

REPORT

Testing and Certification of Naylor C3 38mm Cable Ducts to ENATS 12/24 Issue 2021

Private and Confidential

Prepared for: Naylor Specialist
Plastics Ltd

Report No: A3143_2
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Classification: Confidential

Version History

| Date | Version | Author(s) | Notes |
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| 31/07/2024 | Issue 1 | Sara Griffiths | First Issue |
| 16/08/2024 | Issue 2 | Sara Griffiths | Correction to 1. Cable duct description on Certificate, to headers on subsequent pages. |
| 10/09/2024 | Issue 3 | Sara Griffiths | Correction to 'Naylor Specialist Plastics Ltd', cover page and certificate. |

Final Approval

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| Final | 04/08/2024 | Issue 1 | Jeff Robertson |
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Registered in England number 2566313

Certificate No: A3143_2

Project: Cable Ducts User Spec ENATS 12/24 Issue 2021

Client: Naylor Specialist Plastics Ltd.

Date: 10th September 2024

This certificate is issued to NAYLOR SPECIALIST PLASTICS LTD to certify that the undersigned testing facility did, at their request complete the performance tests stipulated below on the following products:

1. Cable duct description:
 Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable
2. Standard Reference:
 Technical Specification for plastic ducts for buried electric cables, Cable Duct User Spec ENATS 12/24 Issue 2021.
3. The following tests were completed:

| Routine Test | Sample Test | Type Test |
|-----------------|--|---|
| 1. Construction | 1. Dimensions | 1. Marking and documentation |
| | 1.1 - Inside diameter | 2. Duct Assembly, by other means than threads |
| | 1.2 - Ovality | 3. Vicat softening test |
| | 1.3 - Length | 4. Static friction coefficient test |
| | 2. Compression test: Resistance to deformation at 23°C | |
| | 3. Impact test at -5°C | |
| | 4. Heat Reversion | |

4. All results of tests stated in paragraph 3 are included in the client test schedule. The annexes mentioned in the test schedule are supporting documentation.
5. The results of the mentioned tests were found to be within the requirements of the Technical Specification for plastic ducts for buried electric cables, Cable Duct User Spec ENATS 12/24 Issue 2021.

Sara Griffiths
 Materials Lab Technician
 EA Technology Ltd

Safer, Stronger, Smarter

Australia | China | UK | Singapore |



ROUTINE TEST:

Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable

Test period:

May 2024 to June 2024

Standard Reference:

Cable Duct User Spec ENATS 12/24 Issue 2021

| No | Description | Standard Reference Clause | Requirement | Test Method | Results | Remarks |
|----|--------------|---------------------------|--|-------------|---------|---------|
| 1 | Construction | 9 | | | | |
| | | 9.1a | The cross section of the ducts shall be circular, and the internal bore shall be smooth and substantially concentric with the external surfaces | Inspection | Passed | Annex A |
| | | 9.1b | Both ends of the duct shall be cleanly cut perpendicular to the central axis of the duct | Inspection | Passed | Annex A |
| | | 9.1c | All spigot ends or plain ends of the duct shall be radiused, or slightly bull-nosed in profile, to prevent the risk of damage to the cable during cable installation, and to ensure that the ends fit smoothly into the coupling or socket | Inspection | N/A | N/A |
| | | 9.1d | The material shall be free from cracks, inclusions, delamination, or other defects | Inspection | Passed | Annex A |
| | | 9.1e | Any profiled surface of a cellular wall structure shall be complete, with no break in the cell walls | Inspection | N/A | N/A |

SAMPLE TEST: Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable

Test period: May 2024 to June 2024

Standard Reference: Cable Duct User Spec ENATS 12/24 Issue 2021

| No | Description | Standard Reference Clause | Requirement | Test Method | Results | Remarks |
|-----|---|---------------------------|--|-------------------|----------|---------|
| 1 | Dimensions | 8 | | | | |
| 1.1 | Inside diameter | 8.2.3a | Inside diameter of the duct shall be determined by the average of four measurements taken at regular intervals around the cross section. The Measurements shall be taken at the end of the duct. Nominal inside diameter 38mm. | User Spec 8.2.3a | Measured | Annex B |
| 1.2 | Ovality | 8.2.3b | The ovality shall be determined as the difference between the measured maximum internal diameter and the measured minimum internal diameter expressed as a percentage of the nominal internal diameter. The measurement shall be taken from the end of the duct. Maximum Ovality 3.4mm. | User Spec 8.2.3b | Passed | Annex B |
| 1.3 | Length | 8.2.3c | The minimum length shall be the length ordered | User Spec 8.2.3c | Passed | Annex B |
| 2 | Compression test: Resistance to deformation at 23°C | 10.2 | When reaching the deflection of 5%, the applied force shall be at least 450 N or equivalent at 23°C. After test samples shall show no cracks visible to normal or corrected vision without additional magnification. | User Spec 10.2 | Passed | Annex C |
| 3 | Impact test at -5°C | 10.3 | Using a 5kg weight with a fall distance of 300 mm, it shall be possible to pass a 36.1mm ball through the conduit. There shall be no signs of disintegration, nor shall there be any crack allowing the ingress of light or water between the inside and outside. | User Spec 10.3 | Passed | Annex D |
| 4 | Heat Reversion | 16.5 | Maximum percentage change 1%, samples shall be free from blistering | User Spec 16.5.3b | Passed | Annex E |

TYPE TEST: Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable

Test period: May 2024 to June 2024

Standard Reference: Cable Duct User Spec ENATS 12/24 Issue 2021

| No | Description | Standard Reference Clause | Requirement | Test Method | Results | Remarks |
|----|--|---------------------------|---|----------------|---------|---------|
| 1 | Marking and documentation | 7.1 | Ducts, couplings and bends shall be coloured black or red, throughout length | Inspection | Passed | Annex F |
| | | 7.2 | The duct shall be marked "ELECTRIC CABLE DUCT C_MFR" | Inspection | Passed | Annex F |
| | | 7.2a | Class number shall be inserted after "C" | Inspection | Passed | Annex F |
| | | 7.2b | "MFR" shall be replaced by manufacturer's reference | Inspection | Passed | Annex F |
| | | 7.2d | Minimum print size of 6mm | Inspection | Passed | Annex F |
| | | 7.2e | The full print message shall be repeated along the length of the duct. The gap between the end of one print message and start of the next print shall not be more than 200 mm | Inspection | Passed | Annex F |
| | | 7.2f | The markings shall be on two print lines, 180° apart | Inspection | Passed | Annex F |
| | | 7.4 | Cable duct shall also have marked on it at 1m intervals its classification code | Inspection | Passed | Annex F |
| | | 7.5 | The marking shall be durable and easily legible | Inspection | Passed | Annex F |
| 2 | Duct Assembly, by other means than threads | 9.6 | Not designed to be disassembled | N/A | N/A | N/A |
| 3 | Vicat softening test | 16.2 | The vicat softening temperature shall not be less than 75°C | User Spec 16.2 | Passed | Annex G |
| 4 | Static friction coefficient test | 16.3 | The static friction coefficient shall not exceed 0.27 | User Spec 16.3 | Passed | Annex H |

ANNEX A:

| | |
|-------------------------------|---|
| SAMPLE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

CONSTRUCTION

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 clause 9.1c

The cross section of the ducts shall be circular, and the internal bore shall be smooth and substantially concentric with the external surface. The material shall be free from cracks, inclusions, delamination or other defects. Both ends of the duct shall be cleanly cut perpendicular to the central axis of the duct.

Test results: All tests passed.

ANNEX B:

| | |
|-------------------------------|---|
| SAMPLE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

DIMENSIONS- DIAMETER

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 8.2.3a

Test Requirements: Nominal inside diameter 38mm.

Test results:

| Measurement 1 | Duct Diameter (mm) | | | |
|---------------|--------------------|---------------|---------------|---------|
| | Measurement 2 | Measurement 3 | Measurement 4 | Average |
| 38.81 | 37.95 | 37.73 | 37.69 | 38.05 |
| 37.89 | 38.24 | 37.94 | 38.49 | 38.14 |
| 37.84 | 38.11 | 38.17 | 38.50 | 38.16 |
| 38.20 | 38.16 | 37.95 | 38.03 | 38.09 |
| 37.99 | 37.90 | 37.91 | 38.35 | 38.04 |
| 38.52 | 37.75 | 37.67 | 38.58 | 38.13 |

DIMENSIONS- OVALITY

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 8.2.3b

Test Requirements: Maximum Ovality 3.4mm.

Test results:

| Measurement | Maximum Measured Ovality (mm) |
|-------------|-------------------------------|
| 1 | 2.39 |
| 2 | 1.58 |

DIMENSIONS- LENGTH

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2007/08 Clause 8.2.3c

Test Requirements: The minimum length shall be the length ordered.

Test results: All duct samples were provided as 1 meter lengths.

ANNEX C:

| | |
|-------------------------------|---|
| SAMPLE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

COMPRESSION TEST

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 10.2
 Test Requirements: Sample length 200±5 mm, temperature 23°C, nine test samples.
 When reaching the deflection of 5%, the applied force shall be at least 450 N or equivalent at 23°C. After test samples shall show no cracks visible to normal or corrected vision without additional magnification.

Test Equipment Instron 3367 , 15mm +/-0.5 per minute crosshead speed (Figure 1).



Figure 1 Resistance to deformation test rig

Test Results:

| Test Sample | Load at 5% Deformation (N) |
|---------------------------|----------------------------|
| 1 | 991.7493 |
| 2 | 965.1697 |
| 3 | 901.5527 |
| 4 | 996.4597 |
| 5 | 960.0002 |
| 6 | 940.5876 |
| 7 | 904.1335 |
| 8 | 912.9008 |
| 9 | 933.6054 |
| Average | 945.1288 |
| Median | 940.5876 |
| Standard Deviation | 35.71182 |
| Range | 94.90692 |

ANNEX D:

| | |
|-------------------------------|---|
| SAMPLE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

IMPACT TEST at -5°C

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 10.3
Test Requirements: Sample length 200±5 mm, temperature -5°C conditioned for 2 hours, fourteen test samples, hammer weight 5kg, fall distance 300mm, 36.1mm diameter ball used for compliance test.

Test Equipment Temperature controlled environmental chamber, as shown in Figure 2



Figure 2 Impact test rig

Test Results: 36.1mm ball passed through all test pieces freely, no signs of disintegration or any crack that allowed the ingress of light or water between the inside and outside were present.

ANNEX E:

| | |
|-------------------------------|---|
| SAMPLE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

HEAT REVERSION

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 16.5
Test Requirements: Sample length 300±5 mm, temperature 150°C conditioned for 1 hour, one test sample.
Maximum percentage change 5%, samples shall be free from blistering.

Test Equipment Genlab industrial air circulation oven.

Test Results:

| | |
|-------------------|----------|
| Initial length | 100.54mm |
| Final length | 100.13mm |
| Percentage Change | 0.41% |

ANNEX F:

| | |
|------------------------|---|
| SAMPLE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

MARKING

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 7.1, 7.2, 7.4 and 7.5
 Test Requirements: Ducts, couplings and bends shall be coloured black or red, throughout their length
 The duct shall be marked "ELECTRIC CABLE DUCT C_MFR" Class number shall be inserted after "C"

"MFR" shall be replaced by manufacturer's reference Minimum print size of 6mm

The gap between the end of one print message and start of the next print shall not be more than 200 mm

The markings shall be on two print lines, 180° apart
 Classification code marked every 1 metre
 The marking shall be durable and easily legible

Test Equipment Visual Inspection

Test Results: Coloured Black
 Duct marked 'ELECTRIC CABLE DUCT C3NAYLOR"
 Text area more than 6mm
 Gap between repeated print message less than 200mm
 The markings printed on two lines, 180° apart
 Classification code marked every 1 metre
 The markings were legible following rubbing by hand for 15 seconds with a piece of cloth soaked in water and again for 15 seconds with a piece of cloth soaked with petroleum spirits
 Care should be taken in handling the samples to ensure excessive abrasion does not remove the lettering. The consistency and clarity of marking should be continuously reviewed during manufacture.

ANNEX G:

| | |
|------------------------|---|
| TYPE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

VICAT SOFTENING TEMPERATURE

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 16.2

Test Requirements: The vicat softening temperature not be less than 75°C.
Two measurements shall be taken, and the difference shall not exceed 2°C.

Test Equipment Load of 9.81N
Indent size 1mm².
Sample thickness 3mm.
Heat transfer medium Transformer oil.

Test Results: Vicat softening temperature 123.6°C.
No alterations in appearance

ANNEX H:

| | |
|-------------------------------|---|
| TYPE TEST: | Polyethylene, nominal inside diameter 38mm, Class 3, rigid and coilable |
| Sample identification: | 1m Test Samples - Batch from Client |
| Test period: | May 2024 to June 2024 |
| Standard Reference: | Cable Duct User Spec ENATS 12/24 Issue 2021 |

STATIC FRICTION COEFFICIENT TEST

Test Procedure: Cable Duct User Spec ENATS 12/24 Issue 2021 Clause 16.3
 Test Requirements: Sample length 1 metre, three test samples.
 The static friction coefficient shall not exceed 0.27.

Test Equipment See Figure 3



Figure 3 Static friction coefficient test rig

Test Results:

| Test Sample | Test No | Static Friction Coefficient | | | | | | Average |
|-------------|---------|-----------------------------|------|------|------|------|-----------------|---------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | |
| 1 | 1 | 0.17 | 0.13 | 0.12 | 0.13 | 0.10 | 0.12 | 0.13 |
| | 2 | 0.11 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.12 |
| 2 | 1 | 0.13 | 0.14 | 0.15 | 0.13 | 0.14 | 0.15 | 0.14 |
| | 2 | 0.14 | 0.15 | 0.14 | 0.15 | 0.15 | 0.14 | 0.15 |
| 3 | 1 | 0.14 | 0.15 | 0.13 | 0.14 | 0.14 | 0.15 | 0.14 |
| | 2 | 0.15 | 0.16 | 0.14 | 0.15 | 0.16 | 0.16 | 0.15 |
| | | | | | | | Overall Average | 0.14 |



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