BONNA SABLA

The steel cylinder concrete pipe

bonna

Tuyau BONNA®

100 years of performance worldwide

BONNA SABLA

References in the world's largest cities

Black Point power station (Hong Kong)

Marseilles Canal (France)

Windhoek water supply (Namibia)

Ankara and Istanbul water supply (Turkey)

Laibin Thermal power station (China)

Cairo ECPC pipe factory (Egypt)

66 plants set up in 10 countries

An international group,
with over **100 years of experience**

Rio Sosa Water supply (Spain)

- **Water supply systems**
- **Industrial plant pipework**
- **Sea outfalls**
- **Sewage pumping mains**
- **Civil works…**

An experience in **major development projects**

Pipes for Severnaya power station (Azerbaïdjan)

Le Bugey Nuclear Power station (France)

Saint-Alban nuclear power station (France)

Folkestone offshore outfall (UK)

BONNA SABLA's solution

What is the BONNA pipe ?

- A steel core made of rolled steel plates welded lengthwise or helically with welded end-rings.
- A steel reinforcement made by helical winding of a steel wire at a constant pitch.
- A double concrete coating placed:
  - either, by centrifugation inside the steel core and by spraying outside the core,
  - or, by casting the external coating and the lining in one single operation with highly compacted concrete.

T special fitting reinforcement

Vertical casting

Helical welding of the steel core

Centrifugation of the lining

Making of a reinforcement cage

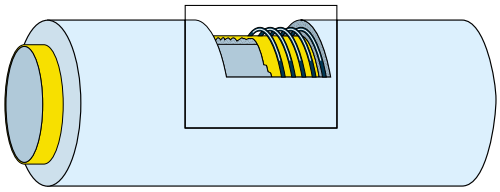
Ring expansion

Dimensional characteristics

Nominal diameter	**(mm)**	250	300	400	500	600	700	800	900	1000	1 100	1 200	1 250	1 400	1 500	1 600
External diameter	**(mm)**	420	420	520	630	730	840	950	1 060	1 164	1 276	1 390	1 470	1 640	1 740	1 880
Effective length*	**(m)**	6.07	6.07	6.15	6.15	6.15	6.15	6.15	6.15	6.15	6.15	6.15	6.15	5.03 6.15	5.03 6.15	5.03
Weight per meter	**(t)**	0.23	0.17	0.22	0.29	0.35	0.43	0.53	0.63	0.71	0.84	0.99	1.20	1.46	1.56	1.95

The characteristics above are those of traditional standard BONNA® pipes.
For further information. please refer to SB 21 and to our technical and commercial offers.
* *Effective length of pipes with SL ends.*

The **steel-concrete** design



The BONNA® concrete pressure pipe design results from the optimum combination of steel and concrete characteristics and performances.

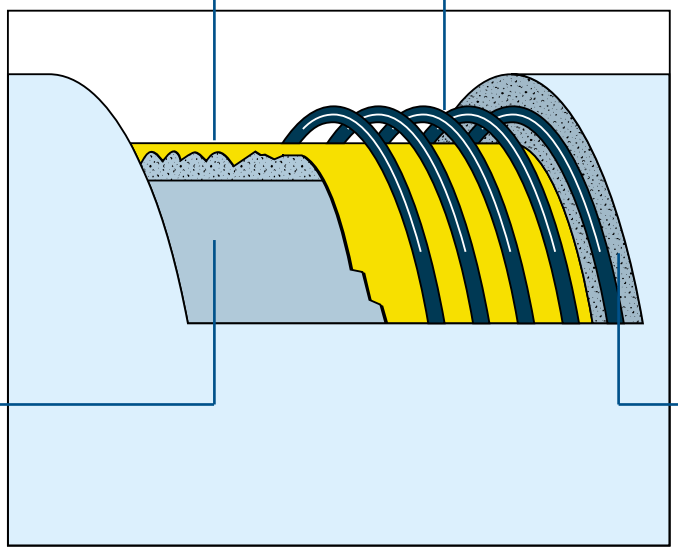
Optimized materials

A welded steel cylinder

Designed to withstand the maximum working pressure including possible water hammer guarantees absolute and immediate watertightness of the pipeline and contributes to the pipeline load resistance.

A very smooth concrete inner surface

With a high cement content giving the pipe an excellent and permanent hydraulic flow coefficient; it protects the steel cylinder from possible corrosion and abrasion phenomena.



Reinforcement

Providing resistance to external loads and internal pressure

An outer reinforced concrete wall

Protecting the steel cylinder from external aggressive agents (soil, underground water table, …) and taking the stresses due to backfill and external dead and live loads.

Dimensional characteristics

Nominal diameter	**(mm)**	1700	1800	2000	2100	2200	2350	2400	2500	2600	2 800	3 000	3 200	3 500	4 000
External diameter	**(mm)**	1980	2100	2320	2440	2560	2730	2800	2 910	3030	3 250	3 480	3 720	4 080	4 640
Effective length*	**(m)**	5,03	5,03 6,15	4,50	4,50	4,50	4,00	5,03	4,00	2,91	3,50	3,60	2,91	2,41	2,05
Weight per meter	**(t)**	2,06	2,34	2,77	3,09	3,43	3,87	4,17	4,44	4,85	5,45	6,23	7,21	8,80	11,07

Specific cases : numerous technical adjustments can be made in order to meet the specific needs of a project (settlement compensators, sismic zones...)

The BONNA® pressure pipe is different because of its composite design that makes it possible to meet the three objectives of a pressure pipeline in a full and homogenous way:

- Resistance to external stresses,
- Resistance to pressure and to vacuum conditions,
- Durability.

Deformation resistance test in 1929

Cavalaire 600 mm dia. offshore outfall (France)

Resistance to external stresses

Deformation Resistance

The reinforced concrete provides the pipeline with the transverse rigidity required for resisting backfill loads and live loads.

Bending strength

If the pipe is used as a span pipeline, the combined effect of concrete and steel provides it with the required longitudinal rigidity.

Longitudinal tensile strength

In case of a pipeline being pulled into place, the steel cylinder tensile strength will be used.

Longitudinal compressive strength

In case of installation by jacking or microtunnelling, the external reinforced concrete compressive strength will be used.

Span pipe - River-crossing in Arcachon (France)

3000 mm dia. Jacking pipe - Madrid (Spain)

Resistance to external stresses

Resistance to impact loading

During and after laying, the pipeline may be submitted to shocks and blows that are likely to damage its coating, and even to destroy its physical integrity. In this case, the best possible protection is secured by the concrete coating.

Lauris water supply (France)

Resistance to pressure

The steel core characteristics are determined so as to resist the maximum working pressure and the factory testing pressure.

The welded joints totally transmit the stresses sustained at changes of direction to the pipeline.

It is thus possible to avoid the use of bulky and costly thrust-blocks at changes of direction.

Le Bugey nuclear power station, dia. 3000 mm (France)

Resistance to vacuum conditions

The pipeline shall withstand full vacuum conditions (water-hammer, empty pipeline, sudden emptying...) thanks to its concrete lining that prevents the buckling of the steel cylinder.

Water intake of a suction pipe (France)

Waste water delivery pipe at Colombes factory (France)
1894 - dia. 1800 mm, pressure : 3.5 bars. This pipeline is still in service.

Durability

The pipeline watertightness and resistance shall last longer than its depreciation time.

The pipeline shall resist all the phenomena likely to impair its initial capacities and to gradually destroy the performances of its components; these phenomena may be the following ones:

- Corrosion of the metallic components,
- Erosion of the concrete walls,
- Damages due to the weather.

Sea-water cooling system for refinery - La Mède (France)

Underwater pipeline, dia. 1600 mm - Geneva (Switzerland)

Properties and **advantages**

Protection against corrosion

The protection of steel by concrete is permanent, does not call for maintenance and causes no pollution (chemical phenomenon of passivation). The balance thus created between concrete and steel is stable and durable.

Protection against abrasion and high hydraulic gradient

Because of its high strength and compactness, BONNA® pipe concrete inner wall does not require any specific protection against abrasion caused by the usual carried fluids.
Besides, the head-losses inside the pipeline remain low as time goes by. Measurements taken in the inlet pipelines of Saut hydroelectric plant in France confirm the characteristic value, K, of 0.0001 m, for the wall roughness. This value that enables one to calculate the headlosses according to Colebrook's formula, is that of the best inner surface quality of the pipes presently produced (reinforced concrete, cast iron, steel,GRP, PVC, etc.).

Weather resistance

Concrete high thermal inertia makes the pipeline less sensitive to the weather conditions. This effect is enhanced by the high compactness of concrete obtained by high frequency vibration, centrifugation...

The BONNA® pipe can therefore be used in any possible environment:

- Buried conditions
- Aboveground conditions
- Submerged conditions (including sea-water)

Buried pipeline
Water supply pipeline, dia. 800-900 mm - Lubéron (France)

Aboveground pipeline
Rhône Poulenc plant, dia. 1000 mm (France)

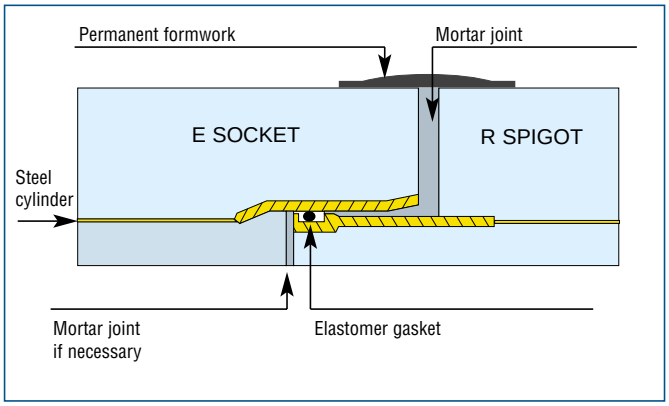
Submerged pipeline
Folkestone, dia. 2100 mm - (United Kingdom)

Internal welding
Marseilles (France)

The various types of joints

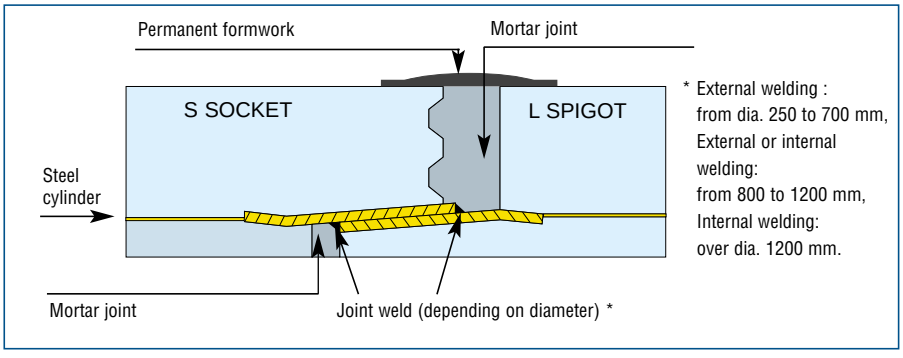
The BONNA® pressure pipe is generally supplied with either one of the two following types of joints to suit any specific conditions.

ER flexible joint



Self-anchored ER joint *(Egypt)*

SL welded joint



Fitting of a flexible sealing gasket:
it replaces the mortar joint providing the pipeline with a greater deflection capacity and protecting the pipe ends from corrosion risks.
Tanjung Jati (Indonesia)

Mortar jointing
Black Point (Hong Kong)

Assembling of two s.c. pipes
Popka (Indonesia)

Inspections and quality

All of our products are subjected to detailed inspection plans that can be consulted on the production site. These plans reproduce the requirements of standards and regulations and can be supplemented by requirements specific to each contract.

Specifications and Quality Assurance

All BONNA® pipes and fittings are designed and manufactured to the European standards EN 639 and 641, and to a Quality Assurance System certified to be in conformity with ISO 9001 version 2000 by an authorized third party.

The inspection plan relates to:

- examining the manufacturing request;
- taking delivery of the raw materials and fittings in compliance with the standards that govern them: sieve analysis;
- inspecting the dimensions of the end joints: diameter, out-of-roundness, etc.;
- inspection of dimensions and of watertightness of the steel cylinders: circonference measurement, squareness, length, weld testing, hydrostatic testing, etc.;
- the inspections of the reinforcements: diameter of the spiral wires and cages, straightness and length of longitudinal wires, visual aspect and quality of welds, etc.;
- quality of the concrete: sieve analysis, water-to-cement ratio, compressive strength, etc.
- concrete casting: thickness, covering over of the reinforcements, visual aspect, etc.;
- finished products: visual and dimensional inspection, pressure testing, joint fitting testing, etc.;
- qualification of staff and of methods: welding, painting and steam curing and operating of the concrete mixing plants, etc.;
- control of inspection, measurement, and testing instruments.

Testing the hardness of the concrete (selerometer)

Sieve analysis

Compressive test on a concrete cylinder

Concrete shrinkage measurement

Water system Engineering

The services offered by Bonna Sabla

In the early stages of water system design, Bonna Sabla's design and engineering department helps customers to optimise their system and to create technical documents.

During the performance of the contract, the design and engineering department works out all the technical documents required for the project, in particular:

- the bills of materials and piping arrangement drawings for the pipes and special fittings for manufacturing and for laying,
- detailed drawings of the equipment and/or accessories supplied,
- calculations notes
- the erection manual and instructions on the protection systems to apply on site.

Why trust Bonna Sabla with your water system engineering?

During the system design phase, Bonna Sabla can stand in for you for all the technical aspects involving engineering and design. You specify the specific features and operating conditions of your system, and the design and engineering department brings you its experience, its ability to find innovative solutions and the extreme flexibility of our products to create the design proposal.

The technical data provided by our design and engineering department simplify the laying of your water system on site and optimises your costs by offering the most suitable solutions.

The design and engineering department may consult other Bonna Sabla departments to come up with the most effective solution. The expertise that it can seek in these cases may be in areas as varied as the feasibility analysis of products, the definition or

modification of production equipment, handling and implementation operating modes. The concentration of all these skills in a single group guarantees the consistency of the solutions delivered.

The design and engineering department also provides a very responsive "after sales" service by coming up with solutions that are always adapted to the changing needs of your water system.

Skills at the service of the customer

Bonna Sabla's design and engineering department has a thorough knowledge of its products, from their geometrical and mechanical characteristics to their manufacturing requirements and specific constraints.

It has worked on a wide variety of specific cases and problems in the water system business, and with the in-depth experience that acquired from them, it is able to place its expertise at the service of your project:

- Pipe laying methodology
- Mastery of product characteristics
- Manufacturing know-how
- Incorporation of engineering constraints (road traffic load, overpressure, earthquakes, etc.).
- Analysis and incorporation of information relevant to design calculations.
- Optimisation and adaptation of special fittings to the systems
- Design of connections that are suited to almost all cases
- Working with the customer to find the most suitable solutions to problems encountered throughout the construction.
- For special types of laying: customized laying engineering and methodologies (span pipes, underwater laying, pipejacking, etc.)
- Monitoring and supervision of the laying site
- Expertise of water systems.

Design of water systems, plants & **production equipment**

Plant engineering

Bonna Sabla's contribution to the design of plants and manufacturing machines

When the project calls for it, we can put our experience at your service to design production equipment, machines or event plants for manufacturing pressure pipes.

Our plant engineering offering comprises the design of the entire project: plant and workshop layout, standard and specific machines and equipment, handling equipment, utilities and civil engineering.

During the commissioning of the plant and, if necessary, during the operating phase, we can provide you with full support by training your production staff and assisting your operators.

Why trust Bonna Sabla with the engineering for your plant?

Our objective is to bring our clients and partners all our expertise accumulated over more than a century to ensure that the end products are perfectly in line with our quality and durability requirements which underpin our reputation.

With a view to maintain this level of quality which is our best retort against competition, the standard machines recommended and the specific ones that we supply are particularly adapted to the manufacture of our products and to project requirements.

The machines designed by our design and engineering department are the fruit of our hands-on manufacturing experience. They take into account the justified changes in our clients' expectations not only with respect to technical performance, but also to changes in legal requirements on such points as safety and environmental impact.

The moulding equipment is designed to enable easy maintenance and servicing through the choice of replacement parts that can be found all over the world.

A wide offering to suit all needs

Each project is accompanied by an elaborate analysis that will determine the proposal made to you. Some of the criteria taken into account by our experts in planning the project are:

- Market studies in the water transport sector: existing segments and foreseeable changes in market trends, competition and potential local partnerships;
- The analysis of any existing infrastructures whether they are production-related (land, plants) or related to the distribution of products (railway network, waterways, etc.);
- Local resources: quality and localisation of raw material deposits, labour quality and cost, local industrial fabric for possible subcontracting contracts, etc.
- Specific local characteristics such as the climate, connection to the various site utilities (electricity, water supply, drainage, etc.).

The nature and scope of plant engineering may greatly vary from one project to another. They may take the following forms:

- Layout of a plant on an undeveloped site
- Appraisal of old plants in view of modernisation or bringing into compliance with standards
- Appraisal of existing plants in view of the extension of the product range to include pressure pipes
- Adaptation of machines in view of the manufacturing of project-specific products

In each case, our design and engineering team draws up an optimised and appropriate proposal.

Fittings

BONNA® steel cylinder fittings of any configuration can be produced to suit the specific needs of a project.
The in-house project design department provides: design calculations, reinforcement drawings, definition of fittings characteristics however complex they may be pipework drawings (connecting flanges, anchoring pieces, settlement compensators,..)

Subsea special
Folkestone (United Kingdom)

Clarinet for pumping station
Tricastin power station (France)

2740 x 1800 x 1800 mm wye
Koreimat power station (Egypt)

Leaktight square-round fitting
☐ 2400 x 240 mm / dia. 2600 mm
Tuas II Power Station (Singapore)

Flanged adaptor
with anchor bars,
dia. 1800 mm (Egypt)

Elbow
Black Point thermal power station
(Hong Kong)

Self-anchored settlement compensators
Ras Abu Fontas (Qatar)

Skikda Power Station - dia. 2000 mm (Algeria)

Panglima Power Station
dia. 2500 mm (Malaysia)

Panglima Power Station (Malaysia)
Pre-assembly of the sections

Dunkirk Power Station DK6 – dia. 2200 mm (France)

Phuny 2.2 Power Station
dia. 1800 mm (Vietnam)

Tanjung Jati Power Station
dia. 3500 mm (Indonesia)

Brindisi Power Station – dia. 2200 mm (Italy)

The **BONNA** pipe
thermal and nuclear power stations

Barking Reach thermal power station, dia. 2200/2400 mm (United Kingdom)

Tanjung Jati thermal power station, dia. 3500 mm (Indonesia)

Rades thermal power station, dia.1600 to 2000 mm (Tunisia)

Haïfu thermal power station, dia. 2400 mm (Taïwan)

Koeberg nuclear power station, dia. 3000 mm (South Africa)

desalination plants,...

Discharge into the Garonne river. Golfech nuclear power station, dia. 3200 mm (France)

Tobruk II electric power station and desalination plant (Libya)

Misurata electric power station and desalination plant, dia. 1400 to 1600 mm (Libya)

for industrial sites
chemical, petrochemical plants,...

Valve chamber installation - Grenoble (France)

Special fitting with flange
Popka Fertilizer plant, dia. 2200 mm (Indonesia)

Amjos Ammonia plant - dia. 1500 mm (Indonesia)

Pipes with outlets
Ruweis chemical plant (UAE)

Pipes designed for an NGL plant, dia. 1800 mm (Qatar)

Settlement compensator
Kaltim IV chemical plant, dia. 1500 mm - Kalimantan (Indonesia)

Water supply, irrigation, sewerage

Paramo Bajo irrigation pipeline, dia. 3000 mm (Spain)

Firefighting system dia. 400 mm.
Geneva Oil port (Switzerland)

Aubonne force main dia. 2000 mm.
Hydroelectric plant (Switzerland)

Lauris Water supply dia. 900 mm (France)

When it is not possible to instal the BONNA® pipe in an open trench (crossing under roads, railways, large depths,…) two techniques can be used.

Pipe jacking

This technique makes it possible to instal pipes with diameters up to 4000 mm underground. It consists in driving the pipe into the ground by means of jacks. As heading proceeds, the soil is excavated from inside and upstream the string of pipes.
Excavating is performed by drilling machines or by full-face shields.

Boulevard Masséna, dia. 1200 mm - Paris (France)

Zurich, dia. 2050 mm (Switzerland)

Microtunnelling

The microtunnelling technique adjusted to difficult environments consists in boring the ground horizontally by using a remote controlled machine from the surface. This technique can be applied to small bore non man-entry pipes.
At the rear of the microtunnelling machine, a string of pipes is pushed ahead in the same way as in pipejacking.
BONNA has thus adjusted its 400 to 1200 mm dia. range to withstand the microtunnelling machine thrust forces. ER flexible type of joints and SL welded type of joints are used, depending on the diameter and the site conditions.

Microtunnelling pipe dia. 600 mm in Saint Malo (France)

Folkestone subsea outfall, dia.1800 mm (United Kingdom)

Whether used as a sea-water intake or as an offshore outfall, the BONNA® pressure pipe keeps its major assets.

Pressure watertightness

- of the steel components (systematic tests throughout the manufacturing stage).
- of connecting joints (SL, ER joints…).

Durability in any kind of water (including sea-water)

- Thanks to the natural protection provided by concrete against steel corrosion.
- There is no need for maintenance inspection.

River crossing, dia. 900 mm - Fréjus (France)

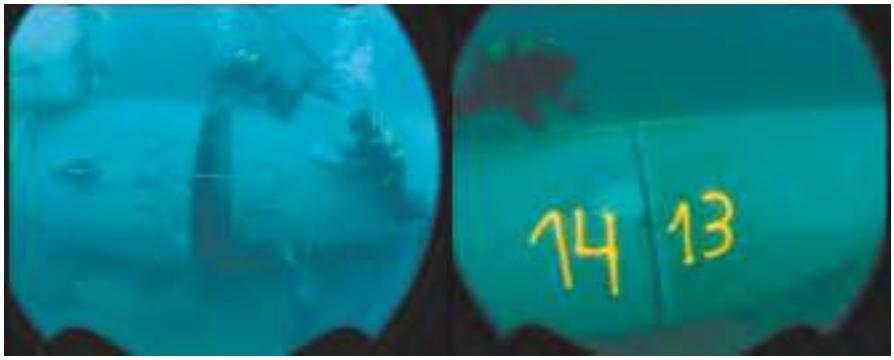
Positioning and sinking of one pipeline section
Sea-water intake, dia. 2100 mm, for Balikpapan Refinery (Indonesia)

Sète offshore outfall, dia. 900 mm (France)

Mechanical strength

- Adjusted to the site conditions: in case of pipes working as span pipes, (even under backfill, or possible rockfill)
- Resistance to impact loads (anchors…)
- Stability with regard to swell and currents and capacity to sustain possible mechanical bending stresses.
- Maximum safety with regard to floating risks: thanks to its reinforced concrete structure, the BONNA® pipe is weightcoated.

Arzew Natural Gas Liquefaction complex, dia. 1250 mm (Algeria)



Undersea outfall of Aboño-Asturies (Spain)

Underwater view of the submarine pipeline in Arzew (Algeria)

Onshore assembling of pipes into sections
Folkestone offshore outfall, dia. 2100 mm (United Kingdom)

Easy and economical installation underwater

Various laying methods are possible: bottom tow or float and lower.

- ER joints for easier connections.
- Minimum digging operations in the sea bottom: no specific compacting or backfilling are required.

Installation by bottom tow

- Onshore assembling of pipes into strings by means of SL welded joints.
- Continuous towing of the pipeline sections.
- Jointing of pipeline sections together by means of SL welded joints.

Installation by float and lower, then jointing of sections together underwater

- Onshore assembling of pipes into strings by means of SL welded joints.
- Floating of sections to their sinking position.
- Sinking of sections.
- Jointing of sections underwater by means of ER joints.
- Fitting by means of hydraulic jacks.
- Operations performed by divers.

Continuous towing of the strings

Cavalaire offshore outfall, dia. 600 mm (France)

Sète offshore outfall, dia. 900 mm (France)

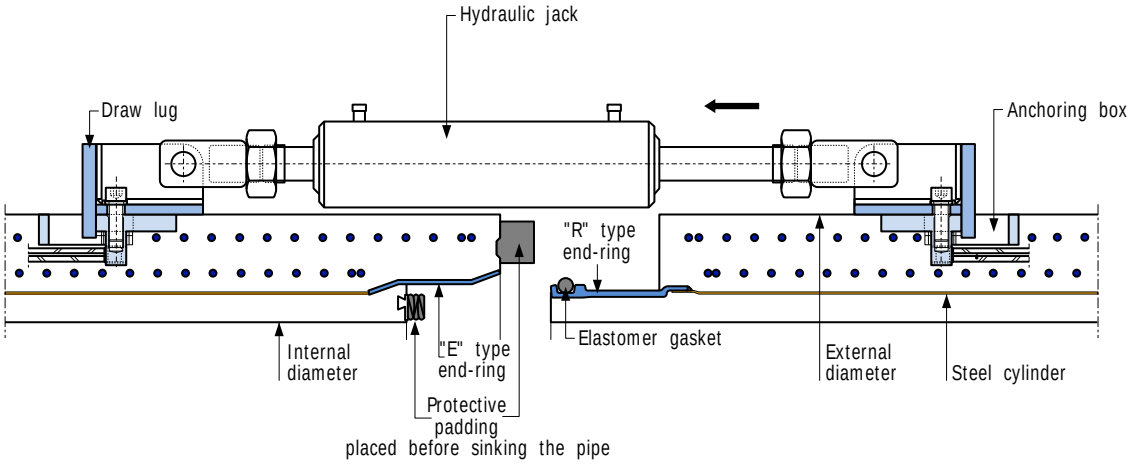
Handling of pipes
Ayoun Moussa power station, dia. 3000 mm (Egypt)

Sidi Krir power station, dia. 2500 mm (Egypt)

Jointing of sections underwater

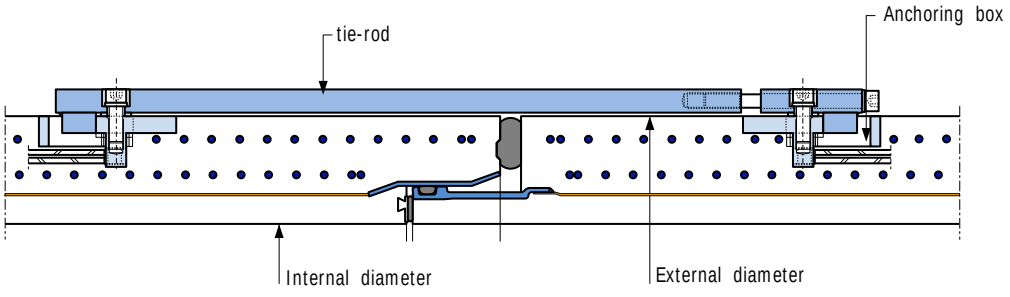
Assembling by hydraulic jacks

Fitting of sections together
"E" - "R" type fitted joint



Final stage with tie-rods

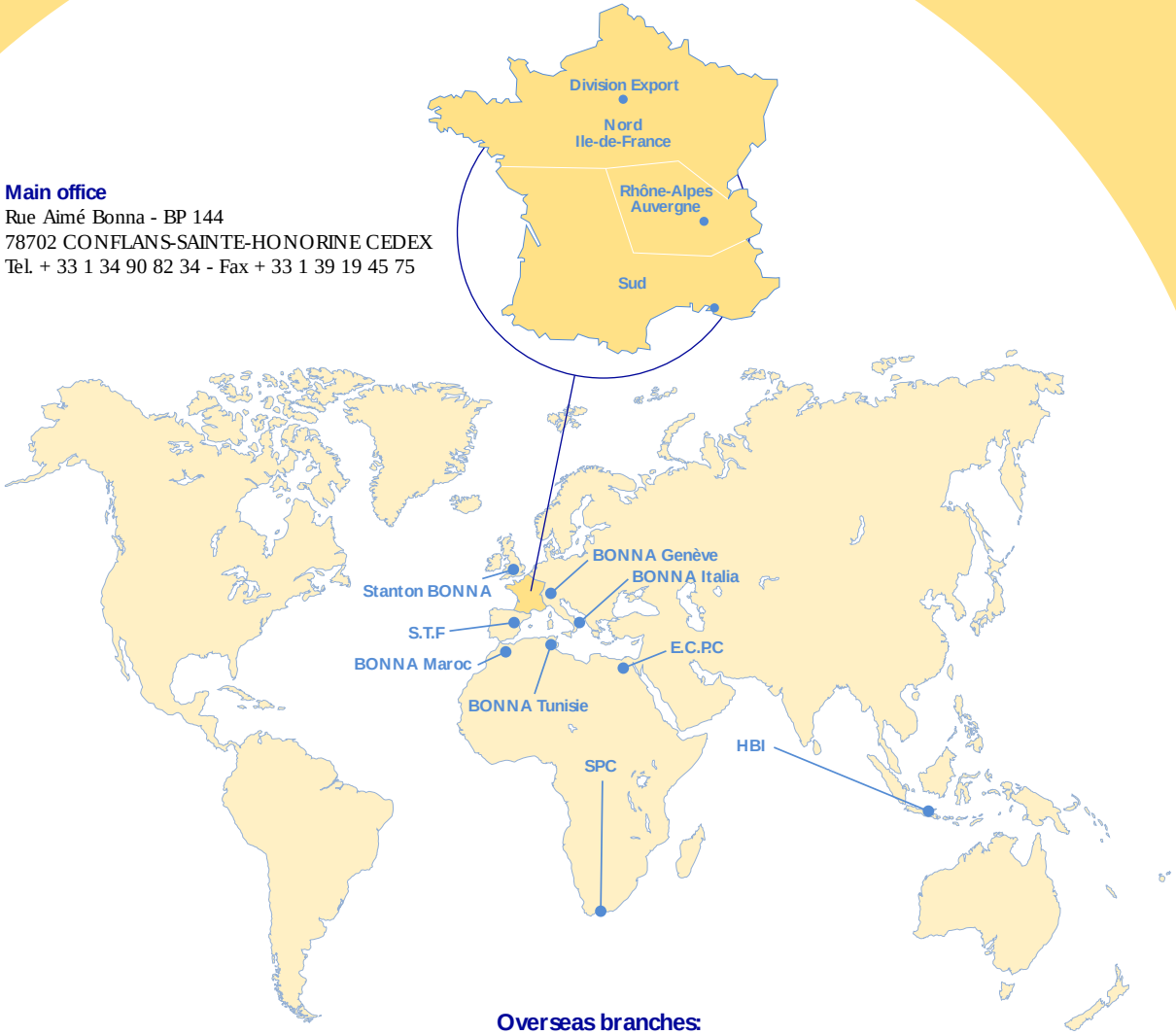
Fitting of sections together
"E" - "R" type fitted joint



Floating of sections to their sinking position
Malaga offshore outfall dia. 1600 mm (Spain)

Lowering of sections
Folkestone offshore outfall dia. 2100 mm (United Kingdom)

Export & Pressure Works: DX



Main office
Rue Aimé Bonna - BP 144
78702 CONFLANS-SAINTE-HONORINE CEDEX
Tel. + 33 1 34 90 82 34 - Fax + 33 1 39 19 45 75

Regional office Nord Ile-de-France
Rue Aimé Bonna – BP 144
78702 CONFLANS-SAINTE-HONORINE CEDEX
Tel. + 33 1 34 90 82 34 – Fax + 33 1 39 19 45 75

Regional office Rhône-Alpes-Auvergne
Le Britannia – 20, Boulevard Eugène Deruelle
69432 LYON CEDEX 3
Tel. + 33 4 78 14 14 37 – Fax + 33 4 78 62 78 44

Regional office Sud
Chemin Vicinal de la Milière à Saint-Menet
BP 43
13368 MARSEILLE CEDEX 11
Tel. + 33 4 91 18 71 00 – Fax + 33 4 91 24 70 43

Overseas branches:

Export Sales Division
Rue Aimé Bonna - BP 144
78702 CONFLANS-
SAINTE-HONORINE CEDEX
Tel. + 33 1 34 90 82 34
Fax + 33 1 34 90 82 95

- **Great Britain**
  STANTON-BONNA CONCRETE Ltd.
- **Switzerland**
  BONNA S.A. GENEVE
- **Italy**
  BONNA ITALIA
- **Spain**
  S.A.E. TUBO FABREGA (S.T.F.)
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- **Indonesia**
  P.T. HUMEX BONNA INDONESIA

AFAQ ISO 9001 VERSION 2000

BONNA SABLA

Head office
TOUR ARIANE - 5, Place de la Pyramide - 92088 PARIS LA DÉFENSE Cedex
Tel. + 33 1 46 53 24 00 - Fax + 33 1 46 53 24 11 - www.bonnasabla.com

Parl'edair - 01 41 45 05 75

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