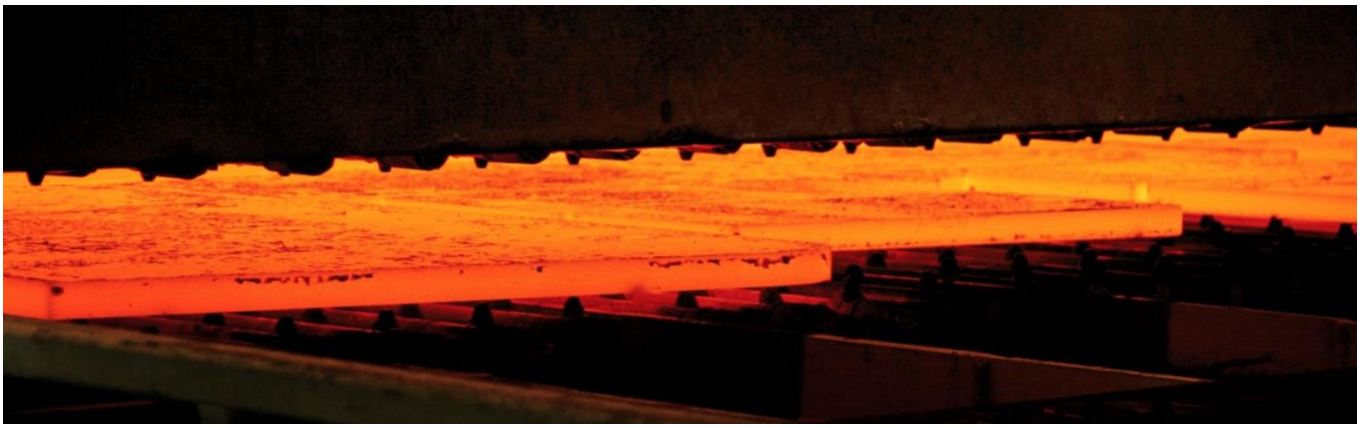
MIILUX PROTECTION® DATASHEET

MIILUX PROTECTION 400 | 450 | 500



Maximum Chemical Composition Content (%) (Ladle Analysis)

Steel grade	Steel Type	Thickness (mm)	C	Si	Mn	P	S	Cr	Ni	Mo	B
Miilux Protection 400	Rolled Homogeneous Armor (RHA)	4-40	0,20	0,60	1,50	0,015	0,005	1,00	0,60	0,30	0,004
Miilux Protection 450	Rolled Homogeneous Armor (RHA)	4-40	0,25	0,70	1,70	0,015	0,005	1,00	0,70	0,50	0,004
Miilux Protection 500	High Hardness Armor (HHA)	4-40	0,30	0,70	1,70	0,015	0,005	0,75	0,80	0,50	0,004

Typical Mechanical Properties and Carbon Equivalent

Product Quality	Thickness	* Yield strength (Rp) 0,2 N/mm²	*Tensile Strength (Rm) N/mm²	*Elongation (A5%)	Impact Charpy-V -40°C Joule (Min.)	Hardness Range (HBW)	**CEV
Miilux Protection 400	4-40 mm	1000	1250	10	25	360-450	0,58
Miilux Protection 450	4-40 mm	1100	1350	8	20	400-480	0,63
Miilux Protection 500	4-40 mm	1300	1600	8	17	480-560	0,70

**Typical values **CEV= C+Mn/6+ (Cr+Mo+V)/5+ (Ni+Cu)/15*

Mechanical Tests

→ Brinell hardness test is applied on every armor steel in accordance with EN ISO 6506-1. If the thickness of the hardness measurement area is less than 4.75 mm, the 5/750 HBW measurement method is used. For other thicknesses, the 10/3000 HBW method is used.
→ Hardness tests are performed on the machined surface at a depth of 0.50 – 1.00 mm from the armor steel surface.
→ Charpy V-Notch impact test is applied in perpendicular and parallel directions to the rolling direction in every casting and thickness* in accordance with EN ISO 148-1 principles.
For products thinner than 11.00 mm nominal thickness, sub-size samples are used. The determined minimum impact value is then proportional to the cross-sectional area of the test specimen. (*6.00 mm order thickness and thicker armor steels)
→ Order-specific test requests should be discussed with Miilux Sales team at the order stage.

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938 www.miilux.com

MIILUX PROTECTION 400 | 450 | 500

Miilux® OY

Typical Ballistic Properties | MIILUX® PROTECTION 500

Ballistic Protection Level Norms	Test Plate Thickness (nominal))	Weapon	Caliber	Ammunition Type	Ammunition Weight	Shooting Distance	Ammunition Speed V2,5 (m/s)
EN1522 FB5	6,50 mm	Rifle	5,56 x 45 mm	SS109 (M855)	4,0 g	10 m	950 ± 10 m/s
EN1522 FB6		Rifle	7,62 x 51 mm	M80 Nato Ball	9,5 g	10 m	830 ± 10 m/s
EN1522 FB7	14,50 mm	Rifle	7,62 x 51 mm	P80 Nato AP	9,5 g	10 m	820 ± 10 m/s
STANAG 4569 LEVEL-1	6,00 mm	Rifle	7,62 x 51 mm	M80 Nato Ball	9,5 g	30 m	833 ± 20 m/s
	6,00 mm		5,56 x 45 mm	SS109 (M855)	4,0 g	30 m	900 ± 20 m/s
	9,00 mm		5,56 x 45 mm	M193	3,5 g	30 m	937 ± 20 m/s
STANAG 4569 LEVEL-2	12,50 mm	Rifle	7,62 x 39 mm	API BZ	7,7 g	30 m	695 ± 20 m/s
VPAM PM9	15,00 mm	Rifle	7,62 x 51 mm	P80 Nato AP	9,7 g	10 m	820 ± 10 m/s
STANAG 4569 LEVEL-3	16,00 mm	Rifle	7,62 x 54R mm	B32 API	10,3 g	30 m	854 ± 20 m/s
	24,00 mm		7,62 x 51 mm	AP (WC core)	8,4 g	30 m	930 ± 20 m/s

The tests mentioned above were carried out in accordance with EN 1522, VPAM and STANAG 4569 norms. Miilux has also conducted tests with different ballistic test classes. (Example: MIL-DTL standard tests) You can contact Miilux Sales team for your order-specific test requests

MIILUX PROTECTION® DATASHEET

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938
www.miilux.com

MIILUX PROTECTION® VERİ SAYFASI

MIILUX PROTECTION 400 | 450 | 500

Heat Treatment Condition

- Quenched (Q)

Ultrasonic Test

- It can be done in accordance with EN ISO 10160. For the application class, please contact Milux Sales team at the order stage.

Tolerances

- EN 10029 or EN 10051 standards are applied for dimensional tolerances.
- EN 10029 Class C tolerances are guaranteed for thickness*.
  The thickness measurement of the cut-edge sheets is made at any point, at least 25 mm from the edge.
- *The thickness measurement of the sheets whose edges are not cut is made from a minimum of 40 mm inside the edges and from any point.*
- EN 10029 Class N, Steel Type H tolerances are guaranteed for flatness*.
  ***** *Shrinked Miilux tolerances (EN 10029 Class N, Steel Type L) are targeted.*

Surface Condition

- EN 10163-2 (Class B, Subclass 3) standard is guaranteed for surface defects.
- The surface of the Steel Plates is sandblasted according to ISO 8501-1 Sa 2½ quality.
- Unless otherwise specified, shop primer is applied to Miilux products, which has been specially developed to provide very high welding and cutting speed after sandblasting, with a very low welding porosity and very low burning rate in the reverse area.
- Shop primer protects the structure against atmospheric corrosion during storage. It is applied at a thickness of 15-25 microns (these values are indicated for a smooth test panel).
- The paint type used has a performance suitable for welding and cutting processes. The protective paint has the feature of protecting Miilux products from
- atmospheric corrosion for up to 6 months.
- Punch marking is applied.
  Paint marking is applied. *(Cast Number, Plate Number, Product Quality, Product Dimensions)*

Product Certificate

- Certified according to EN 10204 norm.
  Test results are provided in English and/or Turkish in accordance with EN 10204-2.2.

It is specified at the order stage for EN 10204-3.1, 3.2 test certificate.

Size and Delivery Conditions

- Miilux products are supplied in a thickness range of 4,00-40,00 mm, with a maximum width of 2500mm and a maximum length of 8000mm. Other sizes are subject to agreement.
  Details, production limits and tolerances are available in the data sheet.
- Miilux products are also available as ready-to-install component parts upon customer request.

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938 www.miilux.com

MIILUX PROTECTION® VERİ SAYFASI
MIILUX PROTECTION 400 | 450 | 500

Miilux®OY

Shrinked Miilux Thickness Tolerances

Plate Thickness (mm)	Tolerances (mm)
4 – 8	- 0,0 + 0,60*
6 – 7,99	- 0,0 + 0,80**
8 – 14,99	- 0,0 + 0,90**
15 – 24,99	- 0,0 + 1,00**
25 - 40	- 0,0 + 1,30**

Other thicknesses are supplied subject to negotiation.
• Sheet from Coil (without edge cutting
*** Sheet (with edge cu*

Manufacturer's Recommendations

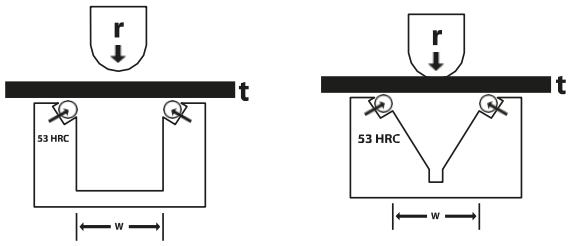
Processing
Miilux products can be machined using high speed tool steels (HSS) with the appropriate combination of machining tool speed and feed rate to provide satisfactory service life.

Welding
Miilux® 400 can be welded well. Miilux® 500 is more limited with heat input and maximum welding energy. With Miilux® 400 preheating is needed when combined plate thickness is more than 40mm and with Miilux® 500 when plate thickness is more than 20mm. Recommended working temperatures are in next table. Preheating temperature should be at least 70 % at working temperature and weld ending temperature shouldn't exceed much more than 30 % working temperature

Cold Forming
In cold forming, sharp transition angles should be avoided as much as possible in Miilux products. In addition, the essence of condition of the equipment used in the operations, the operation plan and the good workshop practices should not be disregarded. The cold forming limits table is given below.

Product	Plate Thickness (mm)	Free bending < 90° Rounding radius of press / plate thickness (r/t) (Bending line to rolling direction)		Free bending – Free Hole Width /Plate Thickness (W/t)		Bottoming 90° - Free Hole Width Free Hole Width
		Transverse	Longitudinal	Transverse	Longitudinal	
Miilux Protection 400	4-20	3,0	4,0	9,0	11,0	~ 15,0
Miilux Protection 450	4-20	4,0	5,0	11,0	13,0	~ 15,0
Miilux Protection 500	4-20	6,0	8,0	15,0	19,0	-

Bending should be done with a single press | Slow pressing speed is recommended | Lower tool should be roller type. *(See Drawings)*



Free Bending V-Bending (Bottoming)

Customer Technical Services
Our Customer Technical Services team assists you when you have a question about product features and usage areas.
E-mail: mth@miilux.com.tr

Sales and Marketing
Our Sales and Marketing team assists you with your order requests and pre-sales services.
E-mail: satis@miilux.com.tr

Miilux®OY

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938 www.miilux.com

MIILUX PROTECTION® DATASHEET

MIILUX PROTECTION® VERİ SAYFASI

MIILUX PROTECTION 280T | 440T | 500T | 600T

General Product Description

Tempered armor steel that can provide ballistic penetration protection and shock resistance together with ideal combinations of hardness and toughness

Chemical Composition Content (%) Ladle Analysis

Steel grade	Steel Type	Ordered Thickness (mm)	C (max %)	Si (max %)	Mn (max %)	P (max %)	S (max %)	Cr (max %)	Ni (max %)	Mo (max %)	B (max %)
Miilux Protection 280T	Homogeneous Rolled Armor Steel (RHA)	4.00 – 25.40	0.25	0.40	1.10	0.010	0.005	0.80	1.80	0.70	0.003
Miilux Protection 440T	Homogeneous Rolled Armor Steel (RHA)	4.00 – 20.00	0.25	0.50	1.20	0.015	0.005	1.00	2.00	0.60	0.003
Miilux Protection 500T	High Hardness Armor Steel (HHA)	4.00 – 24.00	0.32	0.70	1.20	0.015	0.005	0.90	1.20	0.50	0.003
Miilux Protection 600T	Ultra High Hardness Armor Steel (UHHA)	4.00 – 20.00	0.45	0.70	0.80	0.015	0.004	0.50	3.00	0.60	0.003

Guaranteed Mechanical Properties

Steel Quality	Thickness (mm)	Impact Charpy-V Min. -40°C (Joule)	Hardness Min.-Max. (HBW)	CE Max.
Miilux Protection 280T	4.00 – 25.40	60	270-330	0.80
Miilux Protection 440T	4.00 – 20.00	30	420-480	0.74
Miilux Protection 500T	4.00 – 24.00	24	480-560	0.72
Miilux Protection 600T	4.00 – 20.00	14	570-650	0.88
CE = C + [Mn/6] + [(Cr + Mo + V) /5] + [(Ni + Cu) /15]				

Typical Mechanical Properties

Steel Quality	Thickness (mm)	Typical Yield Strength (MPa)	Typical Tensile Strength (MPa)	Elongation (%)
Miilux Protection 280T	4.00 – 25.40	800	900-1100	13
Miilux Protection 440T	4.00 – 20.00	1200	1300-1500	10
Miilux Protection 500T	4.00 – 24.00	1200	1450-1750	7
Miilux Protection 600T	4.00 – 20.00	1400	1950-2150	6

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938 www.miilux.com

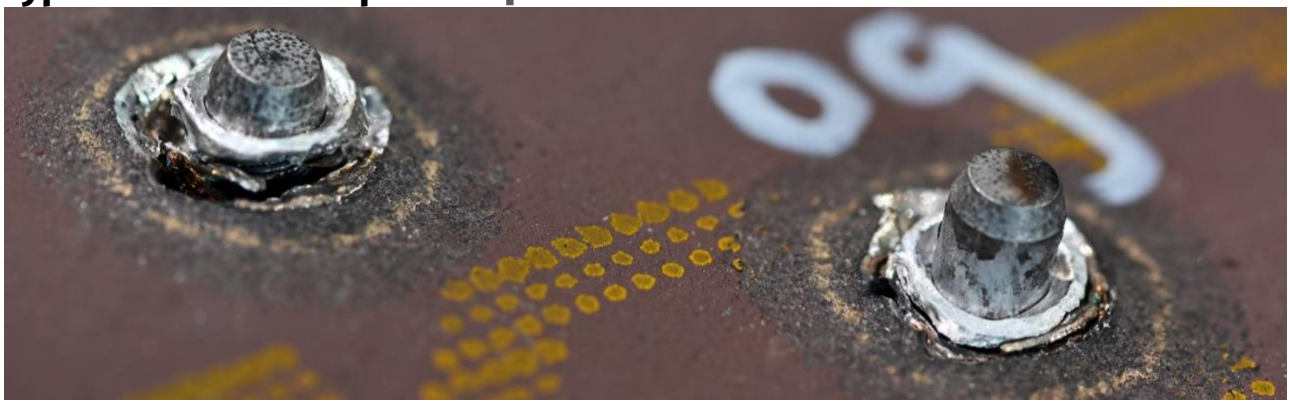
MIILUX PROTECTION® VERİ SAYFASI

MIILUX PROTECTION 280T | 440T | 500T | 600T

Mechanical Tests

→ Brinell hardness test is applied on every armor steel in accordance with EN ISO 6506-1. If the thickness of the hardness measurement area is less than 4.75 mm, the 5/750 HBW measurement method is used. For other thicknesses, the 10/3000 HBW method is used.
→ Hardness tests are performed on the machined surface at a depth of 0.50 – 1.00 mm from the armor steel surface.
→ Charpy V-Notch impact test is applied in perpendicular and parallel directions to the rolling direction in every casting and thickness* in accordance with EN ISO 148-1 principles.
For products thinner than 11.00 mm nominal thickness, sub-size samples are used. The determined minimum impact value is then proportional to the cross-sectional area of the test specimen. (*6.00 mm order thickness and thicker armor steels)
→ Order-specific test requests should be discussed with Miilux Sales team at the order stage.

Typical Ballistic Properties | MIILUX® PROTECTION 500T



Ballistic Protection Level Norms	Test Plate Thickness (nominal))	Caliber	Ammunition Type	Ammunition Weight	Shooting Distance	Ammunition Speed (m/s)
EN 1522 FB6	6.00	5,56 x 45 7,62 x 51	SS109 (M855) M80 Nato Ball	4.0 9.5	10	950 ± 10 830 ± 10
STANAG 4569 Level-1	6.00	7,62 x 51 5,56 x 45	M80 Nato Ball SS109 (M855)	9.5 4.0	30	833 ± 20 900 ± 20
	9.00	5,56 x 45	M193	3.5	30	937 ± 20
STANAG 4569 Level-2	12.00	7,62 x 39	API BZ	7.7	30	695 ± 20
EN1522 FB7	14.00	7,62 x 51	P80 Nato AP	9.5	10	820 ± 10
STANAG 4569 Level-3	16.00	7,62 x 54R	B32 API	10.3	30	854 ± 20
	24.00	7,62 x 51	AP (WC core)	8.4	30	930 ± 20

For order-specific test requests, Miilux Sales team should be contacted at the order stage.
Each customer is obliged to verify the requested plate thickness, to evaluate the suitability of the information given to the request and the potential risks according to the usage area.

Miilux High Strength Steel Production Inc. reserves the right to change product groups and tolerances without prior notification. You can contact our Customer Technical Services team to get information about different tests.

Miilux® Protection 500T Manufacturer's Recommendations

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938 www.miilux.com

MIILUX PROTECTION 280T | 440T | 500T | 600T

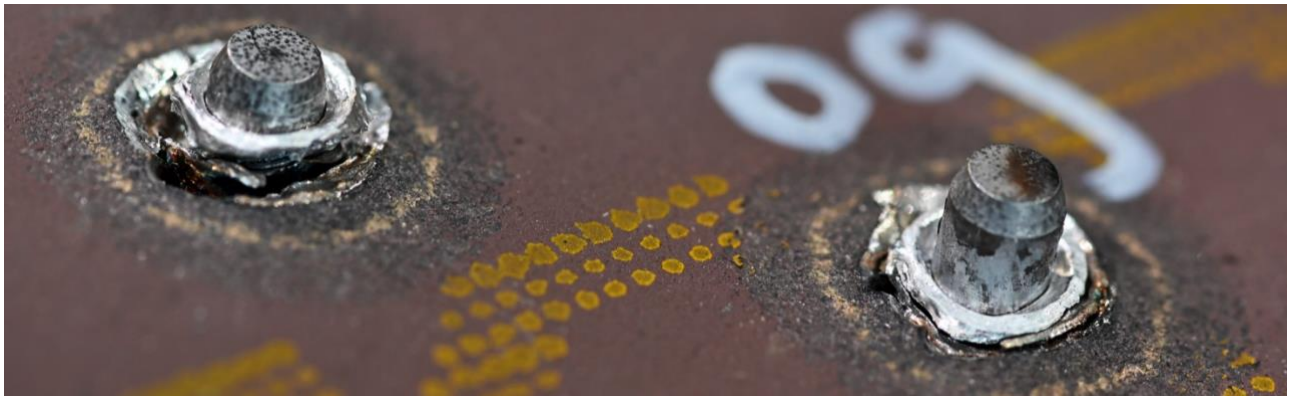
Processing

Miilux products can be machined using high speed tool steels (HSS) with the appropriate combination of machining tool speed and feed rate to provide satisfactory service life.

Welding

Miilux® 400 can be welded well. Miilux® 500 is more limited with heat input and maximum welding energy. With Miilux® 400 preheating is needed when combined plate thickness is more than 40mm and with Miilux® 500 when plate thickness is more than 20mm. Recommended working temperatures are in next table. Preheating temperature should be at least 70 % at working temperature and weld ending temperature shouldn't exceed much more than 30 % working temperature.

Typical Ballistic Properties | MIILUX® PROTECTION 600T



Ballistic Protection Level Norms	Test Plate Thickness (nominal))	Caliber	Ammunition Type	Ammunition Weight	Shooting Distance	Ammunition Speed (m/s)
EN 1522 FB5	4.00	5,56 x 45 mm	SS109 (M855)	4.0	10	950 ± 10 m/s
VPAM PM7	5.00	5,56 x 45 mm 7,62 x 51 mm	SS109 (M855) M80 Nato Ball	4.0 g 9.5 g	10	950 ± 10 m/s 830 ± 10 m/s
STANAG 4569 Level 1	6.00	7,62 x 51 mm 5,56 x 45 mm 5,45 x 45 mm	M80 Nato Ball SS109 (M855) M193	9.5 4.0 3.5	30	833 ± 20 m/s 900 ± 20 m/s 937 ± 20 m/s
STANAG 4569 Level 2	10.00	7,62 x 39 mm	API BZ	7.7	30	695 ± 20 m/s
EN 1522 FB7	10.00	7,62 x 51 mm	P80 Nato AP	9.7 g	10	820 ± 10 m/s

For order-specific test requests, Miilux Sales team should be contacted at the order stage.

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938 www.miilux.com

MIILUX PROTECTION® VERİ SAYFASI

MIILUX PROTECTION 280T | 440T | 500T | 600T

Each customer is obliged to verify the requested plate thickness, to evaluate the suitability of the information given to the request and the potential risks according to the usage area.

Miilux High Strength Steel Production Inc. reserves the right to change product groups and tolerances without prior notification. You can contact our Customer Technical Services team to get information about different tests.

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938
www.miilux.com

MIILUX PROTECTION® VERİ SAYFASI

MIILUX PROTECTION 280T | 440T | 500T | 600T

Heat Treatment Condition

- Quenched and Tempered.
- Tempered Protection plates are not suitable for secondary heat treatments by the user.
- In case of heating above Protection 280T 600°C, Protection 440T°C 190°C, Protection 500T 180°C and Protection 600T 170°C after receipt from Miilux; No warranty is given.

Tolerances

- EN 10029 or EN 10051 standards are applied for dimensional tolerances.
- EN 10029 Class C tolerances are guaranteed for thickness. The thickness tolerance application is based on the Reduced Miilux thickness tolerances, which are more restrictive than EN 10029 Class C.
- EN 10029 Class N, Steel Type H tolerances are guaranteed for flatness

Surface Condition

- - EN 10163-2 (Class B, Subclass 3) standard is guaranteed for surface defects.
- - The surface of the Steel Plates is sandblasted according to ISO 8501-1 Sa 2½ quality.
- - Unless otherwise specified, shop primer is applied to Miilux products, which has been specially developed to provide very high welding and cutting speed after sandblasting, with a very low welding porosity and very low burning rate in the reverse area.
- - Shop-primer protects the structure against atmospheric corrosion during storage. It is applied at a thickness of 15-25 microns (these values are indicated for a smooth test panel).
- - The paint type used has a performance suitable for welding and cutting processes.
- Marking is done with punch.
- - Marking is done with paint.

Product Certificate

- Certified according to EN 10204 norm.
- Test results are provided in English and/or Turkish languages in accordance with EN 10204-3.1.
- For EN-10204-3.2 test certificates, it should be specified at the time of order.

Size and Delivery Conditions

- Miilux products are supplied with a maximum width of 2500 mm and a maximum length of 8000 mm. Special size requests should be discussed at the order stage.
- Miilux products can be supplied as ready-to-assemble component parts in line with the customer's request, by negotiating at the order stage.
- Requests for Protection 280T, 440T, 500T and 600T in other sizes should be discussed at the order stage.

Ultrasonic Test

- It can be done in accordance with EN ISO 10160.

For the application class, please contact Milux Sales team at the order stage.

Shrinked Miilux Thickness Tolerances

Plate Thickness (mm)	Tolerances (mm)
4.00 – 8.00	- 0.00 + 0.60*
6.00 – 7.99	- 0.00 + 0.80**
8.00 – 14.99	- 0.00 + 0.90**
15.00 – 25.40	- 0.00 + 1.00**
25.40 – 40.00 (Subject to negotiation)	- 0.00 + 1.30**

Other thicknesses are supplied subject to negotiation.

• Sheet from Coil (without edge cutting)

*** Sheet (with edge cut)*

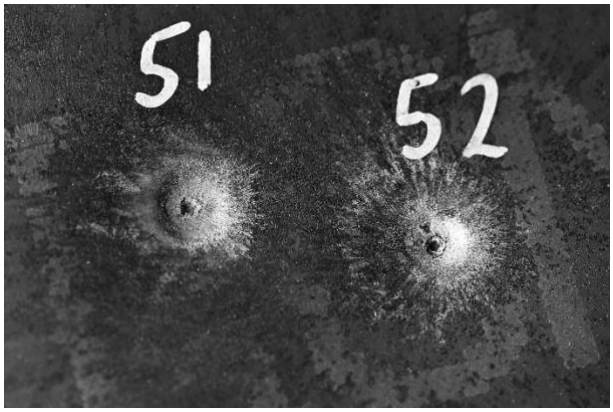
Ballistic Features

- Miilux Protection 280T ballistic performance meets MIL-DTL-12560 Class 2 requirements.

- For order-specific test requests, Miilux Sales team should be contacted at the order stage.

Each customer is obliged to verify the requested plate thickness, to evaluate the suitability of the information given to the request and the potential risks according to the usage area.

Miilux Yüksek Mukavemetli Çelik Üretim A.Ş reserves the right to change product groups and tolerances without prior notification. You can contact our Customer Technical Services team to get information about different tests.



Sales and Marketing

Our Customer Technical Services team assists you when you have a question about product features and usage areas.

E-mail: satis@miilux.com.tr

Customer Technical Services

Our Customer Technical Services team will assist you when you have a question regarding product features, testing and usage areas.

E-mail: mth@miilux.com.tr

MIILUX YÜKSEK MUKAVEMETLİ ÇELİK ÜRETİM A.Ş.
Office: Barbaros Mah. Ardıç Sok. No: 6 34746 Ataşehir İSTANBUL
Factory: Manisa Oraganize Sanayi Bölgesi, Hasan Türek Bulvarı No: 16 MANİSA Tel: 0 262 679 2634
Mersis No: 0620111964000001 Trade Registration No: 433938 www.miilux.com