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## Roads and Bridges Agrément Certificate No 91/R062

Third issue\*

Designated by Government  
to issue  
European Technical  
Approvals

## HELIBORE CULVERTS

Buses métalliques  
Abzugskanal

## Product



• THIS CERTIFICATE RELATES TO HELIBORE CULVERTS, SPIRALLY WOUND AND CORRUGATED GALVANIZED STEEL CULVERTS. THE PROTECTIVE COATINGS AND PAVINGS FOR THESE PRODUCTS ARE DESCRIBED IN THE ACCOMPANYING DETAIL SHEETS.

• The design and construction of culverts must be in accordance with the requirements of the Highways Agency (HA); acting on behalf of the Department for Transport, the Scottish Executive, the Welsh Assembly Government and the Department for Regional Development Northern Ireland; and the conditions set out in the Design Data and Installation parts of this Certificate.

These Front Sheets must be read in conjunction with the accompanying Detail Sheets, which provide information on specific culverts.

## Highways Agency Requirements — Detail Sheet 1

### 1 Requirements

The requirements for the design and construction of corrugated steel buried structures must be in accordance with the following documents:

- Design Manual for Roads and Bridges BD 12/01 *Design of Corrugated Steel Buried Structures with Spans Greater Than 0.9 metres and up to 8.0 metres.*
- Manual of Contract Documents for Highway Works, Volume 1 (MCHW1) *Specification for Highway Works, Series 600 Earthworks, Clause 623<sup>(1)</sup> Earthworks for Corrugated Steel Buried Structures and Series 2500 Special Structures, Clause 2501<sup>(2)</sup> Corrugated Steel Buried Structures.*

Notes: Also see relevant notes for Guidance

- NG623
- NG2501.

## Regulations

### 2 Construction (Design and Management) Regulations 1994 (as amended) Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See sections: 3 Description (3.3), and 5 Delivery, storage and site handling (5.3).

## Technical Specification

### 3 Description

3.1 Helibore Culverts are circular pipe structures manufactured from galvanized steel to BS EN 10143 : 1993, sheet Z600.

3.2 Helibore Culverts are available with a corrugation size of 125 mm by 25 mm deep (Helibore 125) or 68 mm by 13 mm deep (Helibore 68). They are supplied in a standard range of galvanized<sup>(1)</sup> steel thicknesses and a standard range of diameters, conforming to those permitted in BD 12/01 (see Table 1), and may carry the additional corrosion protection described in the Detail Sheets.

(1) Helibore Culverts may also be manufactured from aluminized steel as permitted in BD 12/01.

3.3 The standard length of culvert is 6 m but other lengths can be supplied to order.

*Table 1 Galvanized steel thickness and culvert specification*

Culvert	Internal diameter (m)	Base steel thickness (mm)
Helibore 125	0.9–3.6	1.5–4.25
Helibore 68	0.9–1.5 <sup>(1)</sup>	1.25–3.5

(1) Helibore 68 can also be supplied in diameters of 0.3 m to 0.9 m but these are outside the scope of BD 12/01 and this Certificate.

3.4 Coupling bands are used for joining lengths of Helibore pipes and are available in one, two, three or four segments depending on the diameter of the culvert. The bands are manufactured from galvanized steel with two annular corrugations rolled into the ends, with the same protection coating specification as for the culverts.

3.5 Where specified, gaskets are manufactured from nitril rubber or expanded EPDM (ethylene propylene diene monomer). These are used in conjunction with the coupling band, where necessary, to increase the watertightness of the culvert joint.

### 4 Manufacture and quality control

4.1 Coils of galvanized steel are decoiled, progressively corrugated and helically wound to the required pipe diameter. The edges of the galvanized steel sheet are rolled over and linked together to form a continuous lockseam. The ends of the pipe are re-rolled to form four annular corrugations parallel to the face of the pipe, for jointing.

4.2 The galvanized steel coils and assembly nuts and bolts for the coupling bands are obtained from quality-assured suppliers, approved to BS EN ISO 9002 : 1994.

4.3 Quality controls include visual and dimensional checks on the incoming galvanized steel coils.

### 5 Delivery, storage and site handling

5.1 Helibore Culverts are delivered to site stacked on trailers, secured with metal straps over protective padding, complete with coupling bands and gaskets (where necessary) for jointing sections of pipe. Each

culvert carries a label bearing the BBA identification mark incorporating the number of this Certificate.

5.2 Reasonable care must be taken during unloading and erection to avoid damage. Lifting equipment should have padded contact areas or nylon slings, and the culverts should not be dropped or dragged.

5.3 Pipes of lengths greater than 6 m and/or heavy-metal thicknesses should be handled with a double or triple sling to prevent excessive localized stresses in the pipe barrel that could damage the lockseams.

5.4 On site, Helibore Culverts should be stored on a firm base, fully supported on bearers and away from the possibility of damage.

## Design Data

### 6 General

6.1 Helibore Culverts are satisfactory for use as corrugated steel buried structures in accordance with BD 12/01.

6.2 The culverts with a factory-applied invert (described in the accompanying Detail Sheets) or an in-situ concrete-paved invert (see section 7) are satisfactory for use in accordance with BD 12/01 clause 8.4.1(b), at gradients of up to 3%.

6.3 The coated culverts described in the accompanying Detail Sheets are satisfactory for use in any situation and may be used advantageously in more aggressive situations (see the appropriate Detail Sheet).

### 7 Design considerations

7.1 The culvert specification must be designed in accordance with BD 12/01 to give an overall life of 120 years, taking into consideration the life of any protective coatings, proposed loadings, corrosivity classification of the surroundings, atmospheric environment and the amount of water flow.

7.2 The concrete-paved invert must be reinforced with a steel fabric complying with MCHW1 *Series 1700 Structural Concrete* and designed and installed using a minimum class C30/20 concrete in accordance with BD 12/01. The reinforced-concrete invert should cover a minimum 25% of a circular pipe culvert's periphery or 40% for a pipe arch or the wetted periphery for average flow conditions plus 200 mm on each side, whichever is less.

7.3 The reinforced-concrete paved invert must be a minimum thickness of 100 mm for gradients up to 2%, or a minimum thickness of 125 mm for gradients greater than 2% and for structures with spans greater than 2 m. In extreme conditions, when it is anticipated that water-borne solids in excess of 100 mm diameter will be carried through the structure during normal or flood conditions, drop inlets or catchpits must be installed.

### 8 Mechanical properties

The lockseams and coupling bands have adequate mechanical strength to maintain the integrity of the culvert during its serviceable life, allowing for the

effects of any reduced end corrugation dimensions. The minimum tensile strengths of the lockseams for the various steel thicknesses are given in Table 2.

Table 2 Minimum tensile strengths of lockseams

Base steel thickness (mm)	Minimum tensile force across seam (Nmm <sup>-1</sup> )
1.25	49
1.50	60
2.00	88
2.50	118
3.00	149
3.50	182
4.20	234

## 9 Maintenance

Any protective coating should be maintained using the procedure described in the appropriate Detail Sheet.

## 10 Durability

The installation should be designed to achieve a 120-year-life using the criteria defined in section 7.

## Installation

### 11 General

The installation of Helibore Culverts should be conducted in accordance with the procedures detailed in BD 12/01 and the Certificate holder's *Installation Manual*.

### 12 Excavation and base preparation

Excavation for the bedding and trench should be conducted in accordance with section 9 of BD 12/01. The upper 50 mm to 100 mm layer of bedding should be composed of relatively loose material to ensure the corrugations settle into the bedding.

### 13 Construction

13.1 The Helibore pipe sections should be lifted with care and where applicable placed with the factory-applied invert downwards onto the prepared foundation and bedding. Where sections of pipes are to be joined the coupling bands are placed in position at the end of one section of pipe with the band open to receive the next section. The section to be joined is brought against or within 25 mm of the first and the band and pipes are cleared of any dirt and stones. Bolts are inserted and the band is tightened.

13.2 Where gaskets are to be used, these should be installed in accordance with the Certificate holder's *Installation Manual*.

### 14 Backfill

The structural backfill materials should be granular-type soils complying with the requirements of the MCHW1 Series 600 and selected in accordance with sections 9.10 to 9.17 of BD 12/01. The fill material under the haunches and around the structure should be placed in alternate layers 150 mm to 300 mm thick on both sides of the pipe and a thorough uniform compaction achieved by hand or

mechanical equipment such as tamping rollers or vibrating compactors, depending on site conditions. After the minimum cover requirements of the design have been met and the structure is firmly in place further filling to grade may continue using procedures applicable to regular embankment construction.

## 15 Invert

The reinforced-concrete invert should be installed in accordance with Chapter 13 *Concrete Invert Paving for Closed Invert Structures* of BD 12/01 in maximum cast lengths of 10 m. Water bars should be placed between panels and the joints sealed with a joint sealant to MCHW1 Clause 2303.

## Technical Investigations

The following is a summary of the technical investigations carried out on Helibore Culverts.

### 16 General

Helibore Culverts were assessed for compliance with BD 12/88<sup>(1)</sup> by tests, assessment of existing data, inspection of the manufacturing process and site visits.

(1) BD 12/88 has been replaced by BD 12/01, and Helibore Culverts comply with this latest Standard.

### 17 Investigations

17.1 Tensile strength test data on the lockseams in accordance with Appendix B<sup>(1)</sup> of BD 12/88 for various steel thicknesses were examined.

(1) Appendix B of BD 12/88 has been replaced by BD 12/01, Annex C *Specification for Tensile Strength of Lockseams in Helically Wound Corrugated Steel Culverts*.

17.2 The manufacturing process was examined and details obtained of the quality controls conducted on the raw materials and finished products, the material specifications and the method of manufacture.

17.3 A visit was made to a site in progress to assess the practicability of installation.

## Bibliography

BS EN 10143 : 1993 *Continuously hot-dip metal coated steel sheet and strip — Tolerances on dimensions and shape*

BS EN ISO 9002 : 1994 *Quality systems — Model for quality assurance in production, installation and servicing*

BD 12/88 *Corrugated Steel Buried Structures*

BD 12/01 *Design of Corrugated Steel Buried Structures with Spans Greater Than 0.9 metres and up to 8.0 metres*

Manual of Contract Documents for Highway Works, Volume 1 : *Specification for Highway Works, August 1998 (as amended)*

Manual of Contract Documents for Highway Works, Volume 2 *Notes for Guidance on the Specification for Highway Works, August 1998 (as amended)*

## Conditions of Certification

### 18 Conditions

18.1 This Certificate:

- (a) relates only to the product that is named, described, installed, used and maintained as set out in this Certificate;
- (b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;
- (c) is valid only within the UK;
- (d) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;
- (e) is copyright of the BBA;
- (f) is subject to English law.

18.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

18.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and/or fabrication including all related and relevant processes thereof:

- (a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;
- (b) continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine;

(c) are reviewed by the BBA as and when it considers appropriate; and

(d) remain in accordance with the requirements of the Highways Agency.

18.4 In granting this Certificate, the BBA is not responsible for:

- (a) the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product;
- (b) the right of the Certificate holder to market, supply, install or maintain the product; and
- (c) the actual works in which the product is installed, used and maintained, including the nature, design, methods and workmanship of such works.

18.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.



In the opinion of the British Board of Agrément, Helibore Culverts are fit for their intended use provided they are installed, used and maintained as set out in this Certificate. Certificate No 91/R062 is accordingly awarded to Tubosider UK Ltd.

On behalf of the British Board of Agrément

Date of Third issue: 11th November 2005

A handwritten signature in black ink, appearing to read 'G. A. Cooper', is written over the printed name of the Chief Executive.

Chief Executive

*\*Original Certificate issued 8th July 1991. This version includes change of Certificate holder's address and new Conditions of Certification.*

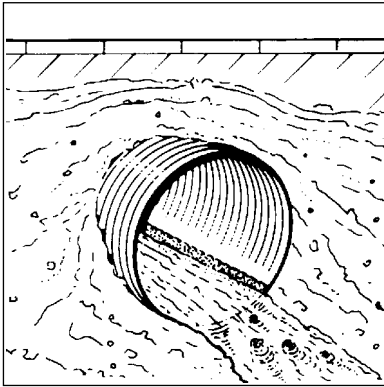


Tubosider United Kingdom Limited

Roads and Bridges  
Certificate No 91/R062  
**DETAIL SHEET 1**

**MONOGUARD**

## Product



• THIS DETAIL SHEET RELATES TO MONOGUARD BPC, A COLD-APPLIED MODIFIED BITUMEN PROTECTION COATING FOR HELIBORE SPIRALLY CORRUGATED GALVANIZED STEEL CULVERTS.

• The Front Sheet gives the Department of Transport Requirements, Technical Specifications, Design Data, Installation, Technical Investigations and Conditions of Certification common to all Helibore Culverts. The Front Sheet and this Detail Sheet must be consulted together.

## Technical Specification

### 1 Description

1.1 Monoguard BPC is a cold-applied solution of modified bitumen for application to either or both the internal and external surfaces of Helibore galvanized steel culverts (as described in section 2.1 of the Front Sheet), at a total dry coating thickness of 700  $\mu\text{m}$ . The coating is available in both summer (BPE) and winter (BPC) grades.

1.2 The fully coated culverts may be installed with either a reinforced concrete paved invert installed on site, or a factory-applied paving.

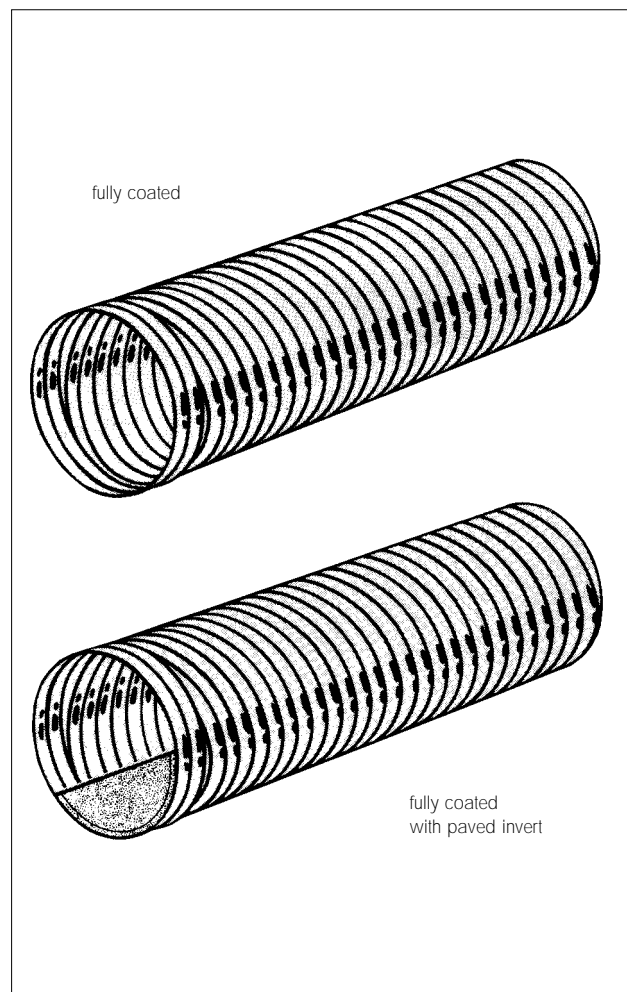
1.3 Monoguard BPC is supplied in 5 litre and 25 litre steel containers for use on site as a repair material.

### 2 Manufacturer and quality control

2.1 After forming, either or both the internal or external surfaces of the Helibore Culverts are coated with Monoguard BPC. This is applied in two coats by airless-spray equipment at a wet film thickness of 500  $\mu\text{m}$  per coat. The first coat is allowed to dry before the second is applied to achieve an overall minimum dry film coating thickness of 700  $\mu\text{m}$  (see Figure 1).

2.2 Where a factory-applied paving is specified the paving is installed prior to the application of Monoguard BPC, which is then applied over the paving (see Figure 1).

Figure 1 Coated Helibore Culverts



# Electronic Copy

2.3 The installation of the factory-applied paving is described in the accompanying Detail Sheet.

2.4 The coupling bands (as described in section 2.2 of the Front Sheet) are coated to the same specification by hand-held airless-spray equipment.

2.5 Monoguard BPC is obtained from quality assured suppliers approved to BS 5750 : Part 2 : 1987.

2.6 Quality control tests for wet film thickness, dry film thickness and visual appearance of the coated culverts are conducted.

## Design Data

### 3 General

3.1 Helibore Culverts are satisfactory for use as corrugated steel buried structures in accordance with DTp BD 12/88.

3.2 The fully coated culverts installed with either a reinforced concrete paved invert (see sections 5 and 6 of the Front Sheet) or a factory-applied paving (as described in the accompanying Detail Sheet) may be advantageously used in the more aggressive situations permitted by DTp BD 12/88.

### 4 Maintenance

Maintenance inspections of the visible areas of the modified bitumen coating should be conducted at regular intervals not exceeding 10 years. Any damaged areas of the coating should be recoated using a cold-applied bitumen-based coating.

### 5 Durability

5.1 Monoguard BPC coating will protect the galvanized steel substrate for a period in excess of

25 years but at the exposed ends of the culvert some imbrittlement and crazing may occur.

5.2 Localised maintenance treatment of exposed surfaces will be necessary to restore areas where the coating has been damaged or eroded.

## Technical Investigations

The following is a summary of the technical investigations carried out on Monoguard BPC or Helibore Culverts.

### 6 Tests

The following tests were conducted on samples of Helibore coated with Monoguard PBC to determine:

salt spray resistance  
alkali resistance  
effect of soil burial  
resistance to artificial weathering  
impact resistance  
adhesion  
flexibility of coating  
resistance to creep  
wet and dry abrasion resistance.

### 7 Investigations

7.1 A visit was made to a site in progress to access the practicability of installation and ease of repair.

7.2 Visits were made to established sites to assess the performance and durability of Monoguard BPC coated Helibore Culverts in service.

7.3 An assessment was made of the durability of the coating.



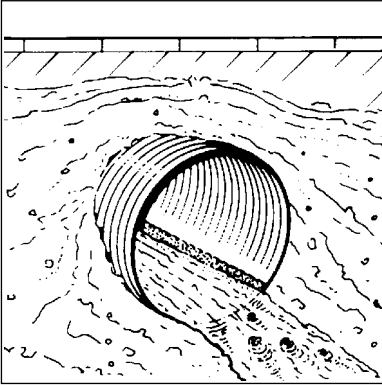
On behalf of the British Board of Agrément

Date of issue: 8th July 1991

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Director

## Product



- THIS DETAIL SHEET RELATES TO THE BITUMEN PAVING FOR HELIBORE SPIRALLY CORRUGATED GALVANIZED STEEL CULVERTS.
- The Front Sheet gives the Department of Transport Requirements, Technical Specification, Design Data, Installation, Technical Investigations and Conditions of Certification common to all Helibore Culverts. The Front Sheet and this Detail Sheet must be consulted together.

## Technical Specification

### 1 Description

1.1 Bitumen Paving for Helibore galvanized steel culverts as described in section 2.1 of the Front Sheet is applied to the invert at a minimum thickness of 3.0 mm above the crest of the corrugations, in accordance with AASHTO\* Designation M190-80 *Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches*.

\*American Association of State Highway Transportation Officials.

### 2 Manufacture and quality control

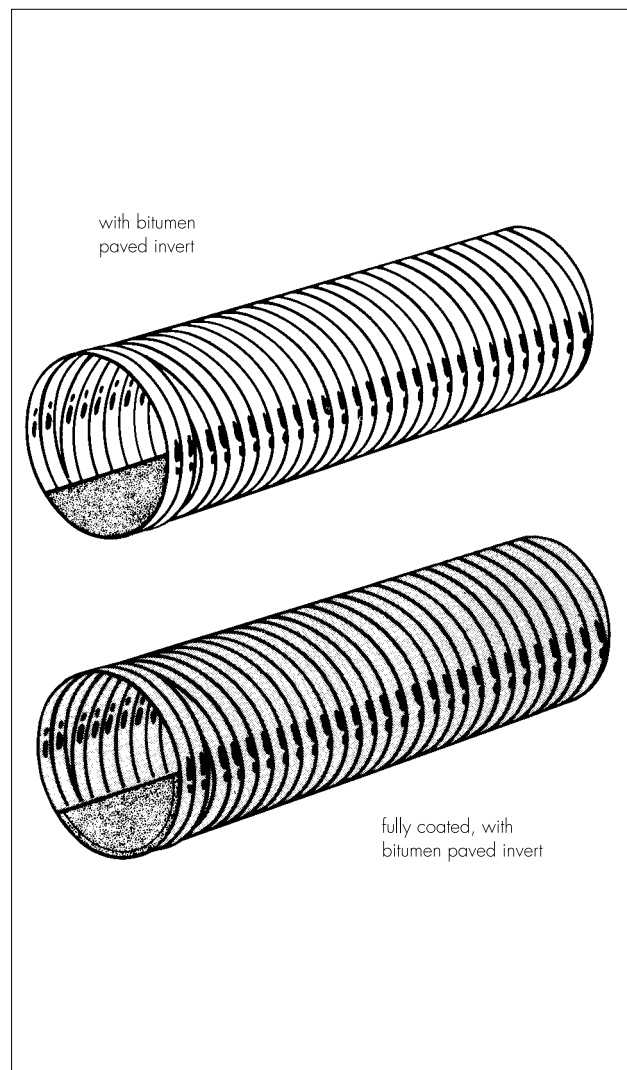
2.1 A smooth bitumen paved invert of minimum thickness 3.0 mm, and covering a minimum of 25% of the culvert's periphery, as required in AASHTO : M190-80, is applied. This process is carried out prior to the application of the protection coating where specified, as described in the accompanying Detail Sheet (see Figure 1).

2.2 The bitumen and blending oil are obtained from quality assured suppliers approved to BS 5750 : Part 2 : 1987.

2.3 Quality control tests for thickness and visual appearance are conducted on the paved culverts.

2.4 Quality control tests for solubility in trichloroethylene, loss on heating and penetration in accordance with AASHTO : M190-80 are conducted on the bitumen paving material by an independent laboratory.

Figure 1 Paved Helibore Culverts



### 3 General

3.1 Helibore Culverts are satisfactory for use as corrugated steel buried structures in accordance with DTp BD 12/88.

3.2 The factory-applied bitumen invert is satisfactory for use in accordance with DTp BD 12/88 clause 8.4.1(b), at gradients of up to 3%.

### 4 Maintenance

Maintenance inspections of the visible areas of Bitumen Paving should be conducted at regular intervals not exceeding 10 years and any damage to the invert repaired.

### 5 Durability

5.1 When applied without a full protection coating the bitumen paved invert should remain effective for a period in excess of 20 years. When applied in conjunction with Monoguard BPC the paved invert should remain effective for a period in excess of 25 years.

5.2 Localised maintenance treatment will be necessary to repair areas where paving has been damaged or eroded.

The following is a summary of the technical investigations carried out on Bitumen Paving for Helibore Culverts.

### 6 Tests

The tests carried out on Bitumen Paving for Helibore Culverts are described in the *Technical Investigations* part of Detail Sheet 1.

### 7 Investigations

7.1 An assessment was made of the durability of Bitumen Paving.

7.2 The following documents were consulted:

*Durability of corrugated metal culverts* State of New York Department of Transportation, Albany, November 1967 — Physical Research Project 291.

*Symposium on durability of culverts and storm drains* Transportation Research Board (TRB) National Research Council — Transportation Research Record No 1001.

*Buses métalliques — recommandations et règles de l'art* Ministère des Transports — Direction générale des transports intérieurs.

*Soil corrosivity assessment* D Eyre and D Lewis, Spencer and Partners.



On behalf of the British Board of Agrément

Date of issue: 8th July 1991

A handwritten signature in black ink, appearing to read 'P. C. Newman'.

Director

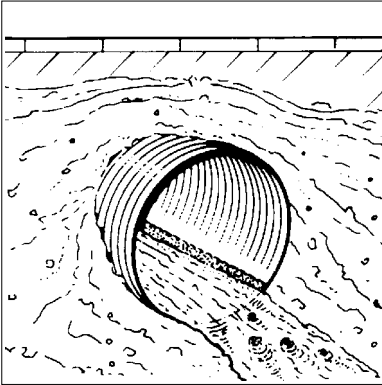


Tubosider United Kingdom Limited

Roads and Bridges  
Certificate No 91/R062  
**DETAIL SHEET 3**

## PLASBORE CULVERTS

### Product



• THIS DETAIL SHEET RELATES TO PLASBORE CULVERTS, PLASTISOL COATED HELIBORE SPIRALLY CORRUGATED GALVANIZED STEEL CULVERTS.

*This Detail Sheet must be read in conjunction with the Front Sheets, which give the product's position regarding Department of Transport Requirements, common information relating to the culverts, and the Conditions of Certification, respectively.*

### Technical Specification

#### 1 Description

1.1 Plasbore Culverts are Helibore Culverts, manufactured from galvanized steel (as described in section 2.1 of the Front Sheets) with a nominal 200 µm thick plastisol coating on both sides.

1.2 The culverts may be installed with either a reinforced concrete invert installed on site, or a factory-applied paving.

1.3 A plastisol repair kit is available for carrying out repairs on the coating if damaged during manufacture and installation, and for the routine repair and maintenance of the culverts during service.

#### 2 Manufacture and quality control

2.1 The plastisol coated galvanized steel is obtained from a BS EN ISO 9002 : 1994 registered supplier, to an agreed specification.

2.2 A visual appearance of the formed culvert is conducted and defects in the coating are repaired using the plastisol repair kit.

### Design Data

#### 3 General

3.1 Plasbore Culverts are satisfactory for use as corrugated steel buried structures in accordance with DOT BD 12/95.

3.2 The culverts installed with either a reinforced concrete paved invert (see sections 5 and 6 of the Front Sheets) or a factory-applied paving (as described in the accompanying Detail Sheet) may be advantageously used in the more aggressive situations permitted by DOT BD 12/95.

#### 4 Maintenance

Maintenance inspections of the visible areas of the plastisol coating should be conducted at regular intervals not exceeding 10 years. Any damaged areas of the coating should be repaired.

#### 5 Durability

5.1 The plastisol coating will protect the galvanized steel substrate for a period in excess of 25 years.

5.2 Localised maintenance treatment of exposed surfaces will be necessary to restore areas where the coating has been damaged or eroded.

## Technical Investigations

The following is a summary of the technical investigations carried out on Plasbore Culverts.

### 6 Tests

The following tests were conducted on the plastisol coated galvanized steel to determine:

resistance to scouring  
effect of applying hot bitumen paving on the coating.

### 7 Investigations

7.1 The manufacturing process was examined and details were obtained of the quality controls conducted on the raw materials and finished products, the material specifications, the method of manufacture and repair of the coating.

7.2 An assessment of existing data on plastisol coated galvanized steel was made to assess the durability of the coating in service.

7.3 The following documents were consulted relating to the durability of plastisol coated galvanized steel culverts used in the USA:

*Symposium on durability of culverts and storm drains.* Transportation Research Board (TRB), National Research Council — Transportation Research Record No 1001 (1984).

*Durability of polymer-coated corrugated steel pipe* (Carl M Hirsch).

*Overview of polymer coatings for corrugated steel pipe in New York* (Robert M Pyskadlo and Wallace W Renfrew).

*Evaluation of Highway Culvert Coating Performance* — Report FHWA/RD-80/059-FHWA, US Department of Transportation, 1980.



On behalf of the British Board of Agrément

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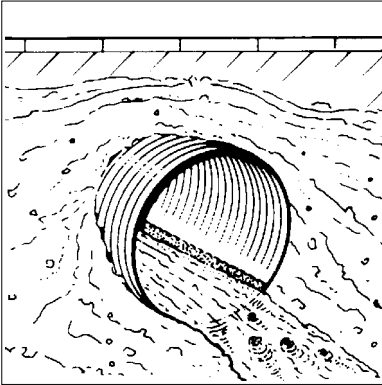
Date of issue: 27th March 1997

Director



Tubosider United Kingdom Limited

Roads and Bridges  
Certificate No 91/R062  
**DETAIL SHEET 4**

**TRENCHCOAT CULVERTS****Product**

• THIS DETAIL SHEET RELATES TO TRENCHCOAT CULVERTS, POLYMER-COATED HELIBORE SPIRALLY WOUND AND CORRUGATED GALVANIZED STEEL CULVERTS.

*This Detail Sheet must be read in conjunction with the Front Sheets, which give the product's position regarding Highways Agency Requirements, common information relating to the culverts, and the Conditions of Certification.*

**Technical Specification****1 Description**

1.1 Trenchcoat Culverts are Helibore Culverts, manufactured from galvanized steel (as described in section 3.1 of the Front Sheets) coated with a nominal 250 µm thick polyethylene and acrylic acid copolymer coating on both sides.

1.2 The culverts may be installed with either a reinforced-concrete invert installed on site, or a factory-applied paving.

1.3 A Ranbar repair kit is available for carrying out repairs on the coating if damaged during manufacture and installation, and for the routine repair and maintenance of the culverts during service.

**2 Manufacture and quality control**

2.1 The Trenchcoat coated galvanized steel is obtained from a ISO 9002 : 1994 registered supplier, to an agreed specification.

2.2 A visual appearance of the formed culvert is conducted and cut ends and defects in the coating are coated using the Ranbar repair kit.

**Design Data****3 General**

Trenchcoat Culverts are satisfactory for use as corrugated steel buried structures in accordance with BD 12/01.

**4 Maintenance**

Maintenance inspections of the visible areas of the trenchcoat coating should be conducted at regular intervals not exceeding 10 years. Any damaged areas of the coating should be repaired.

**5 Durability**

5.1 Trenchcoat has been used to protect galvanized steel culverts in the USA since 1977 and independent report/studies indicate that the coating is performing satisfactorily in a variety of environments. Life expectancy estimates detailed in the National Corrugated Steel Pipe Association's *CSP Durability Guide* (May 2000) indicate that in non-aggressive environments a polymer pre-coated and paved culvert will have an add-on service life of 80 years.

5.2 The results of tests and investigations conducted by the BBA indicate that Trenchcoat Culverts have an abrasion and impact-resistant coating. This will protect the galvanized steel structure in the non-aggressive, aggressive and very aggressive environments described in BD 12/01 for periods in excess of 60, 50 and 35 years respectively provided that localised maintenance is conducted.

## Technical Investigations

The following is a summary of the technical investigations carried out on Trenchcoat Culverts.

### 6 Tests

6.1 Tests were conducted on the Trenchcoat-coated galvanized steel to determine:

- resistance to scouring
- effect of applying hot bitumen paving on the coating
- resistance to salt spray
- tensile bond strength
- effect of immersion in:
  - salt water
  - hydrochloric acid (pH 3.0)
  - ammonium hydroxide (pH 12.0)
  - sulphate
- resistance to artificial weathering (QUV)
- adhesion after impact
- low-temperature flexibility.

6.2 An examination was made of independent test reports on the effect of Trenchcoat on lockseam strength.

### 7 Investigations

7.1 The manufacturing process was examined and details were obtained of the quality controls conducted on the raw materials and finished products, the material specifications, the method of manufacture and repair of the coating.

7.2 An assessment of existing data on trenchcoat-coated galvanized steel was made to assess the durability of the coating in service.

7.3 A user survey of specifiers and users of Trenchcoat Culverts in the USA was conducted to establish the performance in service of the coating.

7.4 The following documents were consulted relating to the durability of Trenchcoat and polymer-coated galvanized steel culverts used in the USA:

*Symposium on durability of culverts and storm drains*. Transportation Research Board (TRB). National Research Council — Transportation Research Record No 1001 (1984).

*Durability of polymer-coated corrugated steel pipe* (Carl M Hirsch).

*Overview of polymer coatings for corrugated steel pipe in New York* (Robert M Pyskadlo and Wallace W Renfrew).

*Evaluation of Highway Culvert Coating Performance* — Report FHWA/RD-80/059-FHWA, US Department of Transportation, 1980.

*CSP Durability Guide* — National Corrugated Steel Pipe Association, May 2000.

## Bibliography

ISO 9002 : 1994 *Quality Systems — Method for quality assurance in production installation and servicing*

BD 12/01 *Design of Corrugated Steel Buried Structures with Spans Greater Than 0.9 metres and up to 8.0 metres*



On behalf of the British Board of Agrément

A handwritten signature in black ink, appearing to read 'P. C. Newson', is written over a light grey background.

Date of issue: 10th September 2002

Chief Executive