



Istituto Meccanica dei Materiali SA

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Test Certificate

RCP4001F

Standard: SN EN 1926, SN EN 1342



COMPRESSIVE STRENGTH

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Delivery: --

Date of testing: 04.02.2014

Nominal sizes: Cubes L = W = H = 70 mm

Load direction: Perpendicular to scistosity

Load rate: 1.000 MPa/s

Operator: Geol. B. Cecchin

Initial Type Test					
Id.	L / W / H [mm]	M [g]	ρ [t/m ³]	F [kN]	R [MPa]
1	70.0/69.9/70.7	921.0	2.662	948.0	193.7
2	70.0/70.0/70.7	925.0	2.670	950.7	194.0
3	70.0/69.9/70.6	922.0	2.669	960.6	196.3
4	70.1/69.8/70.6	924.0	2.675	943.6	192.8
5	70.3/69.9/70.7	928.0	2.671	964.9	196.4
6	70.1/69.9/70.6	922.0	2.665	937.1	191.2
7	70.1/69.9/70.5	936.0	2.710	973.1	198.6
8	69.8/69.8/70.7	919.0	2.668	936.9	192.3
9	70.0/69.9/70.7	926.0	2.677	961.5	196.5
10	70.2/69.8/70.7	924.0	2.667	930.0	189.8

Type Test	Mean and STD	Strength: $R_{i,m} = 194 \pm 3$ MPa	Density: $\rho_{i,m} = 2.673 \pm 0.013$ t/m ³
		Lower expected values	Strength: $R_{i,min} = 188$ MPa

Notes:

Grancia, 20.02.2017

General Manager: Dott. M. Di Tommaso

Settore IMM: prove su pietre naturali

(Procedure interne: PN-03, PN-05)

I risultati si riferiscono ai campioni analizzati. Fa stato a livello legale solo la versione cartacea originale, firmata e timbrata. È vietata la riproduzione anche parziale e l'utilizzazione non autorizzata a scopi pubblicitari.



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Test Certificate

RCG4001F

Standard: SN EN 1926, SN EN 12371, SN EN 1342



FROST RESISTANCE BY COMPRESSIVE STRENGTH

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Delivery: --

Number of cycles: 56 cycles (03.03.2014 ÷ 06.06.2014)

Date of testing: 16.06.2014

Nominal sizes: Cubes L = W = H = 70 mm

Load direction: Perpendicular to scistosity

Load rate: 1.000 MPa/s

Operator: Geol. B. Cecchin

Initial Type Test					
Id.	L / W / H [mm]	M [g]	ρ [t/m ³]	F [kN]	R [MPa]
1	70.0/69.9/70.7	921.0	2.662	948.0	193.7
2	70.0/70.0/70.7	925.0	2.670	950.7	194.0
3	70.0/69.9/70.6	922.0	2.669	960.6	196.3
4	70.1/69.8/70.6	924.0	2.675	943.6	192.8
5	70.3/69.9/70.7	928.0	2.671	964.9	196.4
6	70.1/69.9/70.6	922.0	2.665	937.1	191.2
7	70.1/69.9/70.5	936.0	2.710	973.1	198.6
8	69.8/69.8/70.7	919.0	2.668	936.9	192.3
9	70.0/69.9/70.7	926.0	2.677	961.5	196.5
10	70.2/69.8/70.7	924.0	2.667	930.0	189.8

Test after freeze/thaw cycles (56 cycles)					
Id.	L / W / H [mm]	M [g]	ρ [t/m ³]	F [kN]	R [MPa]
1	70.3/70.0/70.7	929.0	2.670	859.8	174.7
2	70.0/69.9/70.7	924.0	2.671	849.8	173.7
3	70.2/70.0/69.6	929.0	2.716	732.7	149.1
4	70.3/70.0/69.5	912.0	2.667	775.3	157.5
5	70.2/49.8/69.5	911.0	3.749	783.2	224.0
6	70.4/70.0/69.4	912.0	2.667	737.8	149.7
7	70.6/70.4/69.5	917.0	2.655	665.4	133.9
8	70.3/70.0/70.9	926.0	2.654	696.5	141.5
9	70.7/70.5/69.8	924.0	2.656	793.5	159.2
10	70.4/70.3/69.5	918.0	2.669	764.0	154.4

Type Test	Mean and STD	Strength: $R_{i,m} = 194 \pm 3$ MPa	Density: $\rho_{i,m} = 2.673 \pm 0.013$ t/m ³
	Lower expected values	Strength: $R_{i,min} = 188$ MPa	
After freeze/thaw	Mean and STD	Strength: $R_m = 162 \pm 25$ MPa	Density: $\rho_m = 2.777 \pm 0.342$ t/m ³
	Lower expected values	Strength: $R_{min} = 118$ MPa	$\Delta R_{min} = -37.1\%$

Notes:

Grancia, 20.02.2017 General Manager: Dott. M. Di Tommaso

Settore IMM: prove su pietre naturali

(Procedure interne: PN-03, PN-05)

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Test Certificate

RCP4001F.2

Standard: SN EN 1926, SN EN 1342



COMPRESSIVE STRENGTH

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Delivery: --

Date of testing: 04.02.2014

Nominal sizes: Cubes L = W = H = 70 mm

Load direction: Parallel to scistosity

Load rate: 1.000 MPa/s

Operator: Geol. B. Cecchin

Initial Type Test					
Id.	L / W / H [mm]	M [g]	ρ [t/m ³]	F [kN]	R [MPa]
1	70.4/69.5/70.4	918.0	2.665	854.4	174.6
2	70.3/69.5/70.5	919.0	2.668	956.6	195.8
3	70.5/69.4/70.6	919.0	2.660	996.1	203.6
4	70.5/69.4/70.3	916.0	2.663	974.8	199.2
5	70.4/69.5/70.3	916.0	2.663	921.5	188.3
6	70.4/69.4/70.2	913.0	2.662	875.7	179.2
7	70.6/70.0/70.0	921.0	2.662	827.6	167.5
8	70.0/69.4/70.5	913.0	2.666	923.3	190.1
9	70.6/69.6/70.6	919.0	2.649	837.6	170.5
10	70.5/69.6/70.6	922.0	2.662	953.2	194.3

Type Test	Mean and STD	Strength: $R_{i,m} = 186 \pm 13$ MPa	Density: $\rho_{i,m} = 2.662 \pm 0.005$ t/m ³
		Lower expected values	Strength: $R_{i,min} = 161$ MPa

Notes:

Grancia, 20.02.2017 General Manager: Dott. M. Di Tommaso

Settore IMM: prove su pietre naturali

(Procedure interne: PN-03, PN-05)

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Standard: SN EN 14231, SN EN 1342

SLIP RESISTANCE

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Date of testing: 20.02.2014

Nominal sizes: Prisms: L = 150 mm; W = 100 mm; H = 20 mm

Rubber slider width: 76 mm

Surface finish: Blasted

Delivery: --

Operator: Geol. B. Cecchin

Reference stone: Quartz-dolerite type TRL

Test length: 126 mm

		Test direction	Measured values					Mean
Dry test	Specimen 1	Forward						
		Backward						
	Specimen 2	Forward						
		Backward						
	Specimen 3	Forward						
		Backward						
	Specimen 4	Forward						
		Backward						
	Specimen 5	Forward						
		Backward						
	Specimen 6	Forward						
		Backward						
--								
Wet test	Specimen 1	Forward	78	79	77	77	77	77
		Backward	77	77	75	76	76	
	Specimen 2	Forward	80	79	79	79	79	79
		Backward	79	80	79	79	79	
	Specimen 3	Forward	80	79	80	80	80	79
		Backward	80	78	79	80	80	
	Specimen 4	Forward	80	80	79	80	80	80
		Backward	80	80	80	81	81	
	Specimen 5	Forward	79	77	77	78	78	79
		Backward	81	80	80	80	80	
	Specimen 6	Forward	83	82	81	81	81	82
		Backward	84	82	83	83	83	
Lower expected value							76	

Notes: For the intended uses, this test is carried out only in wet condition.

Grancia, 20.02.2017

General Manager: Dott. M. Di Tommaso

Settore IMM: prove su pietre naturali

(Procedura interna: PN-07)

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Standard: SN EN 13755, SN EN 1342



WATER ABSORPTION AT ATMOSPHERIC PRESSURE

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Delivery: --

Date of testing: 19.02.2014 ÷ 26.02.2014

Nominal sizes: Prisms: L = 70 mm; W = 70 mm; H = 70 mm

Operator: Geol. B. Cecchin

Id.	Dry mass m_d [g]	Wet mass m_s [g]	Water absorption A_b [%]
1	923.7	926.2	0.3
2	916.2	918.7	0.3
3	919.0	921.5	0.3
4	927.3	929.8	0.3
5	918.5	921.0	0.3
6	923.5	925.9	0.3

Higher expected value: 0.3 %

Notes:

Grancia, 22.02.2017

General Manager: **Dot. M. Di Tommaso**

Settore IMM: prove su pietre naturali

(Procedura interna: PN-08)

I risultati di riferimento ai campioni analizzati. Fa stato a livello legale solo la versione cartacea originale, firmata e timbrata.
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Test Certificate

MVP4001F

Standard: SN EN 1936, SN EN 1342



APPARENT DENSITY AND OPEN POROSITY

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Delivery: --

Date of testing: 04.02.2014

Nominal sizes: Prisms: L = 70 mm; W = 70 mm; H = 70 mm

Operator: Geol. B. Cecchin

Apparent density and open porosity					
Id.	Wet mass in water m_h [g]	Wet mass in air m_s [g]	Dry mass m_d [g]	Apparent density ρ_b [t/m ³]	Open porosity p_o [%]
1	575.8	918.3	915.8	2.669	0.7%
2	575.9	918.6	916.0	2.668	0.8%
3	581.7	928.4	925.9	2.666	0.7%
4	576.6	919.8	917.2	2.668	0.8%
5	579.3	924.4	922.0	2.667	0.7%
6	583.0	930.3	927.9	2.667	0.7%
Mean and STD				2.667 ± 0.001	0.7 ± 0.03 %

Notes:

Grancia, 22.02.2017

General Manager: Dott. M. Di Tommaso

Settore IMM: prove su pietre naturali

(Procedura interna: PN-10)

I risultati si riferiscono ai campioni analizzati. Fa stato a livello legale solo la versione cartacea originale, firmata e timbrata. È vietata la riproduzione anche parziale e l'utilizzazione non autorizzata a scopi pubblicitari.



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Test Certificate

GSP4001F

Standard: SIA 262/1-C, SN EN 1342



FREEZE-THAW RESISTANCE WITH DEICING AGENT

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Delivery: --

Date of testing: 28.02.2014

Duration of the analysis: 14.02.2014 ÷ 28.02.2014

Nominal sizes: Prisms: L = W = 150 mm; H = 50 mm

Tested surface: Vertical, confined

Orientation of the test: Perpendicular to schistosity

Operator: Geol. B. Cecchin

Id.		1	2	3	
Exposed surface [m ²]		0.0225	0.0225	0.0226	
Cycles 0÷6	Removed mass [g]	0.02	0.01	0.02	
	Remarks*	DP	DP	DP	
Cycles 7÷14	Removed mass [g]	0.02	0.02	0.01	
	Remarks*	DP	DP	DP	
Cycles 15÷28	Removed mass [g]	0.02	0.02	0.02	
	Remarks*	DP	DP	DP	
Results	Δm_6 [g/m ²]	1 ± 0		Total surface [m ²]	0.0676
	Δm_{14} [g/m ²]	1 ± 0		Total mass [g]	7.10
	Δm_{28} [g/m ²]	1 ± 0		<i>m</i> [g/m ²]	2 ± 0

High freeze-thaw resistance → $m \leq 200 \text{ g/m}^2$, or: $m \leq 600 \text{ g/m}^2$ and $\Delta m_{28} \leq (\Delta m_6 + \Delta m_{14})$

Low freeze-thaw resistance → $m > 1200 \text{ g/m}^2$

Evaluation

High freeze-thaw resistance

*Legend: DP = local chipping; DD = widespread chipping and scaling – **Table NA.9, standard SN EN 206-1/NE:2013

Notes:

Grancia, 22.02.2017 General Manager: **Dott. M. Di Tommaso**

Settore IMM: prove su pietre naturali

(Procedura interna: CI-17)

I risultati si riferiscono ai campioni analizzati. Fa stato a livello legale solo la versione cartacea originale, firmata e timbrata.
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Test Certificate

GSP4001F.2

Standard: SIA 262/1-C, SN EN 1342



FREEZE-THAW RESISTANCE WITH DEICING AGENT

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Lodrino Gneiss

Product: Setts of natural stone foreexternal paving

Quarry: Elio Sangiorgio SA

Name of the stone: Lodrino Gneiss

EN 12440 denomination: LODRINOGRANIT

Petrographic description: Orthogneiss

Sampling: Carried out by the client

Delivery: --

Date of testing: 28.02.2014

Duration of the analysis: 14.02.2014 ÷ 28.02.2014

Nominal sizes: Prisms: L = W = 150 mm; H = 50 mm

Tested surface: Vertical, confined

Orientation of the test: Perpendicular to the edge of schistosity planes

Operator: Geol. B. Cecchin

Id.		1	2	3	
Exposed surface	[m ²]	0.0225	0.0226	0.0225	
Cycles 0÷6	Removed mass [g]	0.02	0.02	0.01	
	Remarks*	DP	DP	DP	
Cycles 7÷14	Removed mass [g]	0.02	0.01	0.01	
	Remarks*	DP	DP	DP	
Cycles 15÷28	Removed mass [g]	0.02	0.02	0.02	
	Remarks*	DP	DP	DP	
Results	Δm_6 [g/m ²]	1 ± 0		Total surface [m ²]	0.0677
	Δm_{14} [g/m ²]	1 ± 0		Total mass [g]	6.65
	Δm_{28} [g/m ²]	1 ± 0		m [g/m ²]	2 ± 0

High freeze-thaw resistance → $m \leq 200 \text{ g/m}^2$, or: $m \leq 600 \text{ g/m}^2$ and $\Delta m_{28} \leq (\Delta m_6 + \Delta m_{14})$

Low freeze-thaw resistance → $m > 1200 \text{ g/m}^2$

Evaluation

High freeze-thaw resistance

*Legend: DP = local chipping; DD = widespread chipping and scaling – **Table NA.9, standard SN EN 206-1/NE:2013

Notes:

Grancia, 22.02.2017 General Manager: Dott. M. Di Tommaso

Settore IMM: prove su pietre naturali



(Procedura interna: CI-17)

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Test Certificate

APR4001F.1

Standard: EN 12407

PETROGRAPHIC ANALYSIS

Client:	Elio Sangiorgio SA Industria del granito		
Project:	Natural stone testing - Gneiss di Lodrino		
Product:	Setts of natural stone foreexternal paving - SN EN 1342		
Quarry:	Cava Elio Sangiorgio SA		
Name of the stone:	Gneiss di Lodrino		
EN 12440 denomination:	LODRINOGRANIT		
Sampling:	Carried out by the client	Date of testing:	19.02.2017
Delivery:	Carried out by the client	Operator:	Dott. Geol. B. Cecchin

1. Macroscopic description of the handsample

General description	White-black, medium-to-fine grained rock, characterized by moderate schistosity due to the preferential orientation of mica plates. Texture is typical of gneiss characterized by a granoblastic matrix made of feldspars and quartz crystals combined with numerous thin and discontinuous layers of biotite with minor muscovite.
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2. Microscopic description of the sample

Orientation of the thin section: parallel to lineation and perpendicular to foliation

2.1 Texture and structure

General description	The texture of the rock is typical of gneiss characterized by a granoblastic matrix made of prismatic, crystals of K-feldspar, plagioclase and quartz of different grain sizes and thin, discontinuous and slightly wavy layers made of biotite with minor muscovite.
Microfractures:	Not present.

2.2 Mineralogical composition, grain size and microstructure

General description	The rock is mainly composed of the following minerals: K-feldspar (~ 50%), plagioclase (~ 20%), and quartz (~ 12%). Feldspars are easily recognized by the typical sub-idiomorphic prismatic grain shape and by the twinning. Quartz grains are usually found in interstitial positions and are characterized by irregular shape, lobed edges and undulose extinction. Biotite crystals (~ 15%) shows strong pleochroism (brown), muscovite flakes (~ 3%), clear at PPL, and are characterized by bright interference colors. Rare accessory minerals are also present.
Weathering degree of the thin section	Fresh, not weathered

2.3 Definizione petrografica proposta

Proposed petrographic definition	Protolite: igneous rock Facies: greenschists Rock name: orthogneiss
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IMM section: physical and mechanical testing on rocks

(Method statement: RO-10)

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Standard: EN 12407

PETROGRAPHIC ANALYSIS

Client: Elio Sangiorgio SA Industria del granito

Project: Natural stone testing - Gneiss di Lodrino

Product: Setts of natural stone foreexternal paving - SN EN 1342

Quarry: Gneiss di Lodrino

Image A

The image shows the gneissic texture of the rock characterized by a granoblastic matrix made of subidiomorphic, prismatic crystals of K-feldspar and plagioclase, accompanied by minor quartz. Quartz is recognizable by the irregular shape, typically lobed edges, and undulose extinction. Plagioclase is characterized by frequent polysynthetic twinning. In K-feldspar crystals are sometimes visible small perthite lamellae and in some cases also simple twinning.

Rock schistosity is due to the presence of mica flakes of biotite and muscovite.

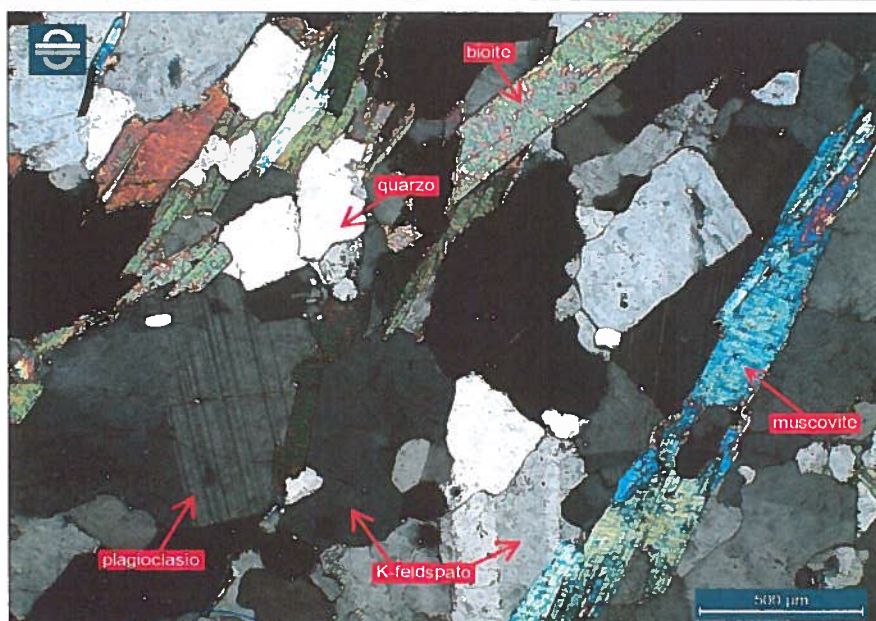


Magnification: 25x

Illumination: PPL

Image B

In the higher magnification image is possible to observe the main minerals of the rock sample. The most part of the image is occupied by prismatic K-feldspar grains. Plagioclase crystals can be distinguished from them thanks to polysynthetic twinning. Quartz is characterized by the irregular, lobed edges, and undulose extinction. Mica flakes are characterized by high-order interference colors: pink-green for biotite (on the left top side), light blue for muscovite (right side).



Magnification: 40x

Illumination: PPL

Grancia, 22.02.2017

General Manager: Dott. M. Di Tommaso

IMM section: physical and mechanical testing on rocks

(Method statement: RO-10)

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