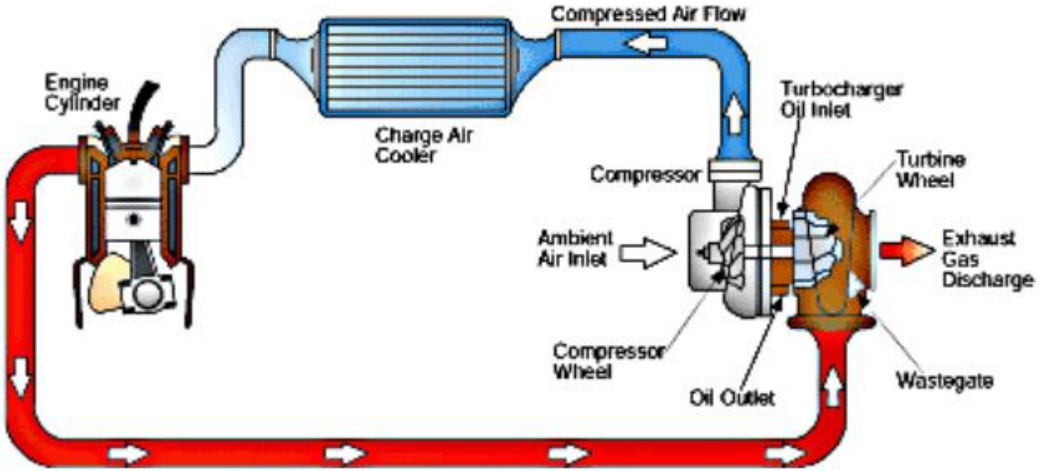
- Need for improved fuel economy
- Lower fuel consumption targets
- Newer emission regulations

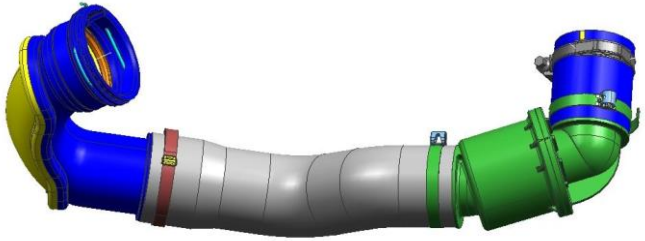
- Increased use of Turbo Charge Engines with EGR systems (engines are becoming smaller)
- Higher Engine Temperatures
- Greater concentration of acid condensates

Temperature range: -30°C to 210 °C; short term temperatures up to 230 °C.

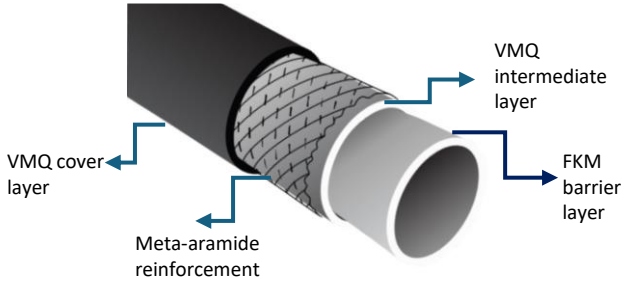
TURBO CHARGE HOSES- TECHNICAL INFORMATION

How a turbo charger works





- Turbo hose delivers pressurized and compressed air from the turbo to the engine.
- Dampens vibrations, transmissions.



TURBO CHARGE HOSES- PRODUCTION TECHNOLOGY

SIMILAR TO DPF HOSES

TURBO CHARGE HOSES- TEST RESULTS

Acc. to TL 52600

INTERMEDIATE/ OUTER LAYER

TL 52600 S3A Blade From Finished Product	VMQ
Post Curing	**4 h, 200 °C**
Initial Conditions	**Results**
Hardness, 65 ± 5 ShoreA, DIN ISO 7619-1	69,0
Tensile Strength, min. 8 N/mm2, DIN 53504	10,9
Elongation at break, 300-600%, DIN 53504	434,0
Tear strength, min. 5 N/mm, DIN ISO 34-1 A	8,1
Heat Ageing 94h, 230 ºC	**Results**
Hardness change, 0 to +10 shore A, DIN ISO 7619-1	6,0
Tensile Strength, min. 5,5 N/mm2, DIN 53504	6,5
Elongation at break, min. 180%, DIN 53504	348,0
Tear strength, min. 2 N/mm, DIN ISO 34-1 A	2,5
Heat Ageing 504 h, 210 ºC	**Results**
Hardness change, 0 to +10 shore A, DIN ISO 7619-1	5,0
Tensile Strength, min. 5,5 N/mm2, DIN 53504	6,7
Elongation at break, min. 180%, DIN 53504	360,0

INITIAL AND HOT AIR AGEING PROPERTIES

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

TURBO CHARGE HOSES- TEST RESULTS

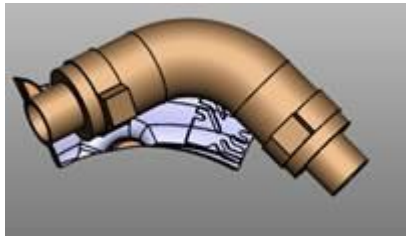
TL 52600 S3A Blade From Finished Product	VMQ
Post Curing	**4 h, 200 °C**
Diesel Fuel Ageing (Liquid F) 94h, 23 ºC	**Results**
Hardness change, 0 to -25 shore A, DIN ISO 7619-1	-24,0
Tensile Strength, min. 4 N/mm2, DIN 53504	4,1
Elongation at break, min. 200%, DIN 53504	202,0
Weight change, 0 to +50 %	49,0
Biodiesel B20 (%80 Liquid F +%20 FAME) Ageing 94h 23ºC	**Results**
Hardness change, 0 to -15 shore A, DIN ISO 7619-1	-23,0
Tensile Strength, min. 6 N/mm2, DIN 53504	3,9
Elongation at break, min. 300%, DIN 53504	181,0
Weight change, 0 to +20 %	52,0

FLUID AGEING PROPERTIES

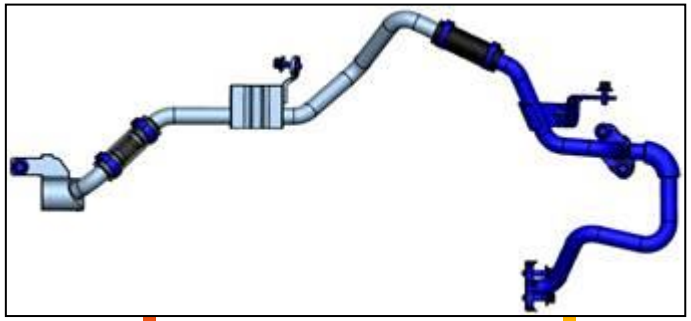
COOLANT HOSES- TECHNICAL INFORMATION

- If there is demand for very high thermal resistance on the outer layer.

- Temperature in long term for outer layer (air) → 175 °C
- Temperature for short term → 190 °C



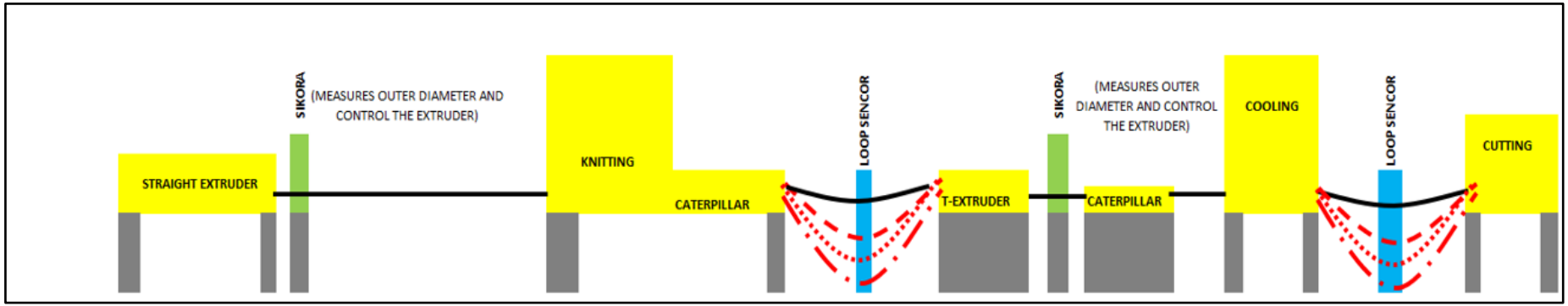
- Temperature in long term in cooling medium for inner layer → 125 °C
- Used as turbo charger cooling hoses.



Inner layer: VMQ
Reinforcement: Meta-aramide
Outer layer: VMQ

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

COOLANT HOSES- PRODUCTION TECHNOLOGY



A view from the inside of a package in the form of bulk hoses

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

COOLANT HOSES- TEST RESULTS

Acc. to DBL 6254.32

INNER LAYER

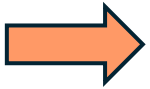
				R 863/65 C1 3013 red brown
DBL 6254.32 (2020-01)				**Inner layer for extruded hoses**
Initial properties	Standards	Unit	Specification	
Viscosity Mooney final value (1 + 4 min)	ISO 289-1 / large rotor / 23 °C	no unit	-	43
Specific gravity	DIN EN ISO 1183-1	g/cm³	-	1,18
Hardness Shore A	DIN ISO 7619-1	no unit	-	65 / 64 / **65** / 65 / 64 / 64
Micro hardness IRHD	DIN ISO 48 M (micro IRHD)	no unit	-	66
Tensile strength	ISO 37, S2	N/mm²	≥7	**9,5** / 10,2 / 9,0
Elongation at break	ISO 37, S2	%	≥300	**440** / 454 / 411
Tear strength	DIN ISO 34-1, Method A	N/mm	≥4	5,0 / 6,6 / 4,2 / 4,3 / **4,4**
Tear strength	DIN ISO 34-1, Method B-b	N/mm	≥4	8,5 / 8,9 / **8,4** / 8,4 / 7,7
Compression set 22h/175°C	ISO 815-1 (3*2mm), Method B	%	<40	21
Immersion in cooling agent Glysantin G40 / distilled water (50:50) 42d/125°C				
Hardness Shore A	DIN ISO 7619-1	no unit	nn	**69** / 68 / 69
Change in hardness		no unit	+/- 10	4
Tensile strength	ISO 37, S2	N/mm²	≥5	7,8 / **9,1** / 9,2
Change in tensile strength		%	≤40	-4
Elongation at break	ISO 37, S2	%	≥200	361 / 421 / **419**
Change in elongation at break		%	≤40	-5
Change in volume	50x25x2 mm	%	+/- 10	-0,9
Compression set	ISO 815-1, Method B - 6.3 mm specimen	%	<90	89

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

COOLANT HOSES- TEST RESULTS

Acc. to DBL 6254.32

OUTER LAYER



				R 760/70 C1 H3 black
DBL 6254.32 (2020-01)				**Outer layer for extruded hoses**
Initial properties	Standards	Unit	Specification	
Viscosity Mooney final value (1 + 4 min)	ISO 289-1 / large rotor / 23 °C	no unit	-	59
Specific gravity	DIN EN ISO 1183-1	g/cm³	-	1,18
Hardness Shore A	DIN ISO 7619-1	no unit	-	72 / 71 / 71 / **72** / 72 / 72
Micro hardness IRHD	DIN ISO 48 M (micro IRHD)	no unit	-	74
Tensile strength	ISO 37, S2	N/mm²	≥7	**10,8** / 9,6 / 11,9
Elongation at break	ISO 37, S2	%	≥300	**479** / 429 / 499
Tear strength	DIN ISO 34-1, Method A	N/mm	≥4	8,7 / **7,8** / 11,2 / 6,9 / 7,2
Tear strength	DIN ISO 34-1, Method B-b	N/mm	≥4	14,0 / 15,6 / 13,4 / **14,**6 / 14,8
Compression set 22h/175°C	ISO 815-1 (3*2mm), Method B	%	<40	26
Heat ageing 42d/175°C				
Hardness Shore A	DIN ISO 7619-1	no unit	nn	**76** / 75 / 76
Change in hardness		no unit	+/- 15	4
Tensile strength	ISO 37, S2	N/mm²	≥6	8,9 / **9,2** / 9,9
Change in tensile strength		%	≤30	-15
Elongation at break	ISO 37, S2	%	≥200	395 / **411** / 433
Change in elongation at break		%	≤50	-14
Change in volume	50x25x2 mm	%	+/- 10	-0,5
Compression set	ISO 815-1 (3*2mm), Method B	%	<85	78
Compression set	ISO 815-1 (6,3 mm), Method B	%	<85	79

ERENLİ
KAUÇUK & PLASTİK SANAYİ A.Ş.

THANKS FOR LISTENING…