



ACCIAIERIE
Valbruna



REVAL[®]

STAINLESS STEEL REINFORCEMENT COIL & BAR

WHY RISK ?



**“REVAL® is the ultimate solution
against risks from chloride attack
on roads, bridges and
constructions”**



REVAL®

REVAL[®]: A PERMANENT SOLUTION



THE BENEFITS OF USING REVAL[®] IN ROADS, BRIDGES AND BUILDINGS

- Excellent corrosion resistance to chlorides
- More than 100 years of expected service life in concrete
- Superior strength levels
- Better self healing to handling damage and abrasion when compared to galvanized or epoxy coated steel
- Low life cycle cost
- High ductility and strength
- Longer storage and service life
- Superior resistance to localized corrosion mechanisms
- Low magnetic permeability
- Better fire and heat resistance comparable to black bar
- Resistant to seismic loading
- Save and easy use with black steel by lapping or coupling



"REVAL[®]: a permanent solution to concrete decay, structure safety and continuous maintenance"



REVAL® ...RESISTANT TO CORROSION

REVAL® = DURABILITY

During their life, structures should resist to:

- Atmospheric and meteorological agents
- Aggressive environmental attacks
- Dynamic and static forces
- Abnormal and unforeseeable factors such as fire, earthquakes and floods.



REVAL® 304L, 316L and especially 318-duplex show an exceptional resistance to high temperatures and to different pH levels in the concrete.

REVAL® offers economic advantages in the medium and long run.

The initial cost of REVAL® is outweighed by saving all maintenance costs.

Consultants, designers and builders of roads and bridges see the benefit of stainless steel reinforcement for cost saving and reduced disruption to traffic.

That has been understood by governments.

The Highway Agency in the UK has issued the "Design Manual for Roads and Bridges" Volume 1, Section 3, part 15, BA 84/02, in which it recommends the use of stainless steel instead of normal carbon steel to eliminate traffic disruption.



Aleghero's Bridge - Italy

AGGRESSIVE ENVIRONMENT

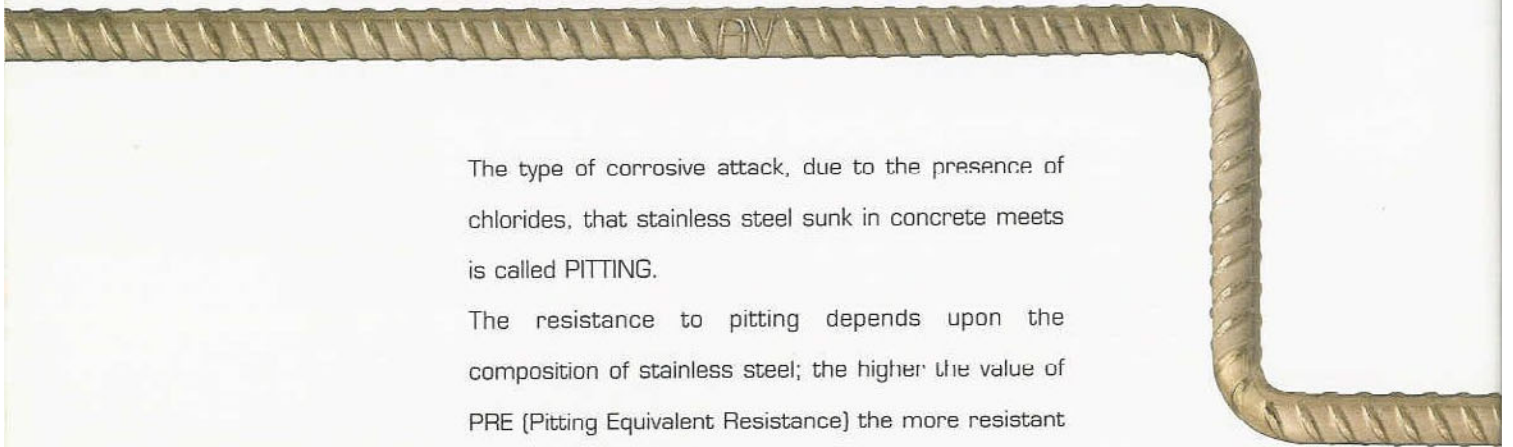
ENVIRONMENT	CAUSE OF CORROSION	STEEL SUGGESTED
Mildly aggressive	Low chloride content	304L
Aggressive	High chloride content	316L
Very aggressive	Carbonation and chloride penetration, high temperature and/or temperature fluctuations	316L/duplex/superduplex

REVAL

3

"REVAL® offer the best available solution against corrosion"

... RESISTANT TO PITTING

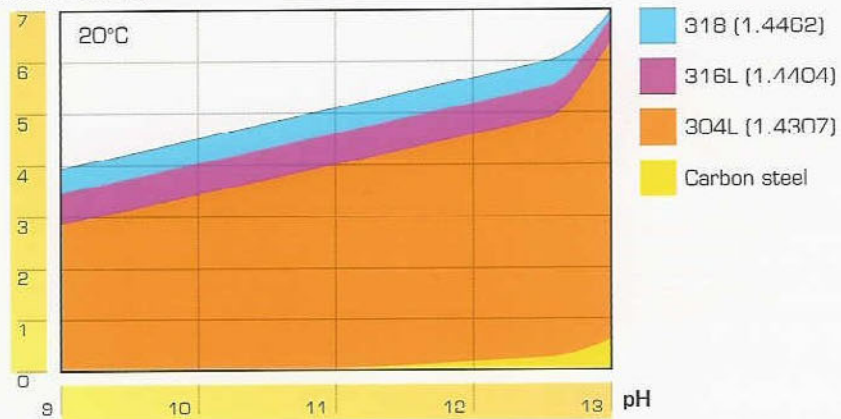


The type of corrosive attack, due to the presence of chlorides, that stainless steel sunk in concrete meets is called PITTING.

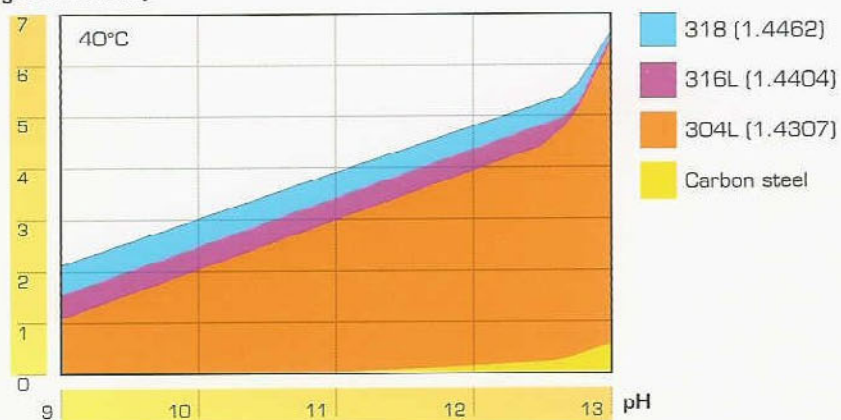
The resistance to pitting depends upon the composition of stainless steel; the higher the value of PRE (Pitting Equivalent Resistance) the more resistant is the steel to chloride attack.

$$PRE = \%Cr + 3.3\% Mo + (16 \div 30)\%N$$

Chloride content
(% by weight of cement)



Chloride content
(% by weight of cement)

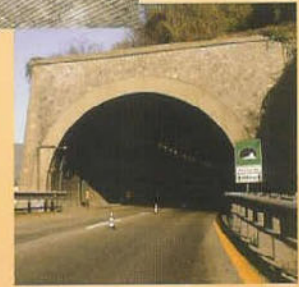
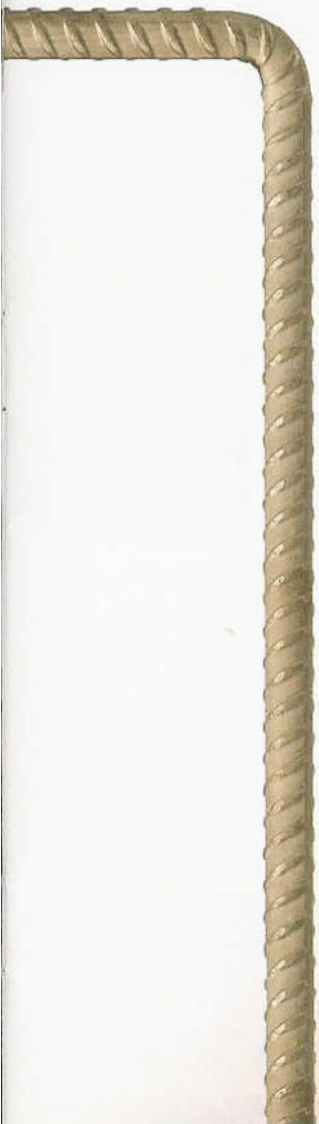
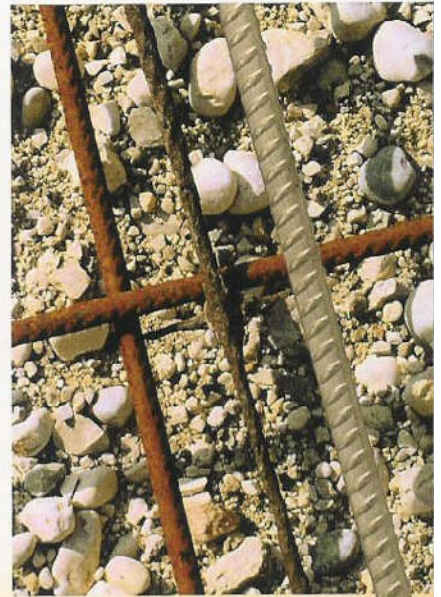


Schematic representation of fields of applicability of stainless steel bars in both alkaline (i.e. with pH around 13) and carbonated (i.e. with pH around 9) chloride contaminated concrete, at 20°C and 40°C.

The threshold levels are indicative only. They can decrease if the oxides produced by welding are not removed, or the potential due to anodic polarization increases (e.g. by stray current), or the concrete is heavily cracked. Conversely, they can increase when there is a lack of oxygen or cathodic polarisation.

... RESISTANT TO STRAY CURRENTS

Stainless steel performs best in chloride contaminated or carbonated concrete structures which are affected by stray currents, because it maintains its passivity. REVAL® in reinforced concrete is highly recommended where there are possible stray currents, such as in train tunnels and underground, especially when running close to marine environment.



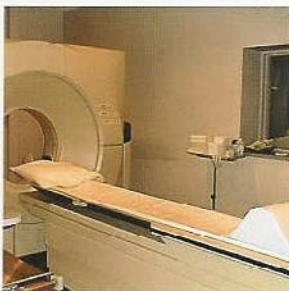
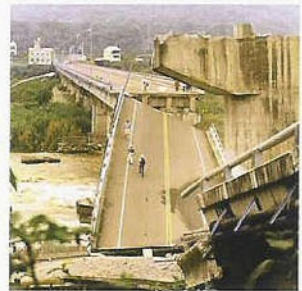
REVAL

5

SEISMIC PROPERTIES

REVAL® = HIGH DUCTILITY AND TOUGHNESS SUPERIOR TO BLACK STEEL

REVAL® 304L and 316L, due to their high content of nickel, a mineral of great toughness, are the most suitable steels for reinforcing structures operating in seismic areas.



MAGNETIC PROPERTIES

REVAL® is a paramagnetic steel, due to its low magnetic permeability.

It is used successfully in structures where disturbing strong magnetic fields have to be avoided, such as in airports, military bases, broadcasting stations, banks, meteorological stations, hospitals etc.

Brunico Hospital - Italy



STABILITY AT LOW

TEMPERATURES

REVAL®'s austenitic structure remains stable up to temperatures of -196°C suggesting its use in the coldest environments .

Several countries have already made compulsory the use of stainless steel in precast panels.



BEHAVIOUR IN PRESENCE OF FIRE

RFVAL[®], being an austenitic steel shows an excellent resistance to high temperature.

Its characteristics are:

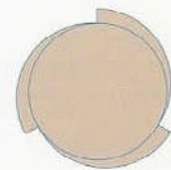
- Low thermal conductivity
- A thermal linear expansion coefficient which remains stable despite temperature variation, unlike black steel
- Permanent maintenance within safety limits of all its properties at critical temperatures (with 55% of residual O.2% P.S. at 500°C)



JOINING STAINLESS STEEL TO BLACK STEEL

REVAL[®] can be easily and safely joined, by lapping or coupling, to black steel.

Extended laboratory research has proved that corrosion is contained when stainless steel is electrically connected to black steel.



REVAL[®] 7

“the use of REVAL[®] guarantees the safety of concrete structures”

REVAL[®]: = NO REPAIR

REVAL[®] = LOW LIFE CYCLE COST

Thanks to the complete absence of maintenance costs, the initial cost of REVAL[®], is largely recovered.

Also traffic disruption, so familiar and unpopular to the general public in case of frequent repairs, is removed.

From the point of view of costs, a greater cost reduction in construction can be obtained considering the following economic motivations, when suitable to the design:

- Fewer tons used (up to 10% of the reinforcement's weight) = lighter structures
- Smaller concrete cover thickness
- No concrete inhibitors against corrosion
- Higher stainless steel scrap value than the scrap iron (up to 5 times higher)

STAINLESS STEEL REINFORCING



Installation costs

Stainless steel cost

OTHER REINFORCINGS



Monitoring costs

Service break costs

Repair costs

Demolition costs

Permission costs

Maintenance project costs

Inspection costs

Installation costs

Epoxy coated or galvanized steel cost

Black steel cost



REVAL® = HIGH QUALITY

REVAL® = DURABILITY

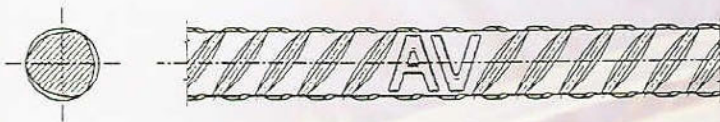
The quality of REVAL® is guaranteed by a manufacturing process approved by Lloyd's Register Quality Assurance (ISO 9001:2000).

It is carried out completely in house, from melting to distributing, assuring full traceability at each stage of production.

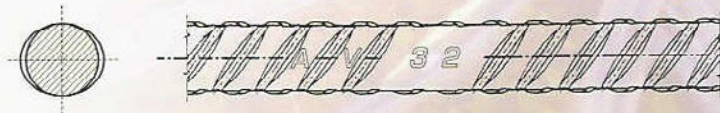


REVAL® bar and coil are identified by the logo AV stamped on the bars as follows:

REVAL®



REVAL®



The logo AV is followed by the dia.
(In this case dia. 32 mm)



MAJOR PROJECTS USING REVAL®

Guildhall London - England



Highway 87/88 Tammaro - Italy



Shenzhen Western Corridor
Hong Kong



The project

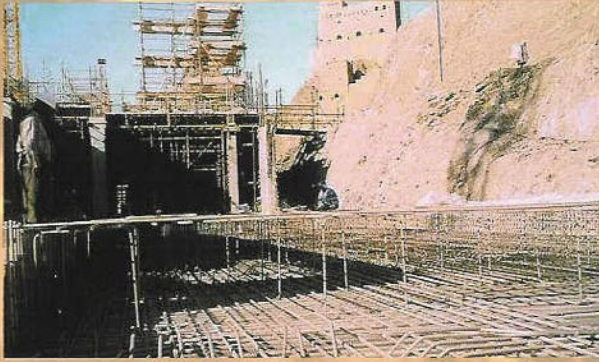




Muscat - Oman



Driscoll Bridge on the Garden State Parkway
Woodbridge - NJ - USA

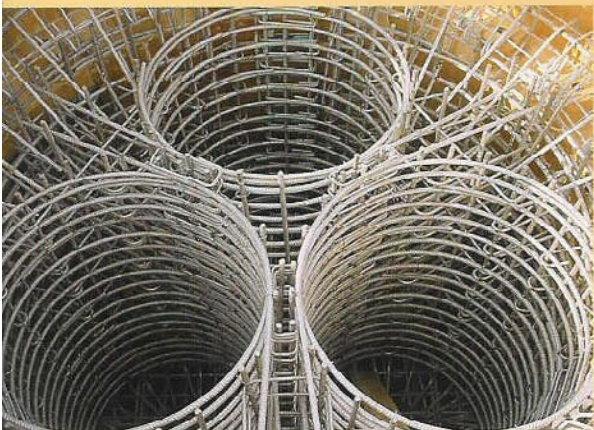


Viaduct SIEVE
Firenze
Italy



Barton Bridge
North Yorkshire
England

Nuclear Waste - France



REVAL

11

REVAL® makes your structures safer

MAJOR PROJECTS USING REVAL®



Trapani Harbour - Italy



Swimming Pool
San Francisco - California - USA





Napoli Harbour
Graving Dock
Italy



Highway 401
Hogg's Hollow Bridge
Canada

Bridge in the Czech Republic



STAINLESS STEEL

Stainless steel is the name given to a group of corrosion resistant steel alloys. The families are distinguished by their microstructure, and their properties:

• AUSTENITIC • FERRITIC • MARTENSITIC • DUPLEX STAINLESS STEEL

Corrosion resistance is enhanced by decreasing the carbon content, and increasing the nitrogen, chromium, nickel and molybdenum contents.

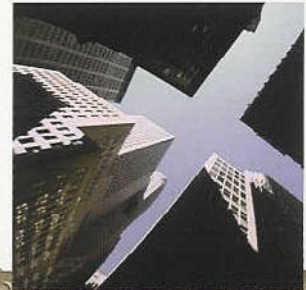
Only austenitic and duplex stainless steel are recommended as reinforcement to concrete because of their high corrosion resistance.

CHEMICAL COMPOSITION

STEEL TYPES	C max	Si max	Mn max	S max	Cr	Ni	Mo	P max	N	Cu
304L (1.4307)	0.03	1.0	2.0	0.03	17.5/19.5	8.0/10.0	-	0.045	≤ 0.11	-
316L (1.4404)	0.03	1.0	2.0	0.03	16.5/18.5	10.0/13.0	2.0/2.5	0.045	≤ 0.11	-
(1.4436)	0.05	1.0	2.0	0.015	16.5/18.5	10.5/13.0	2.5/3.0	0.045	≤ 0.11	-
316LN (1.4429)	0.03	1.0	2.0	0.015	16.5/18.5	11.0/14.0	2.5/3.0	0.045	0.12/0.22	-
318-duplex (1.4462)	0.03	1.0	2.0	0.015	21.0/23.0	4.5/6.5	2.5/3.5	0.035	0.10/0.22	-
- (1.4501)	0.03	1.0	1.0	0.015	24.0/26.0	6.0/8.0	3.0/4.0	0.035	0.20/0.30	-
- (1.4529)	0.02	0.50	1.0	0.010	19.0/21.0	24.0/26.0	6.0/7.0	0.030	0.15/0.25	-
Alloy 4362	0.030	1.0	2.0	0.015	22.0/24.0	3.50/5.50	0.10/0.60	0.035	0.05/0.20	0.10/0.60
Alloy 2101	0.040	1.0	4.0/6.0	0.030	21.0/22.0	1.35/1.70	0.10/0.80	0.040	0.20/0.25	0.10/0.80

STEEL TYPES

AUSTENITIC		DUPLEX	SUPERAUSTENITIC
REVAL 30	REVAL 31	REVAL 32	
304L	316L	318	241MOD
304LN	316LN	318S13	
321	316Ti	1.4462	
304S31	316S33	1.4501	
1.4307	1.4404	S31803	
1.4301	1.4436	Alloy 4362	
S30403	1.4429	Alloy 2101	
S30453	1.4529		
	S31603		
	S31653		



REVAL®

MEET THE FOLLOWING INTERNATIONAL STANDARDS

ASTM A 955M

TENSILE REQUIREMENTS	Grade 420 min	Grade 520 min
Tensile strength, (MPa)	620	690
Yield strength, (MPa)	420	520
Elongation in 200 mm. (%)	9	7

UNE 36-067

TENSILE REQUIREMENTS				
Grade	R _{p 0.2} (MPa) min	R _m (MPa) min	A (%) min	R _m /R _{p 0.2} min
B 500 T INOX	500	600	18	1.10
B 600 T INOX	600	700	18	1.10

DIN 488

TENSILE REQUIREMENTS		
Abbreviation	BSt 500 S	BSt 500 M
Symbol	IV S min	IV M min
0.2% proof stress R _{p 0.2} (N/mm ²)	500	500
Tensile strength R _m (N/mm ²)	550	550
Elongation after fracture A ₁₀ (%)	10	8

AFNOR A 35-016

TENSILE REQUIREMENTS			
Grade	Yield strength ReH min	Ratio R _m /ReH min	Total elongation at maximum force, A _{gt} min
FeE500-2	500	1.08	2.5
FeE500-3	500	1.08	5.0

BS 6744

TENSILE PROPERTIES				
Grade	0.2% proof strength R _{p 0.2} (MPa) min	Stress ratio R _m /R _{p 0.2} min	Elongation at fracture A ₅ (%) min	Total elongation at maximum force, A _{gt} (%) min
500	500	1.10	14	5
650	650	1.10	14	5

D.M. 14 SEPTEMBER 2005

TENSILE REQUIREMENTS	
Grade	B450C
Characteristic yield strength f _{yk} (N/mm ²)	≥ 450
Characteristic tensile strength f _{tk} (N/mm ²)	≥ 540
{f _t /f _y } _k	1.13 - 1.35
{f _y /f _{nom} } _k	≤ 1.25
Elongation (A _{gt}) _k	> 7%



REVAL® 15

REVAL[®]

COIL WEIGHT - BAR LENGTH

Coil	From 3 to 20 mm dia.	700 Kg - 1500 Kg
Bar	From 3 to 50 mm dia.	12 meters max

NOMINAL CROSS-SECTIONAL AREA AND NOMINAL MASS PER METRE RUN

NOMINAL SIZE	NOMINAL CROSS-SECTIONAL AREA	NOMINAL MASS PER METRE RUN		
		STEEL DESIGNATION		
mm	mm ²	304L (1.4307)	316L (1.4404)	318 - duplex
			316LN (1.4429)	(1.4462)
		Kg	Kg	Kg
3	7.1	0.056	0.057	0.055
4	12.6	0.100	0.101	0.098
5	19.6	0.155	0.157	0.153
6	28.3	0.224	0.226	0.221
7	38.5	0.304	0.308	0.300
8	50.3	0.397	0.402	0.392
10	78.5	0.620	0.628	0.612
12	113.1	0.893	0.905	0.882
14	153.9	1.216	1.231	1.200
16	201.1	1.589	1.609	1.569
20	314.2	2.482	2.514	2.451
25	490.9	3.878	3.927	3.829
30	706.9	5.585	5.655	5.513
32	804.2	6.353	6.434	6.273
35	962.1	7.601	7.697	7.504
40	1256.6	9.927	10.053	9.802
50	1963.5	15.512	15.708	15.315

TOLERANCES ON MASS PER METRE RUN

NOMINAL SIZE	TOLERANCES ON MASS PER METRE RUN
mm	%
3 to 6	+/- 9.0
7 to 12	+/- 6.0
over 12	+/- 4.5



REVAL®



REVAL® REINFORCEMENT COUPLERS

Valbruna can supply metric threaded couplers for REVAL® reinforcement for bar diameters 12 mm to 40 mm.

The couplers are manufactured from either grade 316 or Duplex.

REVAL® BAR DIA (mm)	THREAD SIZE AND PITCH (mm)	THREAD LENGTH (mm)	COUPLERS SIZES			
			DIA (mm)	LENGTH (mm)	THICKNESS (mm)	WEIGHT (kg)
12	M12 x 1.75	15	19	29	3.5	0.04
16	M16 x 2	19	25	37	4.5	0.08
20	M20 x 2.5	23	29	45	4.5	0.12
25	M24 x 3	27	35	53	5.5	0.21
32	M30 x 3.5	33	43	65	6.5	0.38
40	M36 x 4	39	52	77	8.0	0.67

REVAL 17

our products change with you...

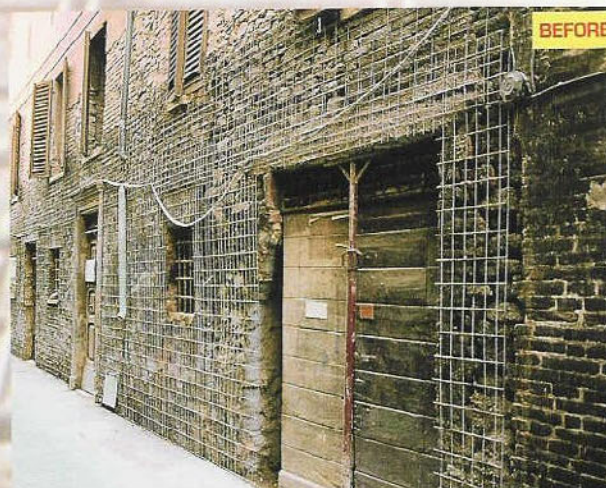
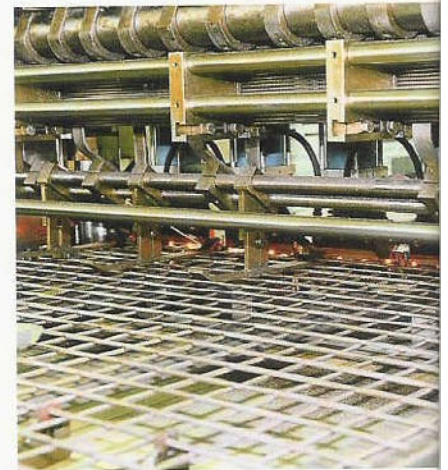
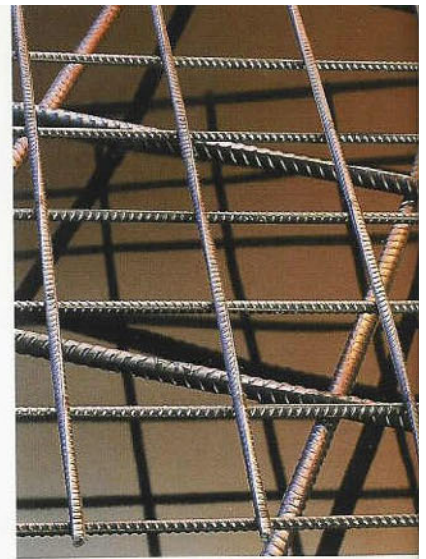
REVAL® ...WIRE MESH AND TYING WIRE



STAINLESS STEEL MESH PANELS

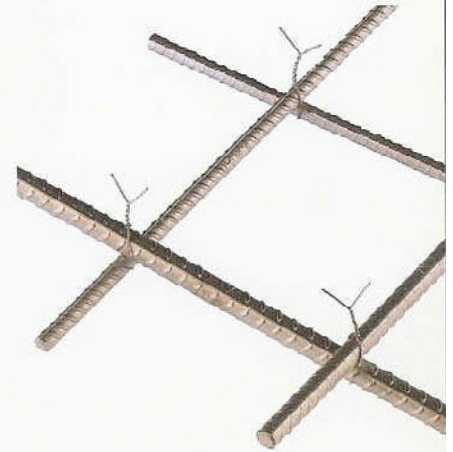
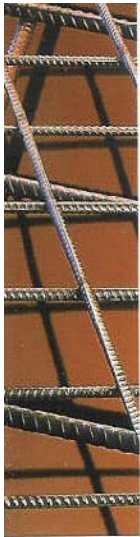
Valbruna manufactures stainless steel mesh that are typically used where the concrete cover to the steel is minimal, or where chloride concentrations are considered to be a threat to the overall structural durability.

They also find their use in aesthetic situations where rust spots on the concrete surface are not acceptable. Stainless Steel mesh with REVAL® is used in roads, bridges, tunnels, viaducts and aqueducts.



BEFORE AFTER





STAINLESS STEEL TYING WIRE

In general it is a sensible practice to always use stainless steel tying wire with stainless steel reinforcing bar, this to ensure that if the tying wire encroaches too close to the surface of the concrete cover, the chances of any rust staining are eliminated.

For building and housing, our tying wire is manufactured in AISI 304, 304L, 316 and 316L. It is supplied soft annealed.

DIA mm	TOL
1 ÷ 1.60	h9

STAINLESS STEEL TYING WIRE

MARCA	AISI	W.N.	BS	UTS N/mm ²
AISR	304L	1.4307	304S11	680 max
APMR	316L	1.4404	316S11	680 max

STANDARD PACKAGING

Bundles from 25 to 30 kg



Drum of 75 lt
dia 500 mm
height 395 mm



Drum of 235 lt
dia 570 mm
height 920 mm



REVAL 19

“our products change with you...”

Deutsches Institut für Bautechnik
Anstalt des öffentlichen Rechts

DIBT

Acciaierie Valbruna s.r.l.
Viale della Scienza, 25
36100 Vicenza
ITALIEN

Eine von Bund und Ländern
gemeinsam getragene Einrichtung
Mitglied der Europäischen Kommission
für Technische Zulassungen EOTA

Telefon 030 78730-0
Telefax 030 78730-320
E-Mail: dtg@diat.de
Internet: www.dibt.de

Übersetzungen (siehe unten angeben)
117-114-5397
Z-14-118

Durchgeber
Herr Riedinger

Telefon 030 78730-342
Fax 030 78730-11-342
E-Mail: help@diat.de

16. Mai 2002

Allgemeine bau
Zulassungsge

Ihr Antrag vom

Sehr geehrte D

Ihrem Antrag

Zulassung. Ein

Wir weisen da

meinen bauzei

ten Voraussetz

ungen Besond

ersächlich e

baufähigkei

ten Gegensta

nd sind, sin

Landesbauord

geregelte Ba

Sonderheft Nr.

Ein Antrag auf

Ihrem eigenen

Einem solchen

Zusammenfas

sungen bei der

erfassten Bau

Das Zeichen enthält die

Prüfungsnummer 301

10029 Berlin

030 78730-0

UNIVERSITÀ DEGLI STUDI DI PADOVA
DIPARTIMENTO DI COSTRUZIONI E TRASPORTI
35131 PADOVA (ITALY) - VIA MARZOLEG, 9
SEGRETARIA TEL. (049) 8275607

RAPPORTO DI PROVA N. 18664
Richiedente: ACCIAIERIE VALBRUNA s.p.a. Viale della Scienza n.25
Data della domanda di prova: 13/12/1996 e integrazione del 18/12
Materiale dichiarato dal Produttore: ACCIAIO INOX PER C.A. L
BARRI AD ADERENZA MIGLIORATA TIPO FEB 44 R SALDABILE NEI DIAMET
40 mm.

DATA PRELIEVO	DIAMETRO (mm)	COLATA	IN CA
10/06/2002	14	234588	
10/06/2002	16	234779	
10/06/2002	18	234727	

PROVE DI VERIFICA DELLA QUALITÀ

(Al sensi del Decreto Ministeriale 02/70)

su prodotti in acciaio inox p
migliorata nei diametri da 14
identificativa riportata in alleg

Deposito della documentazione di
della Presidenza del Consiglio S
protocollo n. 48242 del 21/09/200

Per tutti serie di diametri si ric
della Circolare Ministeriale n. 4

Prelievo eseguito nel mese di
dipartimento all'isopo incaricat
Acciaierie Valbruna s.p.a. sito i

I risultati delle analisi metal
certificazioni rilasciate dal
dell'Università di Padova.

UK Certification Authority for Reinforcing Steels

Certificate of Approval

Product Conformity Certification

This is to certify that
Acciaierie Valbruna S.p.A.
at its establishment at
Vicenza

has satisfied the Authority that it operates a Quality System that complies with the requirements of BS EN ISO 9001:2000 and the relevant CARES Quality and Operations Assessment Schedules. Where appropriate, and as listed below, it has further satisfied the Authority that it manufactures and/or supplies products that conform with the stated product standards and is entitled to use the CARES marks on its products.

**Production of BS 6744 Grade 200 and 500 Bar
Grade 200, 500 and 650 Coil
Hot Rolled Plain and Ribbed Bar 14 - 50mm
(1.4301, 1.4436, 1.4429 and 1.4462)
Cold Drawn Plain and Ribbed Coil 6 - 12mm
(1.4301, 1.4436, 1.4429 and 1.4462)**

using the processes and procedures registered with the Authority.
This Certificate is the property of the Authority and is issued subject to the Regulations of the Authority.

The Certificate Number is: **036802**

Issue Date: **20-May-2005** Expiry Date: **31-December-2005**

Signed on behalf of the Board of Management

[Signature]
Executive Director

USE OF THE MANAGEMENT MARK indicates accreditation in respect of
these activities covered by the accreditation certificate number 001.
Issue January 2003



Ministry of
Transportation

Ministère des
Transports

Ontario

Materials Engineering and Research Office
Concrete Section
Room 235, Building "C"
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Tel: (416) 235-3705
Fax: (416) 235-5338

File: 9.85.78

Published in
Register No. 101



Cert. No.: F701/98

**DET NORSKE VERITAS
APPROVAL OF MANUFACTURER
CERTIFICATE**

This is to certify that

NA S.p.A.,
Y
er for
S
QUIPMENT
IFICATION PT-2 CH 2
rtias' Rules for Classification and the
ow alloy steels
citic stainless steels

[Signature]
P. Lohne

licable to:

eel, stainless steel,
ets, voires, wirerods,
nforcing bars and
on.
quirements of Amex
(PED) 97/23/EC.

10th August 1993

22nd July 2005

10th August 2008

[Signature]
Quality Assurance Italy Srl

CECISA Genova 256247
Email: cc-cert@cecisa.com
and monitored by DGT
Institution Certificate Number 001

7 87 87 89 00, TELEFAX: +47 87 87 89 11

Page 1 of 1