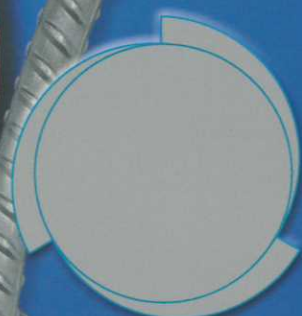
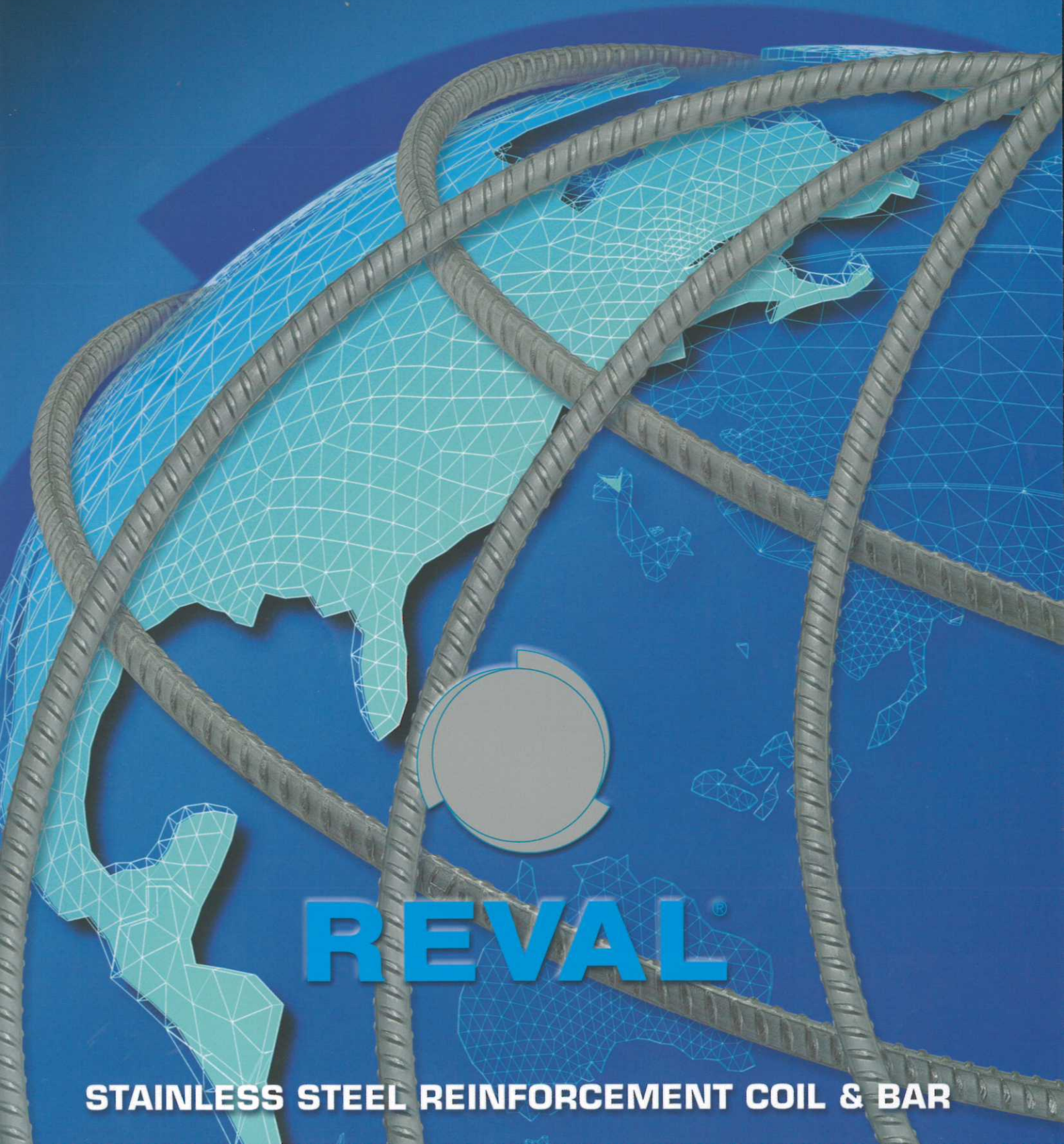


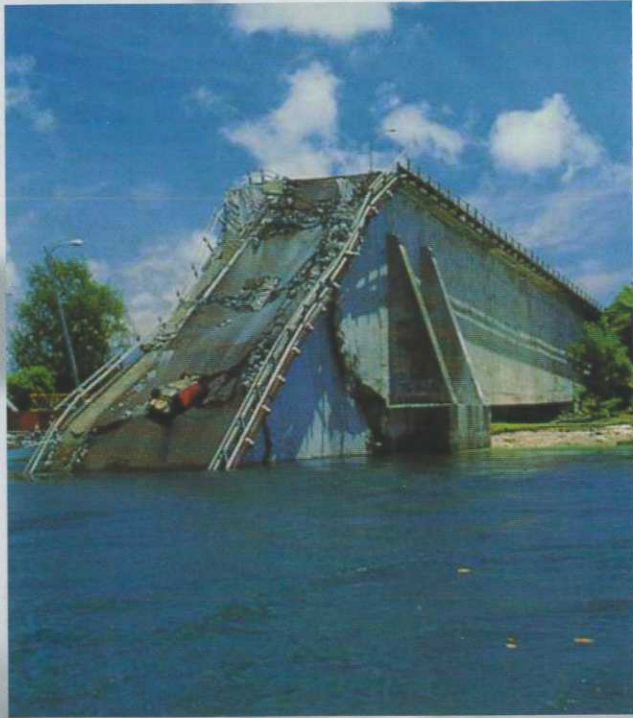


ACCIAIERIE  
**Valbruna**



**REVAL<sup>®</sup>**

**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
- Higher 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
- Better 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® ...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.

## AGGRESSIVE ENVIRONMENT

ENVIRONMENT	CAUSE OF CORROSION	STEEL SUGGESTED
Mildly aggressive	Low chloride content	304L/1.4162
Aggressive	High chloride content	316L/1.4362
Very aggressive	Carbonation and chloride penetration, high temperature and/or temperature fluctuations	316L/1.4462



Aleghero's Bridge - Italy

REVAL

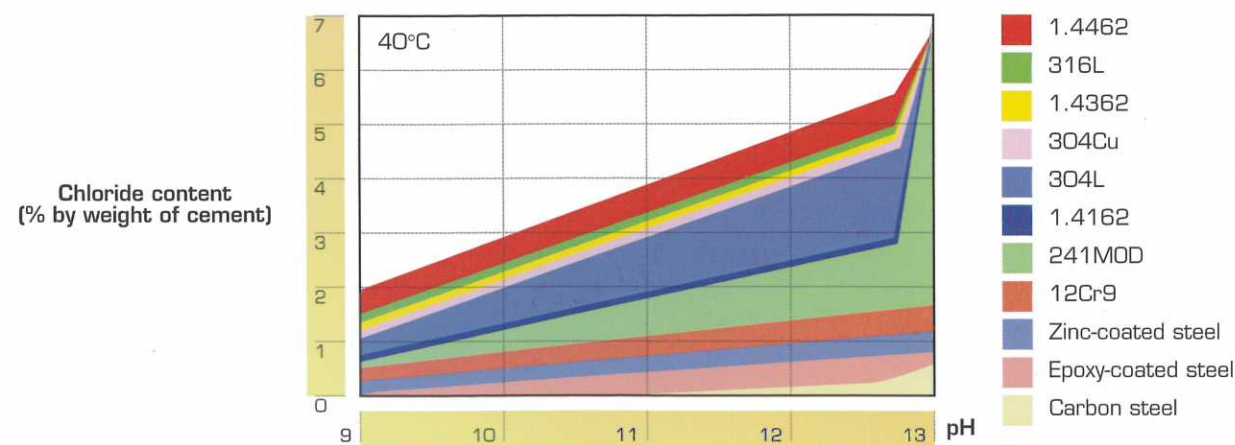
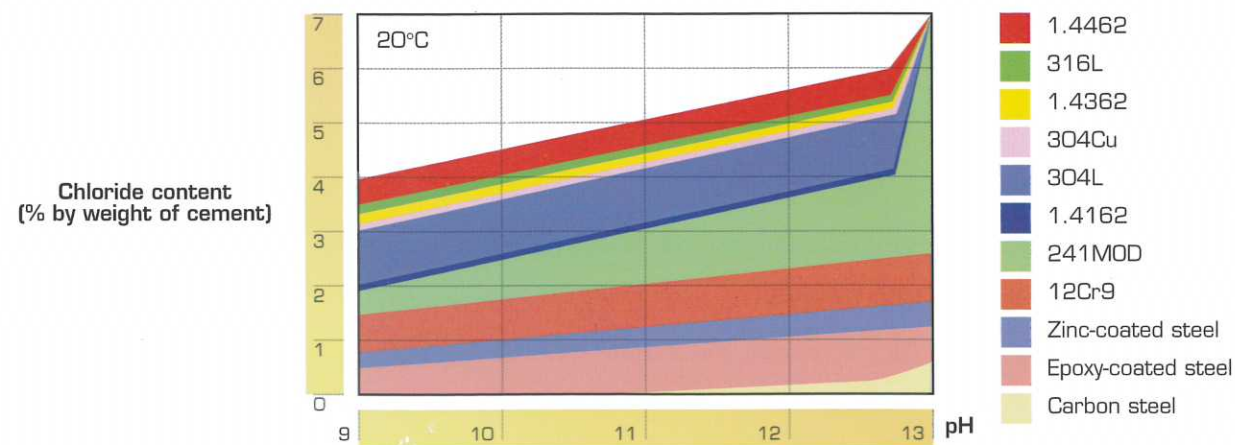
3

"REVAL® offers 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 PRE (Pitting Equivalent Resistance) shows the more resistant steel to chloride attack.



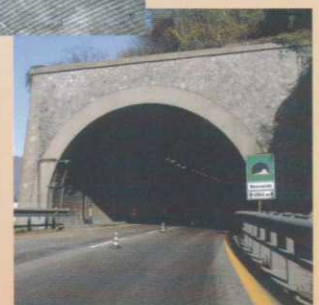
Schematic representation of fields of applicability of stainless steel bars in both alkaline (i.e. with pH around 13) and carbonated (i.e. with pH around 9) chloride contaminated concrete, at 20°C and 40°C. The threshold levels are indicative only.

# ... 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, underground and steelworks.



Extension Melting Shop, Qatar

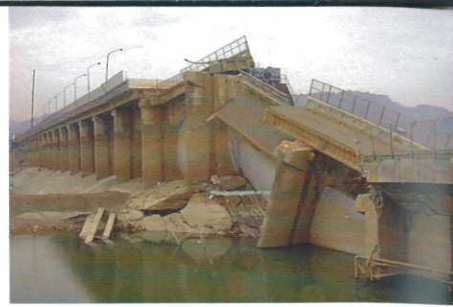


REVAL

## 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.

**BIO-BUILDING:**  
Al Sole Building, GR - Italy



## STABILITY AT LOW TEMPERATURES

REVAL®'s austenitic structure remains stable up to temperatures of  $-196^{\circ}\text{C}$  suggesting its use in the coldest environments.

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

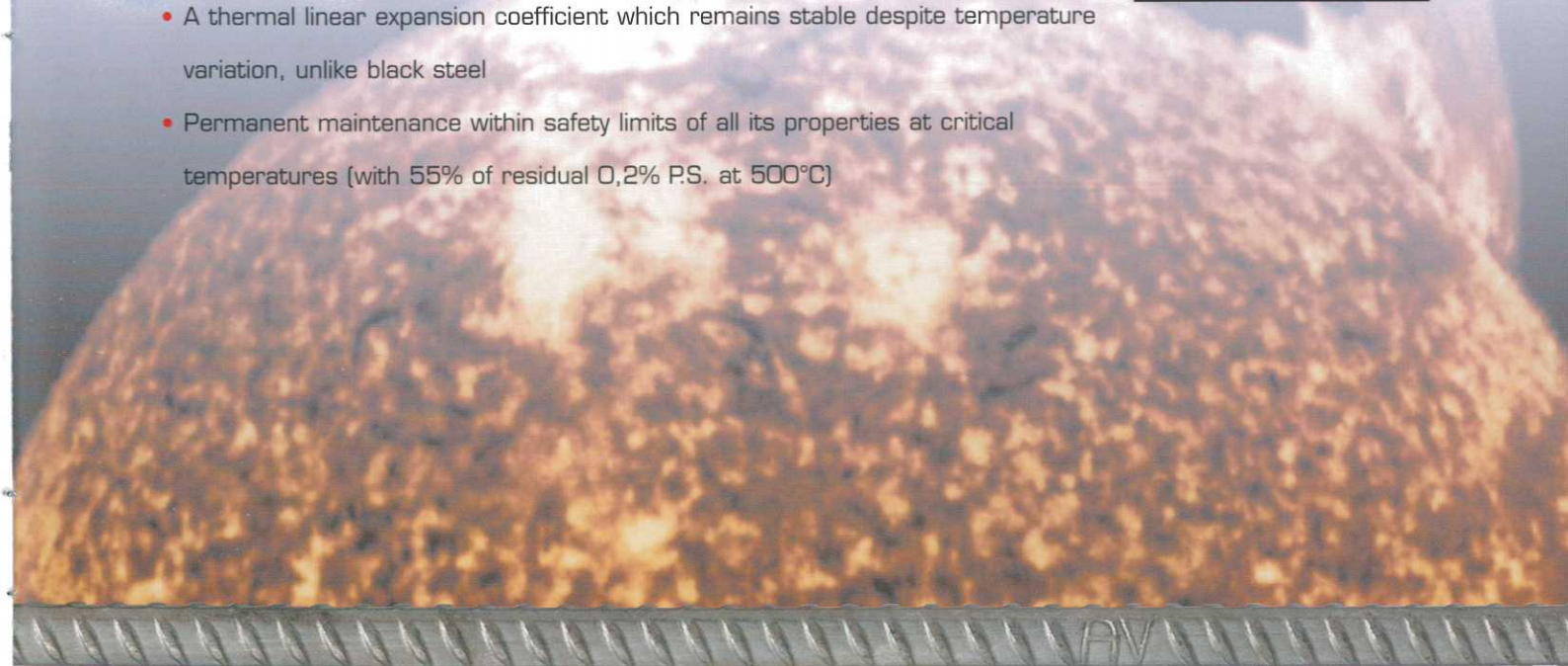


## BEHAVIOUR IN PRESENCE OF FIRE

REVAL®, being an austenitic steel shows an excellent resistance to high temperature.

Its characteristics are:

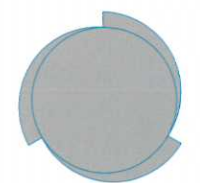
- Low thermal conductivity
- A thermal linear expansion coefficient which remains stable despite temperature variation, unlike black steel
- Permanent maintenance within safety limits of all its properties at critical temperatures (with 55% of residual O, 2% P.S. at  $500^{\circ}\text{C}$ )



## 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 sometimes unpopular to the general public in case of frequent repairs, is removed.

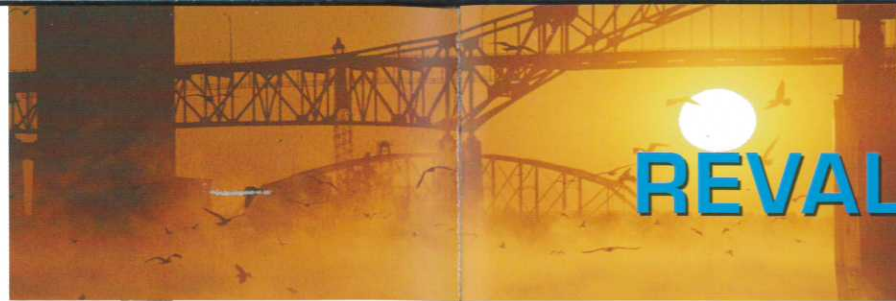
From the point of view of costs, a greater cost reduction in construction can be obtained considering the following economic motivations, when suitable to the design:

- 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



## OTHER REINFORCINGS

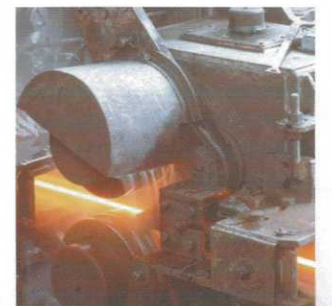


# REVAL® = HIGH QUALITY

## REVAL® = DURABILITY

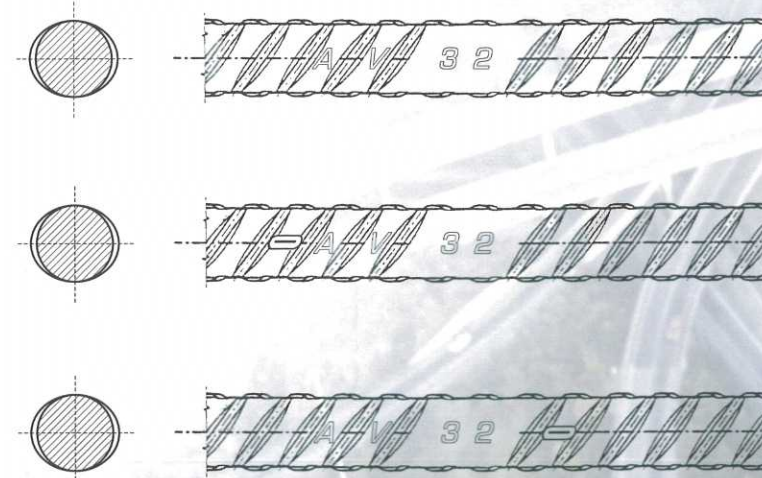
The quality of REVAL® is guaranteed by a manufacturing process approved by Lloyd's Register Quality Assurance ISO 9001:2008 and AS9100 Revision B (Aerospace Standard).

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®



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



REVAL

9

8

# MAJOR PROJECTS USING

# REVAL®

Villastellone Viaduct - Italy



Shenzhen Western Corridor  
Hong Kong



Highway 87/88 Tammaro - Italy



The project



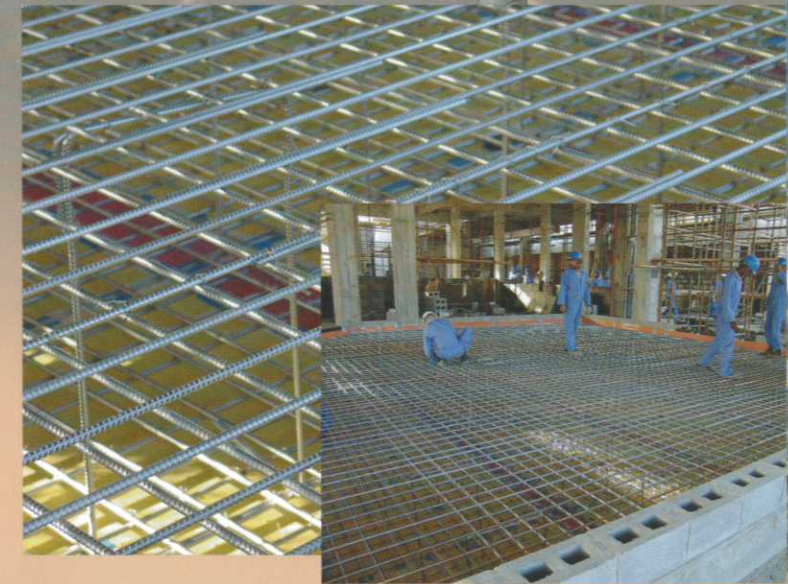
New Guest Complex  
Muscat - Oman



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



Rail Viaduct  
Venezia-Padova,  
Italy



Royal Hospital  
Muscat - Oman

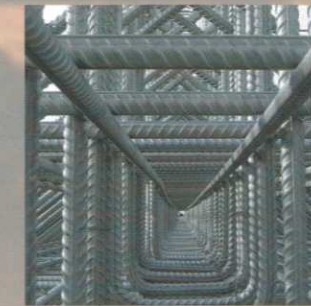
Nuclear Waste - France



# MAJOR PROJECTS USING REVAL®



The Pearl, Doha - Qatar



Trapani Harbour - Italy

Mose, Venezia - Italy



Blackpool sea wall defence UK

Business Bay - Creek Extension  
Dubai - U.A.E.





# 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	Si	Mn	S	Cr	Ni	Mo	P	N	Cu	Others
	max	max	max	max				max			
XM-28 - S24100	0.15	1.0	11.0/14.0	0.030	16.5/19.0	0.5/2.5	-	0.060	0.20/0.45	-	-
304/304L/304LN 1.4301/1.4307	0.03	1.0	2.0	0.030	18.0/19.5	8.0/10.0	-	0.045	≤0.22	-	-
316/316L - 1.4404	0.03	1.0	2.0	0.030	16.5/18.5	10.0/13.0	2.0/2.5	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	-	-
316LN - 1.4436	0.05	1.0	2.0	0.015	16.5/18.5	10.5/13.0	2.5/3.0	0.045	≤0.22	-	-
1.4571	0.08	1.0	2.0	0.030	16.5/18.5	10.5/13.5	2.0/2.5	0.045	-	-	Ti: 5 X C to 0.70
321 - 1.4541	0.08	1.0	2.0	0.030	17.0/19.0	9.0/12.0	-	0.045	-	-	Ti: 5 X C to 0.70
1.4162	0.04	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	-
1.4362	0.03	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	-
318 - 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	-	-
1.4529	0.02	0.5	1.0	0.010	19.0/21.0	24.0/26.0	6.0/7.0	0.030	0.15/0.25	-	-

## STEEL TYPES

AUSTENITIC		DUPLEX	SUPERAUSTENITIC
XM-28	316/316L	1.4162	1.4529
S24100	S31600	*LDX2101®	
S30400	S31603	1.4362	
1.4301	1.4404	318	
304/304L	316S33	S31803	
S30403	316LN	1.4462	
1.4307	1.4429	318S13	
304S31	1.4436		
304LN	S31653		
S30453	1.4571		
321			
1.4541			

\*Outokumpu registered trademark

# REVAL®

MEET THE FOLLOWING INTERNATIONAL STANDARDS

## ASTM A955M

TENSILE REQUIREMENTS	Grade 420 min	Grade 520 min
Tensile strength, (MPa)	620	690
Yield strength, (MPa)	420	520
Elongation in 200 mm, (%)	20	20

## UNE 36-067

TENSILE REQUIREMENTS	Grade	R <sub>p 0.2</sub> (MPa) min	R <sub>m</sub> (MPa) min	A (%) min	R <sub>m</sub> /R <sub>p 0.2</sub> min
B 500 T INOX		500	600	18	1.10
B 600 T INOX		600	700	18	1.10

## DIN 488

TENSILE REQUIREMENTS	BSt 500 S	BSt 500 M
Abbreviation		
Symbol	IV S min	IV M min
0.2% proof stress R <sub>p 0.2</sub> (N/mm <sup>2</sup> )	500	500
Tensile strength R <sub>m</sub> (N/mm <sup>2</sup> )	550	550
Elongation after fracture A <sub>10</sub> (%)	10	8

## AFNOR A 35-016

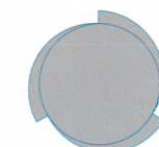
TENSILE REQUIREMENTS	Yield strength ReH min	Ratio R <sub>m</sub> /ReH min	Total elongation at maximum force, Agt min
FeE500-2	500	1.03	2.5
FeE500-3	500	1.08	5.0

## BS 6744

TENSILE PROPERTIES	Grade	0.2% proof strength R <sub>p 0.2</sub> (MPa) min	Stress ratio R <sub>m</sub> /R <sub>p 0.2</sub> min	Elongation at fracture A5 (%) min	Total elongation at maximum force, Agt (%) min
	500	500	1.10	14	5

## D.M. 14 JANUARY 2008

TENSILE REQUIREMENTS	Grade	B450C
Characteristic yield strength f <sub>yk</sub> (N/mm <sup>2</sup> )		≥ 450
Characteristic tensile strength f <sub>tk</sub> (N/mm <sup>2</sup> )		≥ 540
(f <sub>t</sub> /f <sub>y</sub> ) <sub>k</sub>		≥ 1.15 < 1.35
(f <sub>y</sub> /f <sub>ynom</sub> ) <sub>k</sub>		≤ 1.25
Elongation (Agt) <sub>k</sub> %		≥ 7.5





## 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 mm	NOMINAL CROSS-SECTIONAL AREA mm <sup>2</sup>	NOMINAL MASS PER METRE RUN STEEL DESIGNATION		
		304L/304LN Kg	316L/316LN Kg	318 - duplex 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 mm	TOLERANCES ON MASS PER METRE RUN %
3 to 8	+/- 6.0
over 8	+/- 4.5



## 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

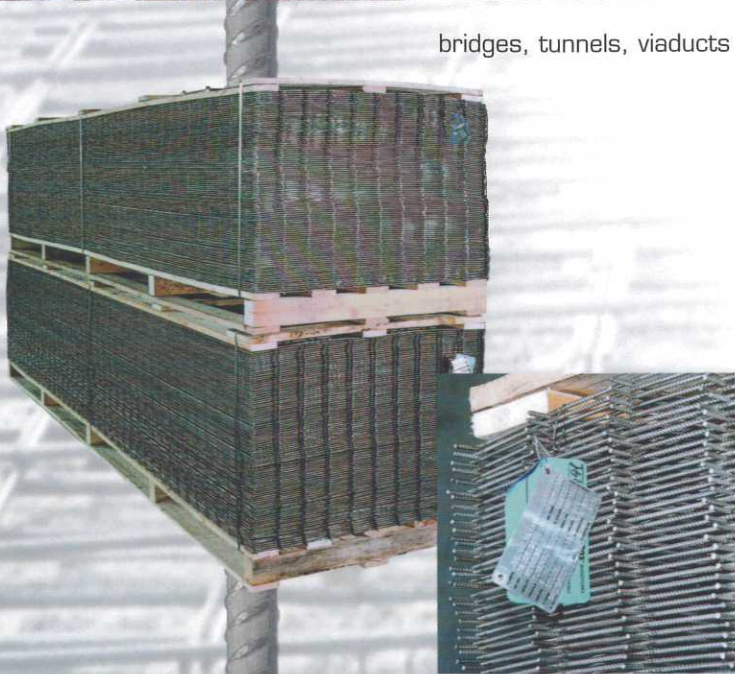
# REVAL® ...WIRE MESH AND TYING WIRE



## 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.



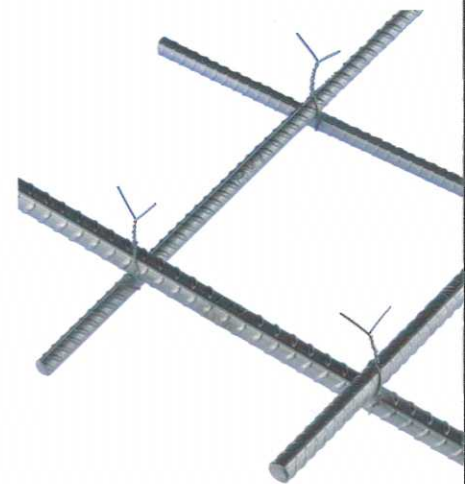
BEFORE AFTER



## 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

GRADE	AISI	W.N.	BS	UTS N/mm <sup>2</sup>
AISR	304/304L	1.4301/1.4307	304S11	680 max
APMR	316/316L	1.4401/1.4404	316S11	680 max

## STANDARD PACKAGING

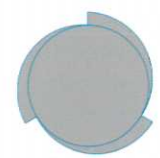
Bundles from 25 to 30 kg



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...”



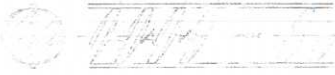
ATTESTATO DI QUALIFICAZIONE

04/10-CA

In conformità al D.M. 14.01.2008 "Norme tecniche per le costruzioni", si attesta che il prodotto da costruzione:

ACCIAIO PER CEMENTO ARMATO LAMINATO A CALDO

B450C, saldabile in rotoli inox laminato a caldo nei diametri da 6 a 16 mm.



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Consiglio Superiore dei Lavori Pubblici - Servizio Tecnico Centrale

ORGANISMO DI CERTIFICAZIONE DELL'ART. 18 DEL D.P.R. 246/93  
ORGANISMO DI RENDICONTI D.P.R. N. 246/93  
ORGANISMO DI RENDICONTI D.P.R. N. 246/93



CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Acciaierie Valbruna S.p.A.  
Via della Scienza, 25 - 36100 Vicenza - Italy  
Via A. Volta, 4 - 39100 Bolzano - Italy

has been approved by Lloyd's Register Quality Assurance to the following Quality Management System Standards:

ISO 9001:2008

The Quality Management System is applicable to:

Manufacture and sales of stainless steel, alloy steel, nickel alloy titanium, carbon steel, in ingots, billets, rolled bars, forged bars, wires, wire rods, threaded bars, stainless steel for concrete reinforcing bars and forgings as per client specification. The Quality Management System supports the requirements of Pressure Equipment

Approval  
Certificate No: LRC 0160080/QMS



issued by

UK Certification Authority for Reinforcing Steels

Certificate of Approval

Technical Approval Certification

This is to certify that  
Acciaierie Valbruna S.p.A.

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 9001:2008 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 bar and coil as follows:  
Grade 200 and 500 Bars  
Hot Rolled Plain and Ribbed Bar 14 - 50mm  
(1.4301, 1.4436 and 1.4462)  
Grade 200, 500 and 650 Coil:  
Cold Drawn Plain and Ribbed Coil 6 - 12mm  
(1.4301, 1.4436 and 1.4462)  
Grade 200 and 500 Coil:  
Hot Rolled Plain and Ribbed Coil 8 - 16mm  
(1.4301, 1.4436 and 1.4429)

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: 030802

Issue Date: 01-January-2010

Expiry Date: 31-December-2010

Signed on behalf of the Board of Management

Signature

Executive Director

The use of the Accreditation Mark indicates accreditation in respect of those activities covered by the accreditation certificate number 002.

UK Certification Authority for Reinforcing Steels  
Pembroke House, 21 Pembroke Road, Sevenoaks, Kent, TN13 1XR, UK. www.ukcares.com

Con. Ref: AHC12010 393 186



ATTESTATO DI QUALIFICAZIONE

041/08-CA

In conformità al D.M. 14.01.2008 "Norme tecniche per le costruzioni", si attesta che il prodotto da costruzione:

ACCIAIO PER CEMENTO ARMATO LAMINATO A CALDO

Acciaio inossidabile con caratteristiche meccaniche del B450C, impiegabile anche come FeB44k, saldabile, in barre, con struttura austenitica o austeno-ferritica, nei diametri da 6 a 32 mm

Marchio di laminazione

Consiglio Superiore dei Lavori Pubblici - Servizio Tecnico Centrale



CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Acciaierie Valbruna S.p.A.  
Via della Scienza, 25 - 36100 Vicenza - Italy  
Via A. Volta, 4 - 39100 Bolzano - Italy

has been approved by Lloyd's Register Quality Assurance Limited, Coventry, UK, to the following Quality Management System Standards:

ISO 9001:2008  
AS9100 Revision B

in accordance with the requirements

of the standards applicable to:

Manufacture of alloy steel, nickel alloy and rolled bars, forged bars, stainless steel, client specification.

Approval Date: 10<sup>th</sup> August 1993

Approval Date: 3<sup>rd</sup> March 2009

Approval Date: 3<sup>rd</sup> March 2009

Approval Date: 3<sup>rd</sup> March 2009

UK Certification Authority for Reinforcing Steels

Certificate of Approval  
Technical Approval Certification

in accordance with the requirements of

BS EN ISO 9001:2008 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.

Expiry Date: 31-December-2010



Expiry Date: 31-December-2010



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UK Certification Authority for Reinforcing Steels  
Pembroke House, 21 Pembroke Road, Sevenoaks, Kent, TN13 1XR, UK. www.ukcares.com