DSV - PDC - VP - PLASTICS

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Confidential Technical Report

ACRYLIC TESTING TO ASME PVHO-1-2019 (TABLE 2-3.4-2)

Prepared for:

Stanley Plastics
Holmbush Industrial Estate
Midhurst
West Sussex
GU29 9HX

For the attention of: Paul Everley

Email: paul@stanleyplastics.co.uk

CTR number: 64520 **Version:** 02 **Date:** 2nd November 2021

Proposal: 164589HG **Project No:** GD0077-2

Author	Technical Review
Tracy Davies Supervisor of Materials Testing Laboratory	Ivan Legge Senior Test Engineer - Materials Testing
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Factual Statement of Pressure Testing of Decompression Chamber

Office: **Newcastle Upon Tyne**

Date: **17 May 2022**

This Statement is issued to Submarine Manufacturing and Products (SMP) Ltd, to confirm that the undersigned surveyor did attend at Hartlepool Marina on board DSV Curtiss Marshall IMO 9775012 on, 05th May 2022, in order to carry out surveys as described below:

Description:	1 off – 60" Shortened SMP hyperbaric chamber. (Fabricated as per PD 5500: 2009 CAT 1 Pressure Equipment Directive 87/23/EC Mod G). Pressure Chamber fabricator: Submarine Manufacturing and Products Ltd. Comprising 1 x Main lock, Entry Lock and Medical Lock. De-rated from 10 Barg to Maximum Allowable Operating pressure 7barg (Hydro Test Pressure 7.7 Barg). Operating Temp Range -10°C to +50°C
Identification:	Chamber Serial No: Serial number IT8412 Year of Build: 2012 Design Pressure: 10 Bar (G) Type: CAT 1
Document Review & Examination	Internal and external General Visual Inspection (GVI) of the chambers and fittings. Internal and external fittings and penetration through the pressure hull found in good condition. No visible sign of deformation and corrosion noted. Document review of the Stanley plastic certification records for the acrylic viewports completed and following noted: 145 Psi / -10°C to +50°C/PVHO/SP/39317/22 Fitted 04 May 2022 (Manufactured 12 April 2022. Ref Stanley Plastic (23954) 145 Psi / -10°C to +50°C/PVHO/SP/39317/22 Fitted 04 May 2022 (Manufactured 12 April 2022). Document review of the gauge calibration record reviewed and found to be in date. Main depth gauge S/N 75842-22-09, 14th January 2022. Entry lock gauge S/N 83258-18-12, 14th January 2022. Medical lock depth gauge S/N 27933 – 857/01, 14th January 2022.
Pressure testing	Internal pneumatic over pressure test was completed as per procedure SMP-HPTP-001 Rev 2 at 77 meters Seawater (1.1 x MSW) for 30 minutes, to Main lock, Medical lock and Entry lock as follows: Main lock shut, medical open & entry to main chamber access shut. Entry lock with doors to each main chamber (either side) closed. Entry lock to main lock open, medical outer open. Main chamber door open x 01 entry lock, medical lock inner door closed and outer door open.
Other	Complete renewal 10 yearly PVHO. Safety interlocking devices for medical lock demonstrated satisfactorily.
Conclusion	On the basis of the surveys now done it is considered that the PVHO's as found and listed above have been installed and tested accordance with the requirements of the applicable section of the IMCA code of Practice on the Periodic Examination of Testing of Diving Plan and Equipment

4. RESULTS

	Acrylic Lot No 22974 (2)		
Property	**Results**	**Mean**	**Specified Values**
Tensile Strength, MPa	76.5, 77.7, 74.0, 72.4, 70.6	74.2	≥ 62 MPa
Elongation At Break, %	4.3, 4.4, 4.6, 4.0, 3.8	4.2	≥ 2 %
Tensile Modulus, MPa	3455, 3384, 3410, 3231, 3125	3321	≥ 2760 MPa
Compressive Yield Strength, MPa	110, 112, 111, 110, 112	111	≥ 103 MPa
Compressive Modulus, MPa	2917, 2945, 2944, 2832, 2852	2898	≥ 2760 MPa
Flexural Strength, MPa	123, 123, 121, 126, 118	122	≥ 97 MPa
Compressive Deformation, %	0.76, 0.63	0.69	≤ 1.0 %
Ultraviolet Transmittance, %	<0.14		≤ 5 %
Monomer Content Methyl Methacrylate, %	0.36, 0.36	0.36	≤ 1.6 %
Visual Clarity	Clear and readable		Clear and readable

Version Number	Submission Date	Description	Reason for changes	Author or Originator
01	19th May 2021	Original Document	N/A	Tracy Davies
02	2nd November 2021	Amended Document	ASME PVHO-1 version changed from 2016 to 2019	Tracy Davies

End of Report

ASME PVHO-1- 2019

Stanley Plastics Ltd

PVHO-1 Form VP-4 Material Testing Certification for Acrylic

1. Test specimens have been supplied already cut by Stanley Plastics Limited.

2. Test specimen taken from acrylic casting No 23954 in Lot 22974 have been produced by Stanley Plastics Limited. under the trademark of 'Transpalite SS' possess the following physical and chemical properties

TEST METHOD	PROPERTY	AVERAGE VALUES
ASTM D 638	Tensile: (a) Ultimate strength (b) Elongation at break (c) Modulus of elasticity	 74.2 Mpa 4.2% 3321 Mpa
ASTM D 695	Compressive: (a) Yield strength (b) Modulus of elasticity	 111 Mpa 2898 Mpa
PVHO-1 method para. 2-3.7 (c)	Compressive deformation at 4,000 psi (27.6 MPa) and 122°F (50° C)	0.69%
PVHO-1 method para 2-3.7(d)	Ultraviolet transmittance (for 1/2 in. (12.5mm) thickness)	<0.14%
PVHO-1, para. 2-3.7(e)	Visual clarity	Clear and Readable
PVHO-1, para. 2-3.8	Total residual methyl methacrylate and ethyl acrylate monomers	0.36%

The experimentally proven properties satisfy the minimum values specified in Table 2-3.4-2 of the Safety Standard for Pressure Vessels for Human Occupancy.

Tracey Davies Laboratory Supervisor. 2nd November 2021

Authorized representative of material testing laboratory Date

Smithers Rapra and Smithers Pira Limited, Shawbury, Shrewsbury, Shropshire SY4 4NR

Name and address of material testing laboratory

Test Data has been mailed to Stanley Plastics Limited, Holmbush Industrial Estate, Midhurst, West Sussex.

ASME PVHO-1-2019

PVHO-1 Form VP-1 Fabrication Certification for Acrylic Windows Page 1 of 2

Window Drawing No: 1101-001 Rev 1 SHT 3

Window Identification: 145 psi / -10 °C + 50°C / PVHO / SP / 39317 / 22

Material Stock Description

Manufacturer of Acrylic	Stanley Plastics Ltd
Trade Name	Transpalite SS
Casting Shape	Flat Disc
Nominal Thickness	72 mm
Lot Number	22974
Casting Number	23954
Certified for Conformance to Table 2-3.4-1 by	Smithers Rapra and Smithers Pira
Date:	2nd November 2021
Certified for Conformance to Table 2-3.4-2 by	Smithers Rapra and Smithers Pira
Date:	2nd November 2021

Window Description

Maximum Allowable Working Pressure Rating	145 psi
Maximum temperature Rating	50 ° C
Window Designed By	(Name of Company and Designer)
Joint Bonding (if applicable)	
Manufacturer of acrylic Cement	Stanley Plastics Limited
Trade Name of Cement	N/A
Curing Means and Duration	N/A
Average Tensile Strength (per ASTM D 638	N/A
Joint Quality Conforms to Para. 2-3.10 (yes/no)	N/A
Polishing Agents	Cannings Lusture
Cleaning Agent	ICI Polish No 2

Stanley Plastics Ltd
Transpalite SS

ASME PVHO-1-2019

PVHO-1 Form VP-1 Fabrication Certification for Acrylic Windows Page 1 of 2

Window Drawing No: 1101-001 Rev 1 SHT 3

Window Identification: 145 psi / -10 °C + 50°C / PVHO / SP / 39318 / 22

Material Stock Description

Manufacturer of Acrylic	Stanley Plastics Ltd
Trade Name	Transpalite SS
Casting Shape	Flat Disc
Nominal Thickness	72 mm
Lot Number	22974
Casting Number	23954
Certified for Conformance to Table 2-3.4-1 by	Smithers Rapra and Smithers Pira
Date:	2nd November 2021
Certified for Conformance to Table 2-3.4-2 by	Smithers Rapra and Smithers Pira
Date:	2nd November 2021

Window Description

Maximum Allowable Working Pressure Rating	145 psi
Maximum temperature Rating	50 ° C
Window Designed By	(Name of Company and Designer)
Joint Bonding (if applicable)	
Manufacturer of acrylic Cement	Stanley Plastics Limited
Trade Name of Cement	N/A
Curing Means and Duration	N/A
Average Tensile Strength (per ASTM D 638	N/A
Joint Quality Conforms to Para. 2-3.10 (yes/no)	N/A
Polishing Agents	Cannings Lusture
Cleaning Agent	ICI Polish No 2

Window Identification: 39317 / 22

Stanley Plastics Ltd
Transpalite SS
ESTD. 1950

ASME PVHO-1-2019

PVHO-1 Form VP-2 Acrylic Window Design Certificate Page 1 of 2

Window Description **Window Drawing No** 1101-001 Rev 1 SHT 3

Maximum allowable working pressure	145 psi
Maximum design temperature	50° C
Minimum design temperature	-10° C
Window shape	Flat Disc
Conversion factor table number	2-2.3.1-1
Pressure range, N	1
Conversion factor, CF	10
Conversion Factor at Temp:	
Maximum Internal Ambient Temp:	°C
Maximum External Ambient Temp:	C
Short-term critical pressure and fig. no.	10 MPa (Fig 2-2.5.1-2

Experimental verification[Note (1)]

Thickness t (actual) _____
D_i (actual) _____
D_0 (actual) _____
Water Temp - °F ____ °C

No.1: - No.2: -
No.3: - No.4: -
No.5: - STCP: -

(Note each test specimen FS for full scale and MS for model scale

Type of Failure	
Test Conducted at	
Test supervised by	

Window Design

Inner Diameter, D (Nominal)	200 mm
Outer Diameter (Nominal):	mm
Included Angle (Nominal)	
External Radius of Curvature (Nominal)	N/A
Minimum t/D_i (Calculated)	0.195 mm
Minimum t (Calculated)	39 mm
Do IDt Nominal:	
Di/Df (Nominal)	- -
Maximum Df Calculated:	

ASME PVHO-1- 2019

Stanley Plastics Ltd
Transpalite SS

PVHO-1 Form VP-4 Material Testing Certification for Acrylic

1. Test specimens have been supplied already cut by Stanley Plastics Limited.

2. Test specimen taken from acrylic casting No 23954 in Lot 22974 have been produced by Stanley Plastics Limited. under the trademark of 'Transpalite SS' possess the following physical and chemical properties

TEST METHOD	PROPERTY	AVERAGE VALUES
ASTM D 638	Tensile: (a) Ultimate strength (b) Elongation at break (c) Modulus of elasticity	 74.2 Mpa 4.2% 3321 Mpa
ASTM D 695	Compressive: (a) Yield strength (b) Modulus of elasticity	 111 Mpa 2898 Mpa
PVHO-1 method para. 2-3.7 (c)	Compressive deformation at 4,000 psi (27.6 MPa) and 122° F (50° C)	0.69%
PVHO-1 method para 2-3.7(d)	Ultraviolet transmittance (for 1/2 in. (12.5mm) thickness)	<0.14%
PVHO-1, para. 2-3.7(e)	Visual clarity	Clear and Readable
PVHO-1, para. 2-3.8	Total residual methyl methacrylate and ethyl acrylate monomers	0.36%

The experimentally proven properties satisfy the minimum values specified in Table 2-3.4-2 of the Safety Standard for Pressure Vessels for Human Occupancy.

Tracey Davies Laboratory Supervisor. 2nd November 2021

Authorized representative of material testing laboratory Date

Smithers Rapra and Smithers Pira Limited, Shawbury, Shrewsbury, Shropshire SY4 4NR

Name and address of material testing laboratory

Test Data has been mailed to Stanley Plastics Limited, Holmbush Industrial Estate, Midhurst, West Sussex.

Stanley Plastics Ltd
Transpalite SS

ASME PVHO-1-2019

PVHO-1 Form VP-3 Material Manufacturer's Certification of Acrylic

The acrylic sheet/custom castings 72 mm thickness of Lot Control No. 22974 have been produced by Stanley Plastics Limited under the trademark of Transpalite SS.

These castings possess typical physical properties satisfying the minimum values specified in

Safety Standard for Pressure Vessels for Human Occupancy, Section 2, Table 2-3.4-1in

accordance with the material manufacturer's Quality Assurance Manual.

Stanley Plastics has ISO 9001:2008 Certification With

URS Certificate 67065/A/0001/UK/EN May 2015

Date

QA Program Audited and Accepted as in Compliance by Purchaser (Vessel Manufacturer, Owner/User, or their designated agent)

Maica Simpson 12 April 2022

Authorised representative of manufacturer of plastic Date

Stanley Plastics Limited, Units 4-7 Holmbush Industrial Estate, Midhurst, West Sussex, GU29 9HX, England

Name and address of manufacturer of plastic

Stanley Plastics Ltd
Transplate SS
ESTD

ASME PVHO-1-2019

PVHO-1 Form VP-2 Acrylic Window Design Certificate Page 1 of 2

Window Description **Window Drawing No** 1101-001 Rev 1 SHT 3

Maximum allowable working pressure	145 psi
Maximum design temperature	50° C
Minimum design temperature	-10° C
Window shape	Flat Disc
Conversion factor table number	2-2.3.1-1
Pressure range, N	1
Conversion factor, CF	10
Conversion Factor at Temp:	
Maximum Internal Ambient Temp:	° C
Maximum External Ambient Temp:	° C
Short-term critical pressure and fig. no.	10 MPa (Fig 2-2.5.1-2

Experimental verification[Note (1)]

Thickness t (actual) _____
D_i (actual) _____
D_0 (actual) _____
Water Temp _____ ° F _____ ° C

No.1: - No.2: -
No.3: - No.4: -
No.5: - STCP: -

(Note each test specimen FS for full scale and MS for model scale

Type of Failure	
Test Conducted at	
Test supervised by	

Window Design

Inner Diameter, D (Nominal)	200 mm
Outer Diameter (Nominal):	mm
Included Angle (Nominal)	
External Radius of Curvature (Nominal)	N/A
Minimum t/D_i (Calculated)	0.195 mm
Minimum t (Calculated)	39 mm
Do IDt Nominal:	
Di/Df (Nominal)	- -
Maximum Df Calculated:	