REPORT ON

Type Approval Testing of the McMurdo Ltd
S4 Search and Rescue Transponder in accordance with IEC 61097-1 (1992-07)
And IEC 60945 (2002-08)

COMMERCIAL-IN-CONFIDENCE

Report No RM 610860/01 Issue 1 Part 2 October 2003

TÜV PRODUCT SERVICE

BABT

ANNEX A

Radar Related Test Information

.

QinetiQ in Confidence

Certificate of Test

QinetiQ

SART FRONT END PROTECTION

Certificate number: QinetiQ/S&E/ MATS/R/TT 12/03-1
Date of issue: 22ND Aug 2003
Issue: 1.0

QinetiQ
Fraser Range
Fort Cumberland Road
Eastney, Portsmouth
Hampshire PO4 9LJ UK
Telephone: 02392 334509
Facsimile: 02392 334519

Customer:	TUV Product Services Ltd
Customer Representative:	Mrs M Hardy
Equipment under test:	Search & Rescue Transponder (SART)
Build Standard:	Production units
Power supply:	Battery powered
Test specifications:	BS EN 61097-1 Clause 6.9.9 Front End Protection
Test dates:	21st Aug 2003
Time	11:00 (BST)
Modes of operation:	Equipment in active mode
Test conducted by	R Sharp
Test witnessed by	M Hardy
Test House Supervisor:	R Sharp
Location of Testing:	Fraser Range
Interrogating Radar details	Selesmar 12.5kW X Band Radar set to 12nm long pulse

Test Item Details

Manufacturer	Type	Serial No
Mc Murdo	S4-9 GHz SART	S4/03/00001

Test Requirement

The SART is required to survive a radiated field of 28dBW/m^2 from an X-Band Marine Radar meeting IMO resolutionA477(XII)

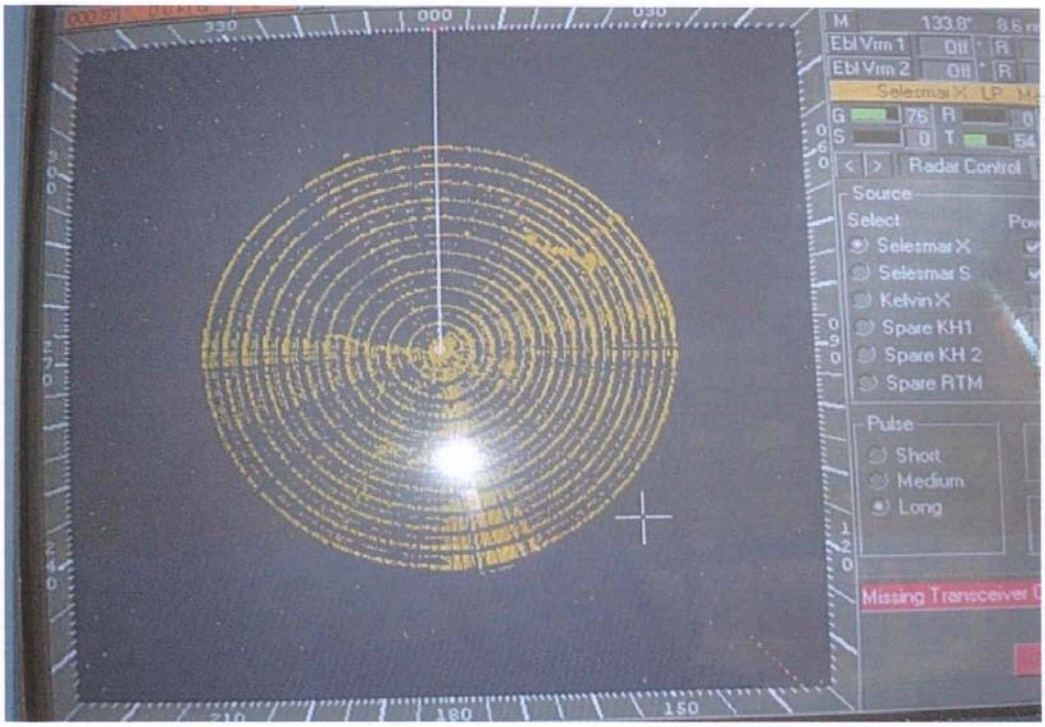
Test Results Summary

Test
It was determined prior to testing that the Selesmar radar listed could produce the required field density. The SART was placed at the appropriate distance from the radar, and the radar was activated. During this period the SART continued to function and pictures of the radar display were taken. After 5 mins the radar was switched off and the SART continued to function correctly. **Result** SART passed front-end Protection test. Picture of the SART response presented on next page.

IT IS CERTIFIED THAT THE TESTS DETAILED IN THIS CERTIFICATE HAVE BEEN CARRIED OUT AS SPECIFIED, WITH THE RESULTS AS SHOWN, TO THE REQUIREMENTS OF THE CONTRACT.

Signed R Sharp Date 22nd August 2003

PICTURES OF MC MURDO SART RESPONSE
DURING
FRONT END PROTECTION TEST



QinetiQ in Confidence

Certificate of Test

QinetiQ

SART RANGE TEST

Certificate number: QinetiQ/S&E/ MATS/R/TT 10/03-1
Date of issue: 11th July 2003
Issue: 1.0

QinetiQ
Fraser Range
Fort Cumberland Road
Eastney, Portsmouth
Hampshire PO4 9LJ UK
Telephone: 02392 334509
Facsimile: 02392 334519

Customer:	TUV Product Services Ltd
Customer Representative:	Mrs M Hardy
Equipment under test:	Search & Rescue Transponder (SART)
Build Standard:	Production units
Power supply:	Battery powered
Test specifications:	BS EN 61097-1 Clause 3.7 Range Performance
Test dates:	10th July 2003
Time	14:40 (BST)
Modes of operation:	Equipment in active mode
Test witnessed by	R Sharp/ M Blackwell
Test House Supervisor:	R Sharp
Location of Testing:	Radar sited at Fraser Range Portsmouth. SART deployed at Bracklesham Bay
Radar Details	Kelvin Hughes Nucleus 2 6000 25kW X- Band
Separation	7nm

Test Item Details

Manufacturer	Type	Serial No
Mc Murdo	S4-9 GHz SART	S4/03/00001

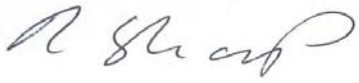
Environmental Conditions

Sea state	Visibility	Tide
1-2	5nm	Low

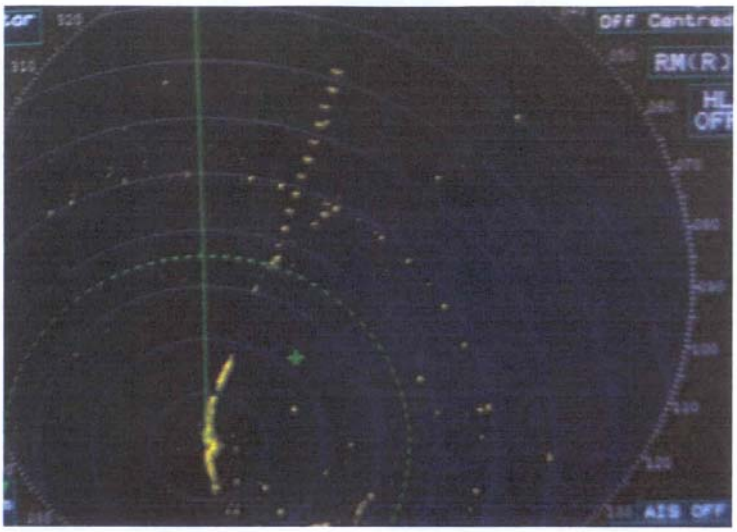
Test Results Summary

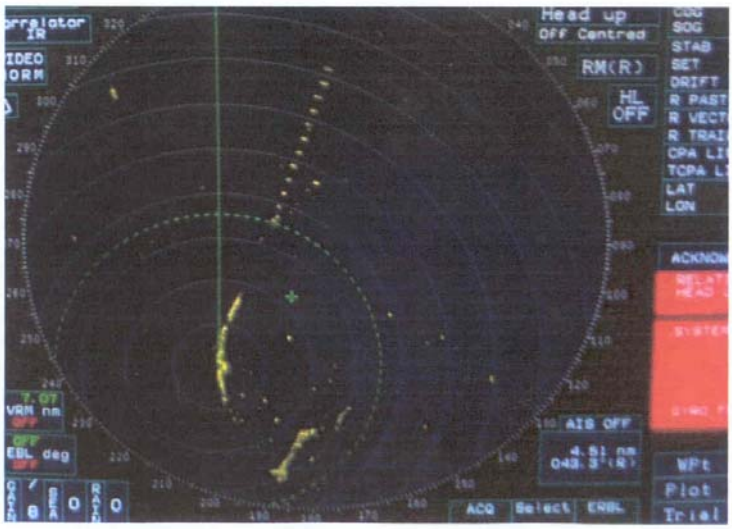
Test
The SART response was tested as defined in the specification indicated, with an X-Band Marine Radar meeting IMO resolutionA477(XII) The test was conducted with the SART positioned at the waters edge with the lowest part of the antenna set at 1 metre above the surface of the sea, and in line of sight to the Radar antenna at Fraser Range over a sea path. The Radar was detuned to reduce land returns and enhance the SART response. The resultant display was photographed. Result SART performance observed as satisfactory.

IT IS CERTIFIED THAT THE TESTS DETAILED IN THIS CERTIFICATE HAVE BEEN CARRIED OUT AS SPECIFIED, WITH THE RESULTS AS SHOWN, TO THE REQUIREMENTS OF THE CONTRACT.

Signed  Date 11th July 2003

PICTURES OF MC MURDO SART RESPONSE





Annex B

Manufacturer Supplied Information

SART S4 EMC failure report

Test: IEC 60945 Clause 10.4 immunity to radiated radio frequencies

Results: SART responding with 12 sweeps between 9.2GHz to 9.5GHz to an electric field of strength 10V/m between the frequencies of 1.445GHz to 1.85GHz.

The EUT under test is required to perform to criterion A as described in 10.1 of IEC 60945, which states:

- performance criterion A: the EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer.

The SART was placed in a modulated electric field of strength 10V/m swept over the frequency range 80MHz to 2GHz. The modulation applied was 400Hz ± 10% to a depth of 80% ± 10%.

Between the frequencies of 1.445GHz to 1.85GHz, the SART responded as if it were being triggered by an X-band radar i.e. with 12 sweeps between 9.2GHz to 9.5GHz.

Referring to Figure 1 on page 2, investigations showed that the gate of FET T18 was picking up the interrogating signal. The signal was then fed straight into the video amp via the Drain of T18, causing the SART to respond with 12 sweeps.

The solution to this was to solder a SIMID 0805 68nH inductor (L1) to the gate of T18, as shown in Figure 1 page 2 and also Figure 2 page 3. The inductor is self-resonant at 1.550GHz, when the solution was modelled in the software package Rfsimm99 the unwanted signals were reduced by some 30dB, as shown in Figure 3 page 4.

A new SART was built to this standard and submitted to TüV for retest.

This modification will be incorporated into the PCB (Part No 86-500) build standard for Production.

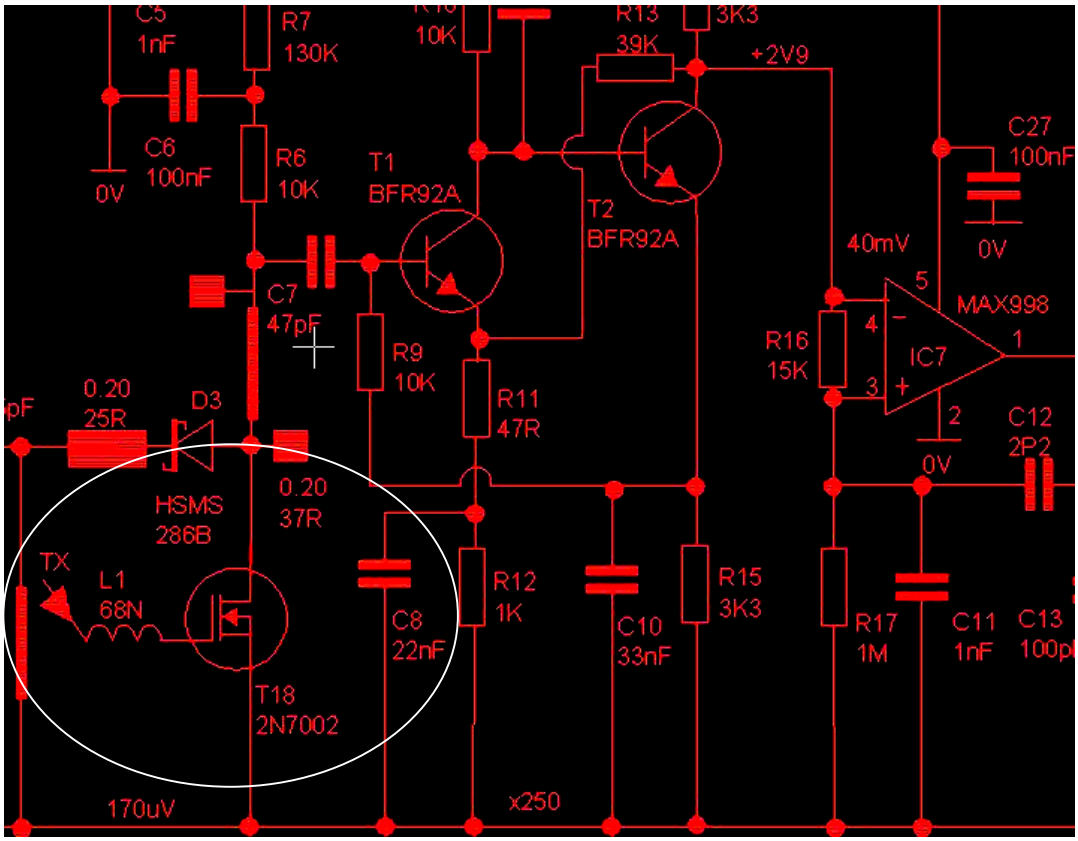


Figure 1

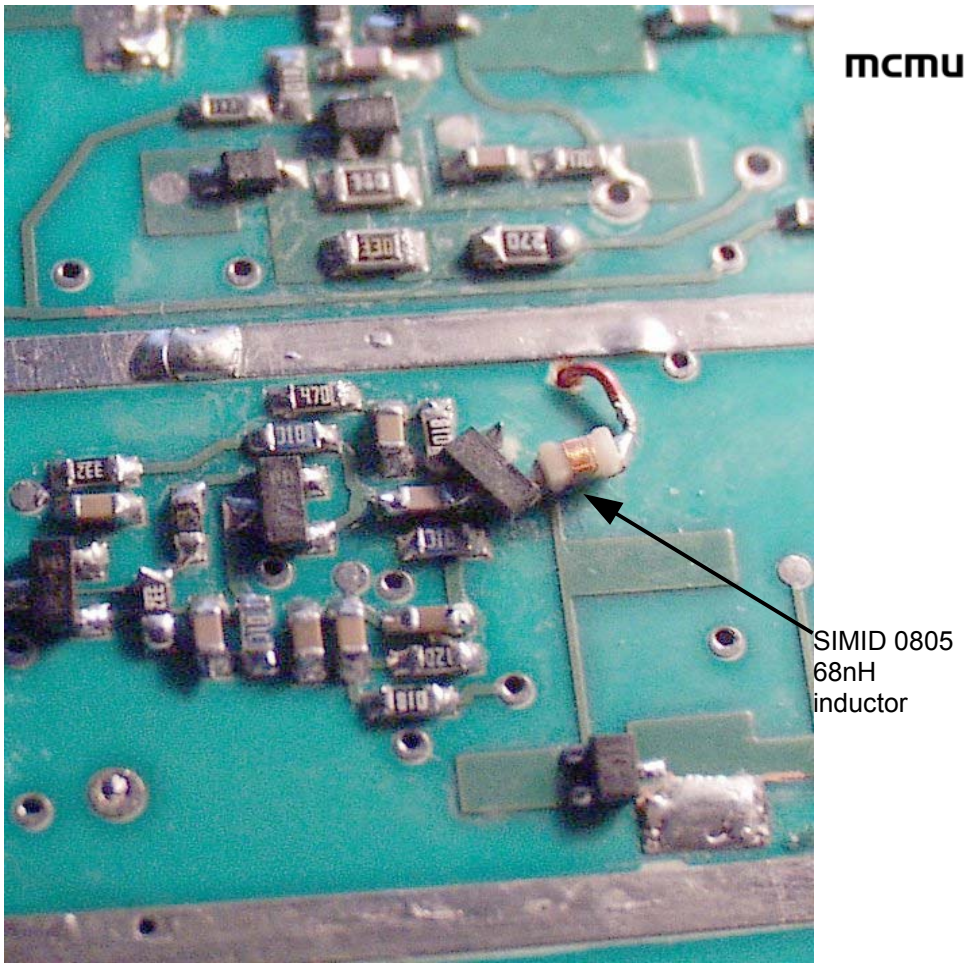


Figure 2

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Bayer

Datasheet for Bayblend T85. Standard grades / Non reinforced

General purpose injection molding grade; Vicat/B 120 temperature = 131° C; high impact and notched impact strength.

PC+ABS
Standard: ISO

Date: 02.10.2003

	Property	Test Condition	Standard	Unit:	Value
	Rheological properties				
	Spiral flow length	260 °C; 2 x 8.7 mm	Bayer test	mm	345
C	Melt volume-flow rate	260 °C; 5 kg	ISO 1133	cm³/(10 min)	12
	Molding shrinkage, parallel	150x105x3; 260 °C / MT 80 °C; 500 bar	based on ISO 2577	%	0.55 - 0.75
	Molding shrinkage, normal	150x105x3; 260 °C / MT 80 °C; 500 bar	based on ISO 2577	%	0.55 - 0.75
	Mechanical properties (23 °C/50 % r.h.)				
C	Tensile modulus	1 mm/min	ISO 527-1,-2	MPa	2300
C	Yield stress	50 mm/min	ISO 527-1,-2	MPa	55
C	Yield strain	50 mm/min	ISO 527-1,-2	%	4.7
	Stress at break	50 mm/min	ISO 527-1,-2	MPa	48
	Strain at break	50 mm/min	based on ISO 527-1,-2	%	> 50
	Izod impact strength	23 °C	ISO 180-1U	kJ/m²	N
	Izod impact strength	-30 °C	ISO 180-1U	kJ/m²	N
	Izod notched impact strength	23 °C	ISO 180-1A	kJ/m²	48
	Izod notched impact strength	-30 °C	ISO 180-1A	kJ/m²	38
	Thermal properties				
C	Temperature of deflection under load	1.80 MPa	ISO 75-1,-2	°C	109
C	Temperature of deflection under load	0.45 MPa	ISO 75-1,-2	°C	127
C	Vicat softening temperature	50 N; 50 °C/h	ISO 306	°C	129
	Vicat softening temperature	50 N; 120 °C/h	ISO 306	°C	131
C	Coefficient of linear thermal expansion, parallel	23 to 55 °C	ISO 11359-1,-2	10^{-4}/K	0.75
C	Coefficient of linear thermal expansion, transverse	23 to 55 °C	ISO 11359-1,-2	10^{-4}/K	0.8
C	Burning behavior UL 94	0.85 mm	UL 94	Class	HB
	Electrical properties (23 °C/50 % r.h.)				
C	Relative permittivity	100 Hz	IEC 60250	-	3.1
C	Relative permittivity	1 MHz	IEC 60250	-	3.0
C	Dissipation factor	100 Hz	IEC 60250	10^{-4}	20
C	Dissipation factor	1 MHz	IEC 60250	10^{-4}	85
C	Volume resistivity		IEC 60093	Ohm*m	1E14
C	Surface resistivity		IEC 60093	Ohm	1E16
C	Electric strength	1 mm	IEC 60243-1	kV/mm	35
C	Comparative tracking index CTI	Solution A	IEC 60112	Rating	200

	Other properties (23 °C)				
C	Water absorption	Saturation value in water at 23 °C	ISO 62	%	0.7
C	Water absorption	Equilibrium value at 23 °C; 50 % RH	ISO 62	%	0.2
C	Density		ISO 1183	kg/m³	1150
	Processing conditions for test specimens				
C	Injection molding-Melt temperature		ISO 294	°C	260
C	Injection molding-Mold temperature		ISO 294	°C	80
C	Injection molding-Injection velocity		ISO 294	mm/s	240

Disclaimer

Standard Disclaimer

The manner in which you use and the purpose to which you put and utilize our products, technical assistance and information (whether verbal, written or by way of production evaluations), including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety and environmental standpoint. Such testing has not necessarily been done by us. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale. All information and technical assistance is given without warranty or guarantee, and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance and information. Any statement or recommendation not contained herein is unauthorized and shall not bind us. Nothing herein shall be construed as a recommendation to use any product in conflict with patents covering any material or its use. No license is implied or in fact granted under the claims of any patent.

Typical Properties

Property data is provided as general information only. Property values are approximate and are not part of the product specifications.

Flammability

Flammability results are based on small-scale laboratory tests for purposes of relative comparison and are not intended to reflect the hazards presented by this or any other material under actual fire conditions.

Health and Safety

Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling Bayer products mentioned in this publication. Before working with any of these products, you must read and become familiar with the available information on their hazards, proper use, and handling. This cannot be overemphasized. Information is available in several forms, e.g., material safety data sheets (MSDS) and product labels. Consult your Bayer Polymers representative or contact the Bayer Product Safety and Regulatory Affairs Department in Pittsburgh, Pennsylvania. For materials that are not Bayer products, appropriate industrial hygiene and other safety precautions recommended by their manufacturer(s) must be followed.

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Bayer

Datasheet for Bayblend T65. Standard grades / Non reinforced

General purpose injection molding grade; Vicat/B 120 temperature = 120 °C; good low temperature impact strength.

PC+ABS
Standard: ISO

Date: 02.10.2003

	Property	Test Condition	Standard	Unit:	Value
	Rheological properties				
	Spiral flow length	260 °C; 2 x 8.7 mm	Bayer test	mm	410
C	Melt volume-flow rate	260 °C; 5 kg	ISO 1133	cm³/(10 min)	12
	Molding shrinkage, parallel	150x105x3; 260 °C / MT 80 °C; 500 bar	based on ISO 2577	%	0.55 - 0.75
	Molding shrinkage, normal	150x105x3; 260 °C / MT 80 °C; 500 bar	based on ISO 2577	%	0.55 - 0.75
	Mechanical properties (23 °C/50 % r.h.)				
C	Tensile modulus	1 mm/min	ISO 527-1,-2	MPa	2200
C	Yield stress	50 mm/min	ISO 527-1,-2	MPa	52
C	Yield strain	50 mm/min	ISO 527-1,-2	%	4.2
	Stress at break	50 mm/min	ISO 527-1,-2	MPa	45
	Strain at break	50 mm/min	based on ISO 527-1,-2	%	> 50
	Izod impact strength	23 °C	ISO 180-1U	kJ/m²	N
	Izod impact strength	-30 °C	ISO 180-1U	kJ/m²	N
	Izod notched impact strength	23 °C	ISO 180-1A	kJ/m²	45
	Izod notched impact strength	-30 °C	ISO 180-1A	kJ/m²	41
	Thermal properties				
C	Temperature of deflection under load	1.80 MPa	ISO 75-1,-2	°C	100
C	Temperature of deflection under load	0.45 MPa	ISO 75-1,-2	°C	122
C	Vicat softening temperature	50 N; 50 °C/h	ISO 306	°C	118
	Vicat softening temperature	50 N; 120 °C/h	ISO 306	°C	120
C	Coefficient of linear thermal expansion, parallel	23 to 55 °C	ISO 11359-1,-2	10^{-4}/K	0.8
C	Coefficient of linear thermal expansion, transverse	23 to 55 °C	ISO 11359-1,-2	10^{-4}/K	0.85
C	Burning behavior UL 94	0.85 mm	UL 94	Class	HB
	Electrical properties (23 °C/50 % r.h.)				
C	Relative permittivity	100 Hz	IEC 60250	-	3.1
C	Relative permittivity	1 MHz	IEC 60250	-	3.0
C	Dissipation factor	100 Hz	IEC 60250	10^{-4}	30
C	Dissipation factor	1 MHz	IEC 60250	10^{-4}	85
C	Volume resistivity		IEC 60093	Ohm*m	1E14
C	Surface resistivity		IEC 60093	Ohm	1E16
C	Electric strength	1 mm	IEC 60243-1	kV/mm	35
C	Comparative tracking index CTI	Solution A	IEC 60112	Rating	250

	Other properties (23 °C)				
C	Water absorption	Saturation value in water at 23 °C	ISO 62	%	0.7
C	Water absorption	Equilibrium value at 23 °C; 50 % RH	ISO 62	%	0.2
C	Density		ISO 1183	kg/m³	1130
	Processing conditions for test specimens				
C	Injection molding-Melt temperature		ISO 294	°C	260
C	Injection molding-Mold temperature		ISO 294	°C	80
C	Injection molding-Injection velocity		ISO 294	mm/s	240

Disclaimer

Standard Disclaimer

The manner in which you use and the purpose to which you put and utilize our products, technical assistance and information (whether verbal, written or by way of production evaluations), including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety and environmental standpoint. Such testing has not necessarily been done by us. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale. All information and technical assistance is given without warranty or guarantee, and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance and information. Any statement or recommendation not contained herein is unauthorized and shall not bind us. Nothing herein shall be construed as a recommendation to use any product in conflict with patents covering any material or its use. No license is implied or in fact granted under the claims of any patent.

Typical Properties

Property data is provided as general information only. Property values are approximate and are not part of the product specifications.

Flammability

Flammability results are based on small-scale laboratory tests for purposes of relative comparison and are not intended to reflect the hazards presented by this or any other material under actual fire conditions.

Health and Safety

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ARROWCREST PC/ABS TRILOY

PRODUCT DATA

ENGINEERING THERMOPLASTIC

TRILOY combines excellent ambient and low temperature impact strength with a high degree of dimensional stability, surface hardness and low overall shrinkage. TRILOY is manufactured by the Sam Yang Corporation, an International company accredited to ISO9002 and marketed in the UK. by Arrowcrest Industrial Limited.

TRILOY			200	210	215	210N	200NH
Property	Test Method	Expressed Unit	General Purpose	Heat Resistance	High Heat Resistance	FR Impact	FR Non-Halogen
Mechanical							
Tensile Strength	ASTM D638	Kg/cm^2	550	580	600	600	600
Tensile Elongation	ASTM D638	%	100	110	120	90	80
Flexural Strength	ASTM D790	Kg/cm^2	780	830	850	830	830
Flexural Modulus	ASTM D790	Kg/cm^2	22000	22000	25000	23000	23000
IZOD Impact Strength 1/8"	ASTM D256	Kgcm/cm	75	75	80	70	45
Rockwell Hardness	ASTM D785	R Scale	115	118	120	115	115
Thermal							
Heat Distortion Temperature 18.6 Kg/cm^2	ASTM D638	°C	102	110	118	113	83
Coefficient of linear thermal expansion	ASTM D696	mm/mm °C	7.3×10^{-5}	7.3×10^{-5}	7.3×10^{-5}	8.3×10^{-5}	8.3×10^{-5}
Electrical							
Volume Resistivity	ASTM D257	Ω cm	5.0	5.0	5.0	5.0	9.0
Dielectric Strength	ASTM D149	KV/mm	25	25	25	30	30
Dielectric Constant	ASTM D150	-	3.0	3.0	3.0	3.0	3.0
Dissipation Factor	ASTM D150	-	0.009	0.009	0.009	0.009	0.009
ARC Resistance	ASTM D495	sec	123	123	123	120	120
Flame Resistance							
Flammability @ 1/16"	UL 94	-	HB	HB	HB	V0	V0
Miscellaneous							
Mould Shrinkage	ASTM D955	%	0.5-0.7	0.5-0.7	0.5-0.7	0.5-0.7	0.5-0.7
Water Absorption	ASTM D570	%	0.20	0.20	0.20	0.20	0.20
Specific Gravity	ASTM D792	-	1.08	1.13	1.14	1.22	1.17

The typical values listed were obtained from natural materials tested under laboratory conditions. The information is offered in good faith but without warranty or guarantee. It does not constitute [illegible] and remains the user's responsibility to satisfy themselves as to the materials suitability for any purpose. For further information please contact

Arrowcrest Industrial Limited, Kendrick House, Wharf Street, Newbury, Berkshire.
RG14 5AP Telephone : 01635 521134 Facsimile : 01635 36100

uide Data* for Bayblend

Properties		Units	Standards	Specimens	T 44	T 45 MN	T 64	T 65 MN	T 84	T 85 MN	KU 1-1445**
Mechanical Properties											
Tensile yield strength σ_S		N/mm²	ISO 527, DIN 53 455	Tensile bar no. 3, (4 mm)	45	45	50	50	55	55	53
Tensile yield elongation ε_S		%	"	"	3	4	4	4	4	5	5
Tensile strength σ_R		N/mm²	"	"	40		40	45	45	50	53
Elongation at break ε_R		%	"	"	> 50	> 50	> 50	> 50	> 50	> 50	> 50
Flexural stress at max. force (max. strain in outer fibres)		N/mm²	ISO 178, DIN 53 452	80 mm · 10 mm · 4 mm	64 (5.3 %)	70 (5.4 %)	75 (5.4 %)	75 (5.5 %)	80 (5.8 %)	80 (6 %)	85 (6 %)
Tensile modulus E_t		N/mm²	DIN 53 457-1	Tensile bar no. 3, (4 mm)	2000	2000	2100	2100	2200	2200	2200
Flexural modulus E_B (3 pt.-test)		N/mm²	DIN 53 457-B3	80 mm · 10 mm · 4 mm	2000	2000	2100	2100	2200	2200	–
Impact strength a_n (CHARPY)	23 °C	kJ/m²	ISO 179, DIN 53 453	Small standard bar	no failure	no failure	no failure	no failure	no failure	no failure	no failure
	-40 °C	kJ/m²	"		no failure	no failure	no failure	no failure	no failure	no failure	no failure
Notched impact strength a_k (CHARPY)	23 °C	kJ/m²			25	30	30	35	30	35	25
	0 °C	kJ/m²	"		17	20	20	25	20	25	23
	-20 °C	kJ/m²	"								–
	-40 °C	kJ/m²	"		10	10	10	15	12	15	7
Ball indentation hardness H 30		N/mm²	ISO 2039, DIN 53 456	Small standard bar	80	80	90	90	90	90	–
Thermal Properties											
Heat deflection temperature HDT		°C	ISO 75, DIN 53 461	80 mm · 10 mm · 4 mm							
A (1.80 N/mm²)		°C	"	"	100	100	100	105	108	110	138
B (0.45 N/mm²)		°C	"	"	105	105	120	125	128	130	125
Vicat softening temperature VST/B 120		°C	DIN ISO 306	Small standard bar	112	112	120	122	129	131	130
Coefficient of linear thermal expansion α	with flow	10^{-4} K^{-1}	DIN 53 752	80 mm · 10 mm · 4 mm	0.90	0.90	0.85	0.85	0.80	0.80	0.7
	across flow	10^{-4} K^{-1}	"		0.95	0.95	0.90	0.90	0.85	0.85	0.5
Max. temperature in glow wire test		°C	IEC 695-2-1, VDE 0471 pt. 2	Plates	650	650	750	750	750	750	

guide data do not represent minimum values. They are typical product data whose actual values may be higher or lower.

** is a trial product which has not yet reached the final stage of development. The conclusions can therefore be drawn as to type conformity, processability and long-term testing under various conditions or similar production and technical parameters. We cannot give any guarantee regarding the products' behaviour during processing or use and disclaim any liability for its application.

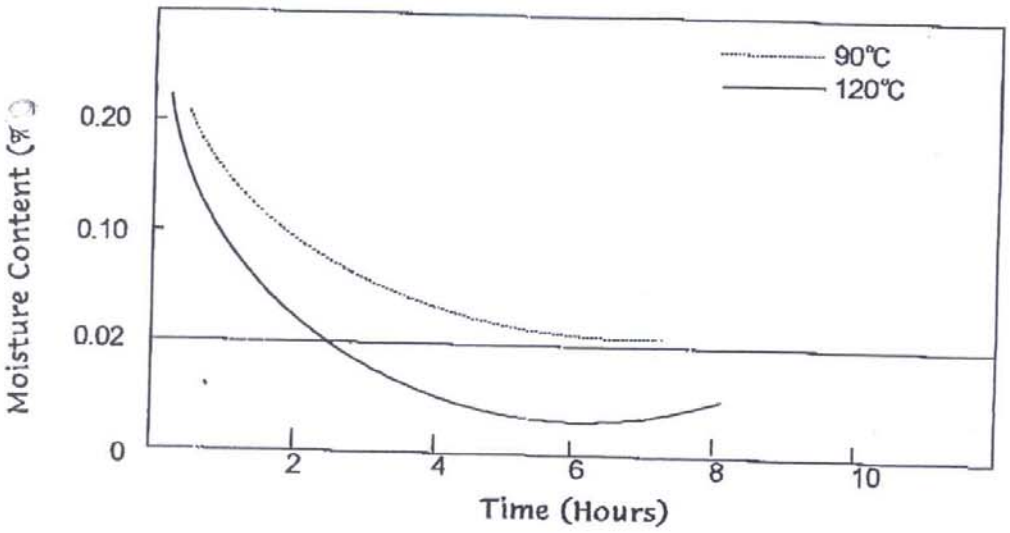
C These property data are taken from the CAMPUS® plastics data bank (CAMPUS = Computer Aided Material Preselection by Uniform Standards) and are based on the mandatory "Guidelines on the drafting of standards for thermoplastic moulding compounds, part 2. Manufacture of test specimens and determination of properties" drawn up by the West German Technical Standards Committee for Plastics. CAMPUS is a [illegible] trademark of Chemie-Wirtschaftsförderungs-Gesellschaft (CWFG mbH), D-60329 Frankfurt/M., Germany.

OWCREST FAX COPY
ICAL PROCESSING CONDITIONS
the Attention of: Glen Blake
McMurdo Fax No. 02392 827707

TRILOY
ENGINEERING THERMOPLASTIC

equate drying of Triloy PC/ABS is imperative to obtain a good result from injection ›ulding. Triloy materials must be fully dried before processing (H_2O below 0.02%) to ıieve their maximum potential. Insufficient drying may seriously affect the polymer's egrity. It is recommended that the drying time for Triloy PC/ABS should be at least three urs, at a temperature of 120°C.

ɛ graph illustrates the relationship between moisture content and required drying times two specified temperatures.



Typical moulding conditions

Function	TRILOY Grade	200	210 215 225	200N 210N	200NH 210NH 230NH	120H 130 170	410 410N
inder ıp (°C)	Nozzle	240-250	250-260	250-260	230-240	250-260	250-260
	Front	230-240	240-250	240-250	220-230	240-250	240-250
	Middle	220-230	230-240	230-240	210-20	230-240	230-240
	Rear	200-220	210-230	210-230	200-210	210-230	210-230
uld Temperature (°C)		60-80	60-90	60-80	50-70	60-90	60-90
ɛction Pressure (Kg/cm²)		400-800	700-1100	600-1000	400-800	700-1100	700-1100
ɛction Speed (%)		30-60	30-70	30-70	30-70	30-70	30-70
ɛw rpm		40-60	40-70	40-70	40-70	40-70	40-70

The information in this data sheet is offered in good faith but without warranty or guarantee.

›. of ent:

Arrowcrest Industrial Limited, Kendrick House, Wharf Street, Newbury. RG14 5AP.
Telephone: 01635 521134 Facsimile: 01635 36100 E-mail: info@arrowcrest.co.uk

Triloy Data

TRILOY PC/ABS alloy has better processability than TRIREX(PC) due to good flow of ABS resin.
t can be applicable to structural application.
ınalysis of spiral flow is very helpful for designing the injection molding condition

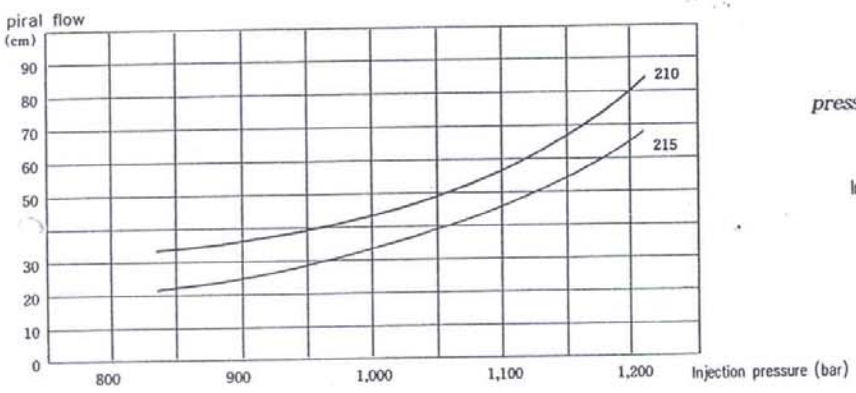


Fig. 4
Effect of injection pressure on spiral flow.
Cavity thickness:3㎜
Cavity width:6㎜
Injection Temperature:260°C

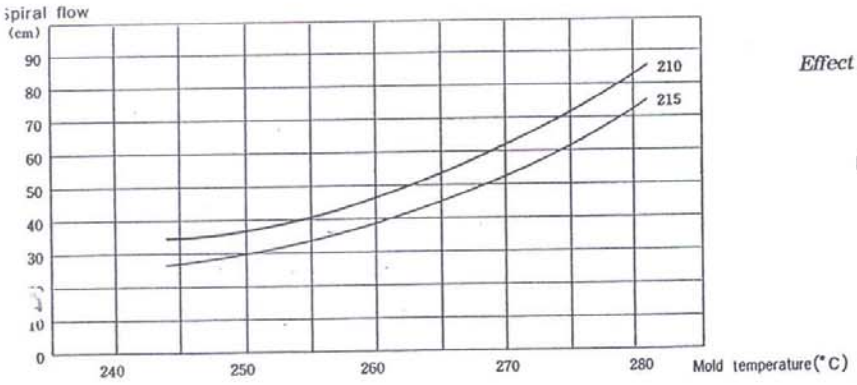


Fig. 5
Effect of temperature on spiral flow.
Cavity thickness:3㎜
Cavity width:6㎜
Injection pressure:1,050bar

TRILOY PC/ABS alloy has high impact stength over a wide temperature range.

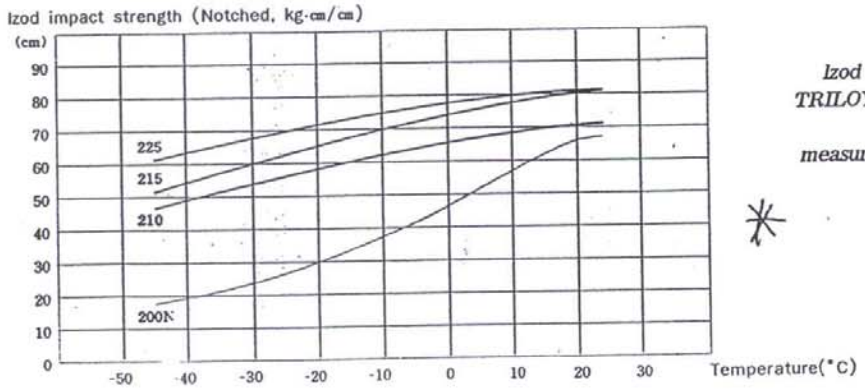


Fig. 6
Izod impact strength of TRILOY PC/ABS alloy to ASTM D256 measured on 3.2mm-thick specimens.

Technical diagrams of PC/ABS alloy

TRILOY PC/ABS alloy exhibits excellent tensile strength, tensile elongation and Izod impact strength on high temperature(120°C) Effect of exposure time on mechanical properties are very useful for designing of product and situation of product use.

Fig. 1
Effect of exposure time on tensile strength at high temperature.(120°C)

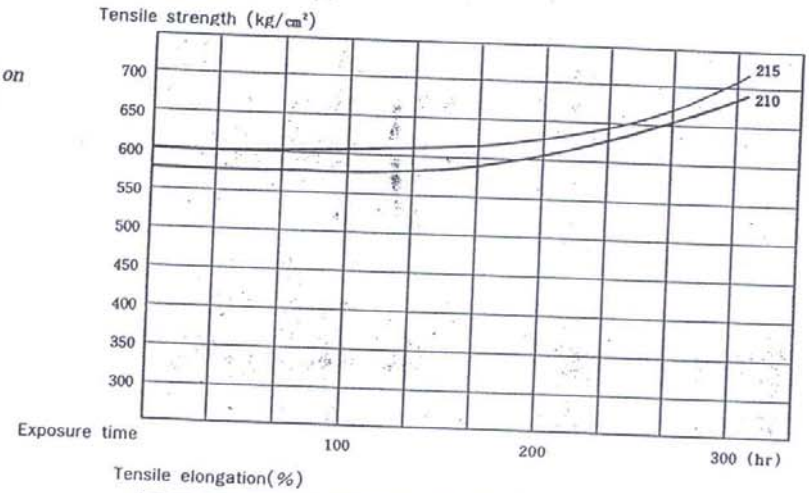


Fig. 2
Effect of exposure time on tensile elongation at high temperature.(120°C)

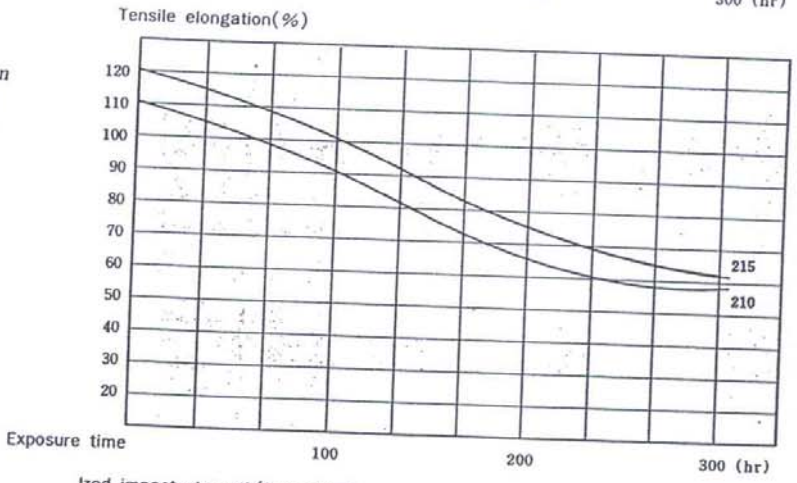
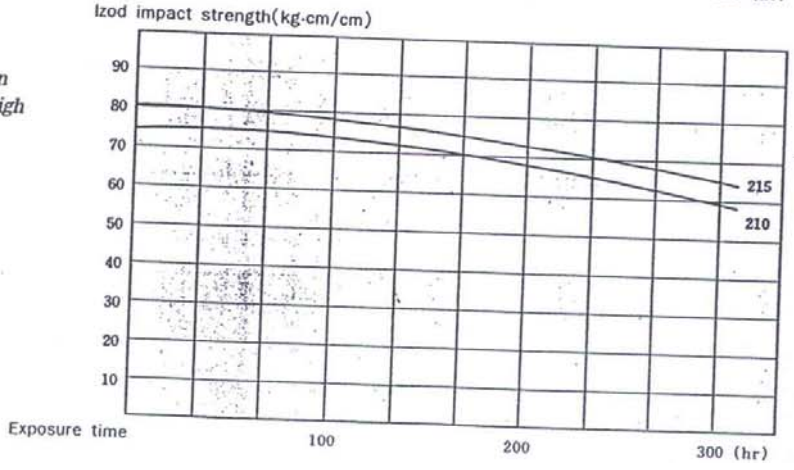


Fig. 3
Effect of exposure time on Izod impact strength at high temperature.(120°C)



10.2.8 Force Test on Fitting

McMurdo Test Lab. 11/7/00 (witnessed by BV Surveyor):

The UUT previously subjected to Drop Test (10.2.8) was selected. The unit was held in a fixture and a lanyard was looped around the smoke canister retaining bracket (76-113). The lanyard was attached to Force Gauge E1079 and a force applied gradually until 252N was reached. The maximum force of 252N was held for 10 seconds and then released. The UUT was then removed from the fixture and examined. There was no evidence of damage and the unit functioned as required.

CONCLUSION:

The requirement was met.

10.4 Common Environmental Tests

10.4.1 Vibration Test

TUV Product Service Ltd: see Appendix 4 for TUV Test Report.

CONCLUSION:

The requirement was met.

10.4.2 Mould Growth Test

TUV Product Service Ltd: see Appendix 5 for TUV Test Report.

10.4.3 Switch Arrangement Test

Not applicable: MANOVERBOARD 360 has automatic switch activation

10.4.4 Corrosion and Seawater Resistance Test (IEC 945, 3rd Edn.Nov.1996, para.8.12)

TUV Product Service Ltd: see Appendix 6 for TUV Test Report.

CONCLUSION:

The requirement was met.

10.4.5 Solar Radiation Test (IEC 945, 3rd Edn.Nov.1996, para.8.10)

TUV Product Service Ltd: see Appendix 7 for TUV Test Report.

CONCLUSION:

The requirement was met.

10.4.6 Test for Oil Resistance (IEC 945, 3rd Edn.Nov.1996, para.8.11)

McMurdo Ltd. Test Lab 11/7/00 (witnessed by BV Surveyor):

The UUT was immersed in oil at ambient room temperature (21 °C) for a minimum period of three hours. After removal from the oil, the unit was wiped clean and examined. There was no sign of damage such as shrinking, cracking, swelling, dissolution or change in mechanical properties, or of any other damage. The unit functioned normally.

Note: Supplier RAPRA Technology Ltd., Shawbury SY4 4NR, United Kingdom confirmed oil used for test as follows:

Type of oil: - ASTM No.1

Oil manufactured by: - R.E.Carrol, Inc., 1570 North Olden Ave., P.O.Box 5806, Trenton, New Jersey, 08638-0805, United States of America.

Batch No: - L7002A (manufactured on 4/3/1997).

CONCLUSION:

The requirement was met.

10.4.7 Rain Test & Water-Tightness Test (IEC 945, 3rd Edn.Nov.1996, para.8.8)

TUV Product Service Ltd: see Appendix 8 for TUV Test Report.

CONCLUSION:

The requirement was met.

25/10/00

BUREAU VERITAS SURVEYOR AT LONDON PARIS 1828 T.BROOKS INTERNATIONAL REGISTER

Manufacturer:	McMurdo Ltd.	Date: 5.10.01	Time: n/a
Model:	L6 Lifejacket Light	Surveyor:	Mr. Toby Brooks
Lot/Serial Number:	All Products or Serial Nos. Specified	Organization:	Bureau Veritas

2.2.3.11 Test for Oil Resistance	Regulations: LSA Code 1.2.2.4; MSC.81(70) 1/ 10.4/10.4.6	
Test Procedure	Acceptance Criteria	Significant Test Data
One lifejacket light which has passed the visual inspection should be subjected to the test for oil resistance according to IEC 945, paragraph 8.11. Automatic activated version should be prevented from switching during the test. The light shall be immersed at a temperature of 19°C +/- 5°C for 3 hour in a mineral oil of the following specification: Aniline point: 120°C =/- 5 °C Flashpoint: minimum 240 °C Viscosity: (10-25)cST at 99 °C The following oils may be used: ASTM oil No. 1 ASTM oil No.5 ISO oil No. 1	After this test the lifejacket light should not be unduly affected by oil and should show no sign of damage such as shrinking, cracking, swelling, dissolution or change of mechanical qualities. The lifejacket light should function after the test.	Results: PASS: ✓ ~~FAIL:~~ **Comments/Observations** Unit Serial No. 044 Unit was immersed in ASTM Oil No. 1 Aniline point: 124.9 °C, Flashpoint: > 290°C Viscosity: 20.17 cST at 99 °C at 10.25 on 3rd Oct 2001. The oil temperature was measured at 23.9 °C. The unit was removed from the oil at 13.27 when the oil temp. was measured at 23.7 °C. The unit was wiped cleaned, examined and operated. The unit functioned correctly and showed no sign of damage such as shrinking, cracking, swelling, dissolution or change of mechanical qualities. Refer to Appendix 3 (006-01) Witnessed Test Certificate

BV

McMurdo

McMurdo Ltd, Rodney Road, Portsmouth, Hampshire, United Kingdom

E3 MATERIALS DECLARATION

A list of materials used on the E3 is attached to this declaration. These materials are in contact with the marine environment and would normally, during type approval, be tested for immunity to...

Salt fog	(RTCM SC110 part A7.0)
Corrosion	(ETS 300-066 part 6.5)
Solar radiation	(ETS 300-066 part 6.11)
Oil resistance	(ETS 300-066 part 6.12)

McMurdo believe this testing is unnecessary for one or more of the following reasons...

1) The materials have a proven history of service in a marine environment. Either from use in McMurdo's existing approved marine equipment range, or by implication from a long established history of exposure without effect (e.g. stainless steel).

2) The material manufacturer has conducted equivalent testing and has declared the product as being immune to these effects in the relevant material data sheet.

3) McMurdo in-house testing has proven the materials to be immune to the cause of degradation (eg Oil resistance).

DECLARATION

McMurdo Ltd hereby declares that the materials used on the E3 are not affected by the degrading agents listed above.

Signed on behalf of McMurdo Ltd

.....

John Norrish BSc (Eng)
Product Manager - Electronics

Date....11/11/98.....

10.2.8 Force Test on Fitting

McMurdo Test Lab. 11/7/00 (witnessed by BV Surveyor):

The UUT previously subjected to Drop Test (10.2.8) was selected. The unit was held in a fixture and a lanyard was looped around the smoke canister retaining bracket (76-113). The lanyard was attached to Force Gauge E1079 and a force applied gradually until 252N was reached. The maximum force of 252N was held for 10 seconds and then released. The UUT was then removed from the fixture and examined. There was no evidence of damage and the unit functioned as required.

CONCLUSION:

The requirement was met.

10.4 Common Environmental Tests

10.4.1 Vibration Test

TUV Product Service Ltd: see Appendix 4 for TUV Test Report.

CONCLUSION:

The requirement was met.

10.4.2 Mould Growth Test

TUV Product Service Ltd: see Appendix 5 for TUV Test Report.

10.4.3 Switch Arrangement Test

Not applicable: MANOVERBOARD 360 has automatic switch activation

10.4.4 Corrosion and Seawater Resistance Test (IEC 945, 3rd Edn.Nov.1996, para.8.12)

TUV Product Service Ltd: see Appendix 6 for TUV Test Report.

CONCLUSION:

The requirement was met.

10.4.5 Solar Radiation Test (IEC 945, 3rd Edn.Nov.1996, para.8.10)

TUV Product Service Ltd: see Appendix 7 for TUV Test Report.

CONCLUSION:

The requirement was met.

10.4.6 Test for Oil Resistance (IEC 945, 3rd Edn.Nov.1996, para.8.11)

McMurdo Ltd. Test Lab 11/7/00 (witnessed by BV Surveyor):

The UUT was immersed in oil at ambient room temperature (21 °C) for a minimum period of three hours. After removal from the oil, the unit was wiped clean and examined. There was no sign of damage such as shrinking, cracking, swelling, dissolution or change in mechanical properties, or of any other damage. The unit functioned normally.

Note: Supplier RAPRA Technology Ltd., Shawbury SY4 4NR, United Kingdom confirmed oil used for test as follows:

Type of oil: - ASTM No.1

Oil manufactured by: - R.E.Carrol, Inc., 1570 North Olden Ave., P.O.Box 5806, Trenton, New Jersey, 08638-0805, United States of America.

Batch No: - L7002A (manufactured on 4/3/1997).

CONCLUSION:

The requirement was met.

10.4.7 Rain Test & Water-Tightness Test (IEC 945, 3rd Edn.Nov.1996, para.8.8)

TUV Product Service Ltd: see Appendix 8 for TUV Test Report.

CONCLUSION:

The requirement was met.

25/10/04

BUREAU VERITAS SURVEYOR AT LONDON PARIS 1828 T BROOKS INTERNATIONAL REGISTER

TÜV PRODUCT SERVICE

TÜV Product Service Ltd
Segensworth Road
Fareham Hampshire
United Kingdom PO15 5RH

Tel: +44 (0)1329 443300
Fax: +44 (0)1329 443421

TEST HOUSE CERTIFICATE

CLIENT:	McMurdo Limited Rodney Road Portsmouth Hampshire PO4 8SG	**CERTIFICATE NUMBER**	Env/ 16170
		PROJECT NUMBER	SX607254/GDS
		CLIENT'S ORDER NUMBER	701998, dated 13 July 2000

INCOMING RELEASE NOTE	Not Supplied
DATE OF RECEIPT	1 August 2000
TEST ITEM(S)	Lifebuoy Light Type MOB 360
NUMBER OF ITEMS TESTED	One
SERIAL NUMBER(S)	Not Supplied. TÜV Sample Registration No 07
DRAWING / PART NUMBER	76-002A (float/light & strap only)
TEST SPECIFICATION / ISSUE	MSC 70/23/Add.1 (Annex 6) clause 10.4.5, IEC 945:1996 Clause 8.10 and IEC 68-2-5:1975 Test Sa (Procedure C)
DATE OF TEST	4 to 8 September 2000
TEST(S) APPLIED	Solar Radiation The test item was installed into the chamber, and the chamber temperature increased over a period of 2 hours to 40°C, maintained at this level for 76 hours, and then returned to laboratory ambient during a further 2 hours. During the entire period of 80 hours the unit was also exposed to simulated solar radiation at an intensity of 1120 W/m² (nominal). This test was sub-contracted to the Solar Energy Testing Service at Cardiff University, NAMAS Laboratory No 0392. See Cardiff School of Engineering Test Report No 2676/N246 for further details.
RESULT(S) OF TEST	No damage or detrimental effects were observed during or on completion of the test.

Approved by ..... Date 27 September 2000

D J Wilson
Environmental Test Dept Manager

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TÜV PRODUCT SERVICE

TÜV Product Service Ltd
Segensworth Road
Fareham Hampshire
United Kingdom PO15 5RH

Tel: +44 (0)1329 443300
Fax: +44 (0)1329 443421

TEST HOUSE CERTIFICATE

CLIENT:	McMurdo Limited Rodney Road Portsmouth Hampshire PO4 8SG	**CERTIFICATE NUMBER**	Env/ 16166
		PROJECT NUMBER	SX607254/GDS
		CLIENT'S ORDER NUMBER	702059, dated 1 August 2000

INCOMING RELEASE NOTE	Not Supplied
DATE OF RECEIPT	1 August 2000
TEST ITEM(S)	Lifebuoy Light Type MOB 360
NUMBER OF ITEMS TESTED	One of each item identified below
SERIAL NUMBER(S)	Not Supplied. TÜV Sample Registration No 16
DRAWING / PART NUMBER	1. 76-002A (float/light & strap) 2. 76-103A (bracket)
TEST SPECIFICATION / ISSUE	MSC 70/23/Add.1 (Annex 6) clause 10.4.4, IEC 945:1996 Clause 8.12 and IEC 68-2-52:1996 Test Kb (Severity 1)
DATE OF TEST	3 August to 1 September 2000
TEST(S) APPLIED	Corrosion (Salt Mist) The test items were installed into the chamber and sprayed with a salt water solution at a temperature of 20°C to 27°C for a period of 2 hours. The samples were then transferred to a storage chamber and maintained at 40°C 93% RH for 6 days 22 hours. The cycle was then repeated so that 4 spray and 4 storage periods were completed, a total test duration of 28 days. The 5% sodium chloride (NaCl) salt solution complied with the specification requirement for pH value and collection rate.
RESULT(S) OF TEST	On completion of the test the two samples were examined, rinsed off with cold fresh water, and stored at standard laboratory conditions for a period of one hour before re-examination. The bracket support forks exhibited slight surface staining, in a localised area under the edge of each rubber sleeve, at the "bridge" side of each tine. An accumulation of salt deposits was observed around the base of the electrical "button" contacts.

Approved by ..... **Date** 26 September 2000

D J Wilson
Environmental Test Dept Manager

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