SGS

Tested For:	**Rebecca Johnson**	**Phone:**	**(651) 282-4485**	**Received:**	**1/26/2021**
	3M Company	**Fax:**		**Completed:**	**2/25/2021**
	3M Center Bldg 230-BE-16	**Mobile:**		**Code:**	**A9**
	Maplewood, MN 55144	**PO#:**	**3501090188**	**Test Report:**	**3-42295-9**
	USA	**Email:**			

Key Test: **ISO 5660-1** 1045

Client's Identification:

Lot No.: LA-D100-2874-7. Style: DP8610NS. Composition: 2K Acrylic Adhesive. Product End Use: Rail Applications for Structural Adhesive. Adhesive sandwiched between 2 pieces of 1 mm thick Aluminum panels. Adhesive thickness 0.4 mm.

Test Category: Cone Specifier: Eurorail LE: 2015; V 2/19 PC: 48H(ME) /rb

TEST PERFORMED: ISO 5660-1 - Reaction-to-fire tests -- Heat release, smoke production and mass loss rate -- Part 1: Heat release rate (cone calorimeter method) [LE 2015; V 2/19] --

As cited by EN 45545-2 Railway applications - Fire protection on Railway vehicles - Part 2: Requirements for fire behaviour of material and components.

APPROXIMATE ☒ THICKNESS ☐ DIAMETER OF MATERIAL (as measured by SGS North America): 2.6 mm

☒ Flat Specimen: 4" x 4"; ☐ Cylindrical Specimen: 4" lengths vertically grouped to form the 4" x 4" test specimens

HEAT FLUX: ☐ 25 kW/m² [CODE 1045]; ☒ 50 kW/m² [CODE 1045]

IGNITION MODE: ☒ External Spark; ☐ Non External

RETAINING WIRE GRID PLACED OVER FACE OF SPECIMEN: ☐ Yes; ☒ No

BRIEF DESCRIPTION OF TEST: A test specimen measuring 4" x 4" maximum thickness 2" is mounted into the specimen holder. The specimen holder sits on a load cell. The opening of a "cone shaped" radiant heat source faces the test specimen. The heat flux (optionally 25 kW or 50 kW) is radiated onto the surface of the specimen. A spark is introduced to ignite the off-gases. While the test specimen burns and decomposes, measurements are made in the exhaust system of the apparatus. Using the oxygen concentrations present during combustion, pressure flow rates and thermocouple temperatures, the mass of oxygen consumed at any given time can be calculated. Heat release values are then determined using a defined formula based on the release rate of 13.1 MJ per kg oxygen consumed (hence the term oxygen consumption calorimetry). Simultaneously, the optical photometrics, or smoke obscuration measuring system, is gauging smoke release while the weigh cell is tracking specimen mass loss. The data is reported. The smoke value is reported as the specific extinction area [SEA].

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This report contains the values that are required to be reported by ISO 5660-1. Additionally, it contains the MARHE (Maximum Average Rate of Heat Emission) value that is required to determine Hazard Levels specified by EN 45545-2.

CATEGORY:		RESULTS: Specimen #1	Specimen #2	Specimen #3	AVERAGE
MARHE:	[kW/m²]:	0	2	2	2
Time to Ignition:	[seconds]:	DNI	DNI	DNI	DNI
Test Length:	[seconds]:	1804	1827	1823	1818
Test End:	[code]:	2	2	2	N/A
Peak Heat Release Rate (HRR):	[kW/m²]:	1.5	5.9	5.6	4.3
Average Heat Release Rate (Avg HRR):					
At 60 seconds:	[kW/m²]:	0.1	1.3	1.3	0.9
At 180 seconds:	[kW/m²]:	0.0	1.7	1.3	1.0
At 300 seconds:	[kW/m²]	0.0	1.0	0.9	0.6
Average Mass Loss Rate:	[g/m² sec]:	0.2	0.3	0.2	0.3
Total Heat Release:	[MJ/m²]:	0.0	1.6	3.3	1.6
SEA:					
At 180 seconds	[m²/kg]:	826	962	70	619
At test end	[m²/kg]:	439	164	591	398
Effective Heat of Combustion:	[MJ/kg]:	0.1	3.9	11.9	5.3
Caloric Content:	[MJ/kg]:	0.0	0.3	0.6	0.3
Flaming Droplets/Particles:	[yes/no]:	No	No	No	N/A

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SEA = Visible smoke development of material (expressed as the Specific Extinction Area).
N/A = Not applicable.

TEST END CODES:

1 = 32 minutes after the time to sustained flaming.
2 = 30 minutes have elapsed, and the specimen has not ignited.
3 = Oxygen returned to near-pretest values for 10 minutes.
4 = The mass of the specimen is less than 0.1 g for 60 s. Minimum test duration shall be 5 minutes.

REMARKS:

☒ None.

☐ Test specimens are thermally thin, containing little mass and fuel. The small amount of fuel results in a very short burning time, e.g. the specimen under test never reaches a steady state burning condition. The small mass results in extremely small mass loss rates nearing the limit of the instrument's capability to measure. This results in high variability in reported results calculated with mass in the denominator, specifically SEA and Effective Heat of Combustion.

☐ Specimen/s _____ exhibited intumescent behavior (swelling as a result of heat exposure) of approximately _____ mm above the top of the specimen holder frame which did not interfere with the burner.

☐ Specimen/s _____ exhibited intumescent behavior (swelling as a result of heat exposure) which interfered with the burner. The distance of the heating surface of the cone heater or the face of the specimen was increased to 60 mm as per the instructions in ISO 5660-1.

☐ Other (described): _____

CLASSIFICATION CRITERIA AND CONCLUSION: The reader is referred to the "Summary of EN 45545-2 Hazard Levels" contained elsewhere in this report to determine the hazard level based on the results contained in this report. To achieve a "Complete Hazard Level Certification", other fire tests are required.

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	USA	**Email:**			

Key Test: **ISO 5660-1** 1045

CERTIFICATION: I certify that the reported results were obtained after testing specimens in accordance with the procedures and equipment specified above.

MAR 19 2021

Bobby Brown

AUTHORIZED SIGNATURE
SGS NORTH AMERICA
/jab

ISO 5660 25 kW Exposure

R Set	Hazard Level	Maximum MARHE (kW/m²)
R5	HL1	50
	HL2	50
	HL3	50
R8	HL1	-
	HL2	50
	HL3	50
R9	HL1	90
	HL2	90
	HL2	60
R10	HL1	-
	HL2	-
	HL3	-
R19, R21	HL1	75
	HL2	50
	HL3	50
R20	HL1	50
	HL2	50
	HL3	50

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ISO 5660 50 kW Exposure

R Set	Hazard Level	Maximum MARHE (kW/m²)
R1, R7, R17	HL1	a –
	HL2	90
	HL3	60
R2	HL1	a –
	HL2	a –
	HL3	90
R3	HL1	a –
	HL2	a –
	HL3	a -
R6, R11	HL1	90
	HL2	90
	HL3	60
R12	HL1	60
	HL2	60
	HL3	60

EXPLANATION: Footnote "a" is taken directly from EN 45545-2.

It is apparently a typographical error as it pertains to ISO 5658-2 rather than ISO 5660-2.

The "-" is also taken directly from EN 45545-2 and is unexplained by EN 45545-2.

Practically, a product that falls within the maximum values for either HL2 or HL3 should automatically qualify for a lower hazard level.

The results contained in this report relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke obscuration hazard of the product in use.

SGS GOVMARK

Program: ASTM E1354 (version 4.32)

ISO 5660 Test Report

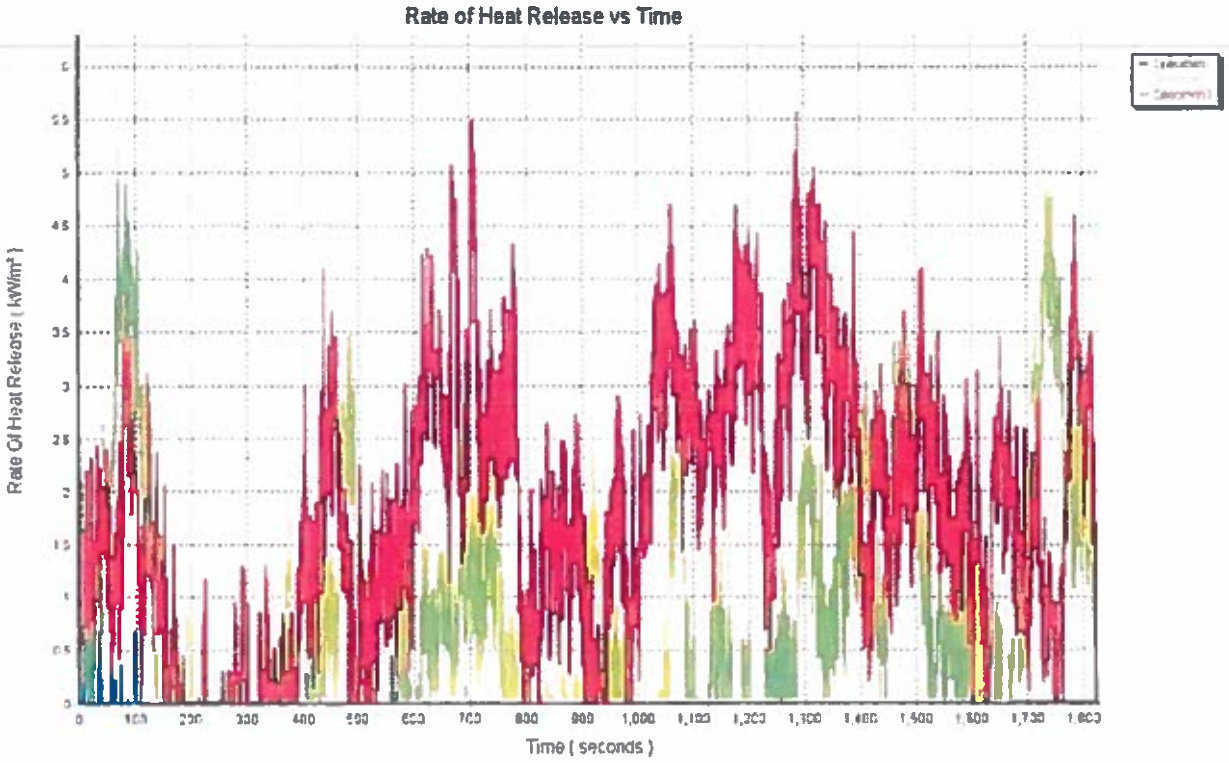
Test Report Number	: 3-42295-9-A9	Test Date	: 02/25/21
Client	: 3M COMPANY	Operator	: JR
Specimen ID	: LA-D100-2874-7	Heat Flux	: 50 kW/m²
Composition	: 2K SCRYLIC ADHESIVE	Calibration Constant	: 0.053
Specimen Color	: YELLOW	Test Orientation	: Horizontal
Specimens Tested	: 3	Retaining Wire Grid Used	: No

	Specimen			
	1	2	3	Average
Test Duration (seconds)	1804	1827	1823	1818
Time to Sustained Ignition (seconds)	DNI	DNI	DNI	DNI
Peak Rate of Heat Release (kW/m²)	1.5	5.9	5.6	4.3
Average RHR - 60 seconds (kW/m²)	0.1	1.3	1.3	0.9
Average RHR - 180 seconds (kW/m²)	0.0	1.7	1.3	1.0
Average RHR - 300 seconds (kW/m²)	0.0	1.0	0.9	0.6
Total Heat Released (MJ/m²)	0.0	1.6	3.3	1.6
Initial Mass (g)	55.5	56.9	56.1	56.2
Final Mass (g)	51.9	52.8	53.3	52.7
Mass at Sustained Flaming (g)	n/a	n/a	n/a	n/a
Mass Loss (g/m²)	360.0	410.0	280.0	350.0
Average Mass Loss Rate (g/m²-s)	0.2	0.3	0.2	0.3
Avg Effective Heat of Combustion (MJ/kg)	0.1	3.9	11.9	5.3
Caloric Content (MJ/kg)	0.0	0.3	0.6	0.3
Avg Specific Extinction Area (m²/kg)	439	164	591	398
Avg SEA at 180 seconds (m²/kg)	826	962	70	619
Thickness (mm)	2.6	2.6	2.6	2.6
MARHE (kW/m²)	0	2	2	2
Total Smoke Production	157.9	67.4	165.4	130.2
Total Smoke Production Before Ignition	n/a	n/a	n/a	0.0
Total Smoke Production After Ignition	157.9	67.4	165.4	130.2

SGS GOVMARK

Program: ASTM E1354 (version 4 32)

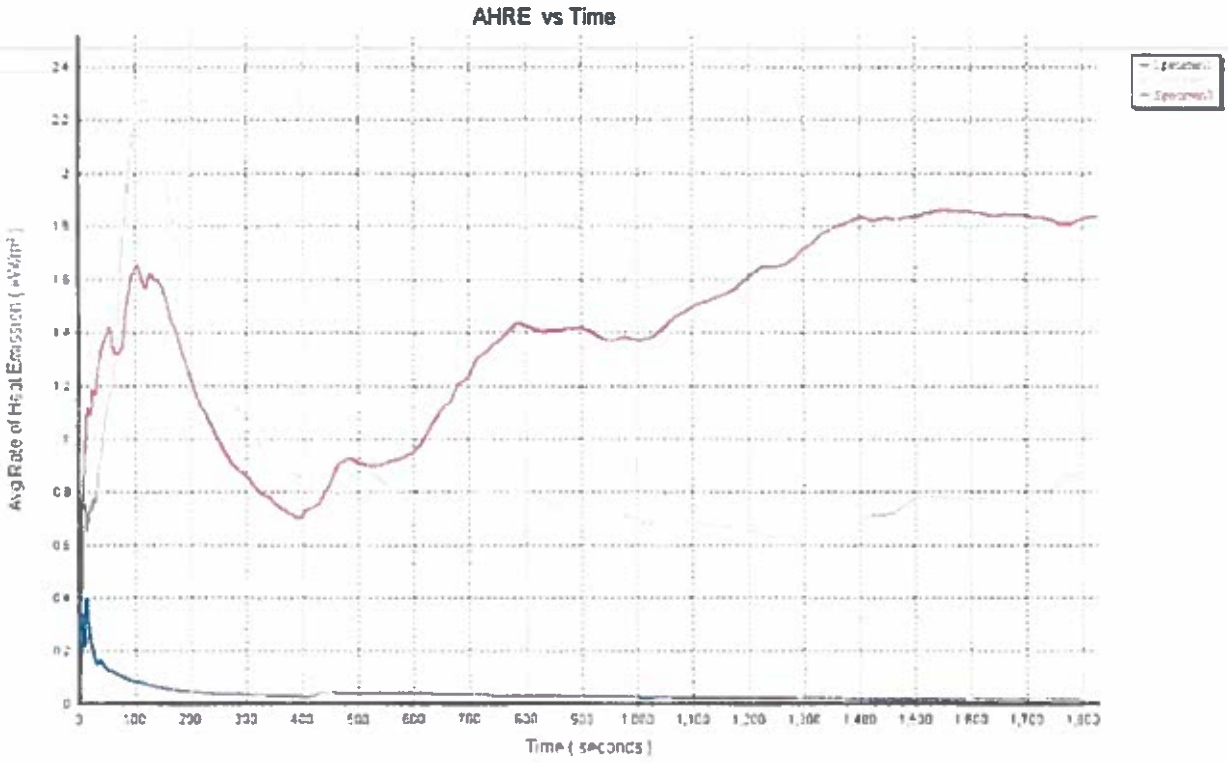
Test : ISO 5660
Test Report # 3-42295-9-A9



SGS GOVMARK

Program: ASTM E1354 (version 4.32)

Test : ISO 5660
Test Report # 3-42295-9-A9



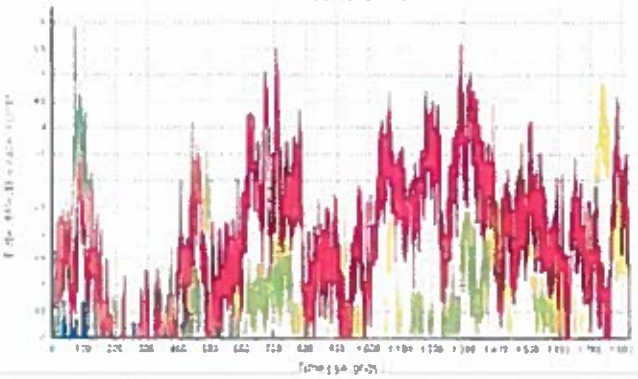
SGS GOVMARK

Test : Cone Calorimeter

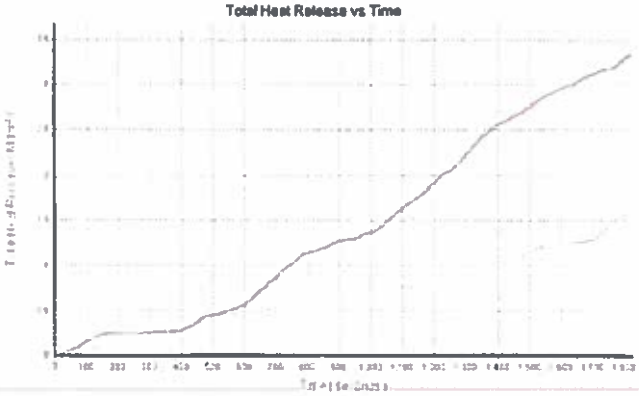
Test Report # 3-42295-9-A9

Program: ASTM E1354 (version 4.32)

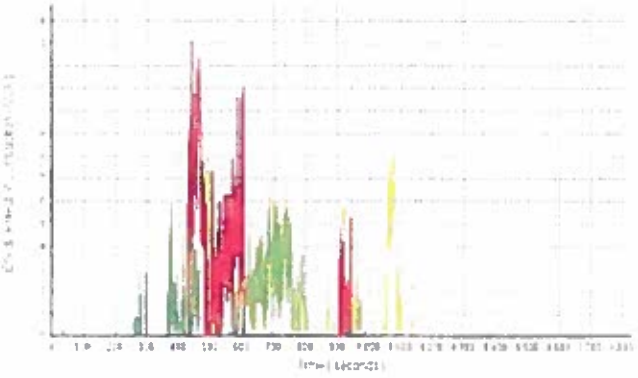
Rate of Heat Release vs Time



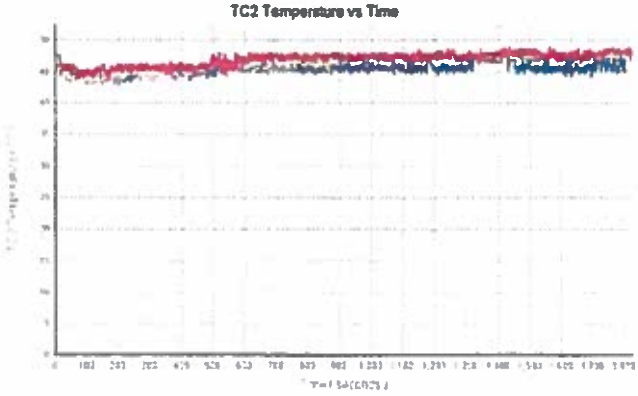
Total Heat Release vs Time



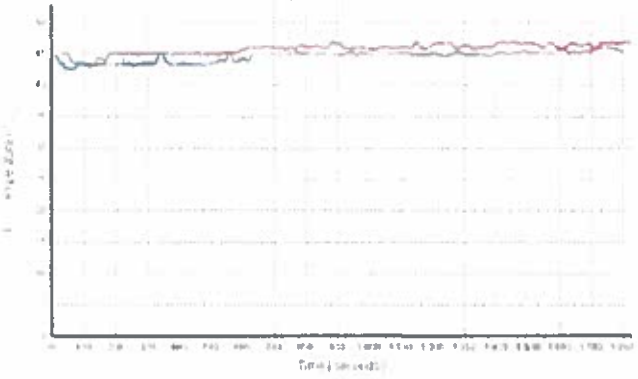
Effective Heat of Combustion vs Time



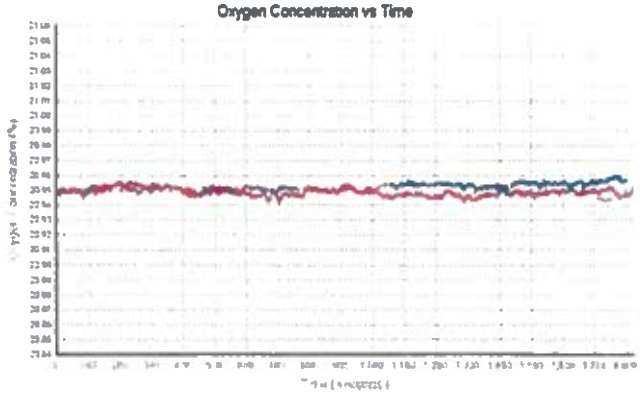
TC2 Temperature vs Time



TC1 Temperature vs Time



Oxygen Concentration vs Time



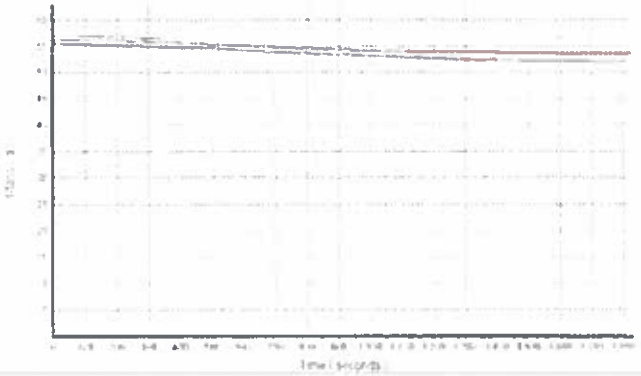
SGS GOVMARK

Test : Cone Calorimeter

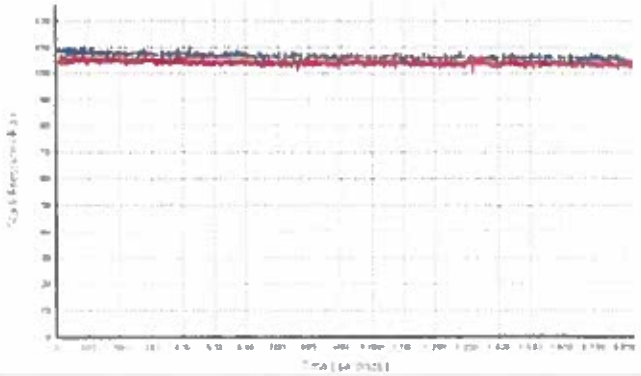
Test Report # 3-42295-9-A9

Program: ASTM E1354 (version 4.32)

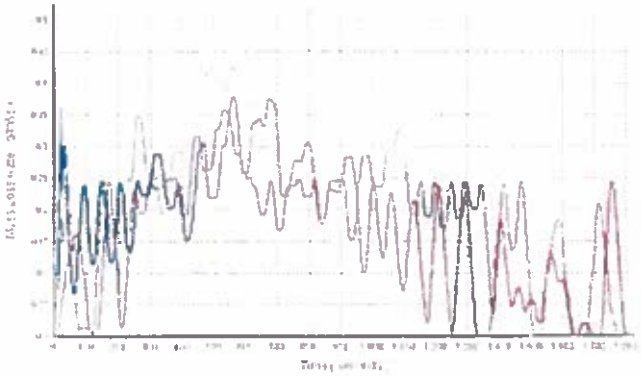
Mass vs Time



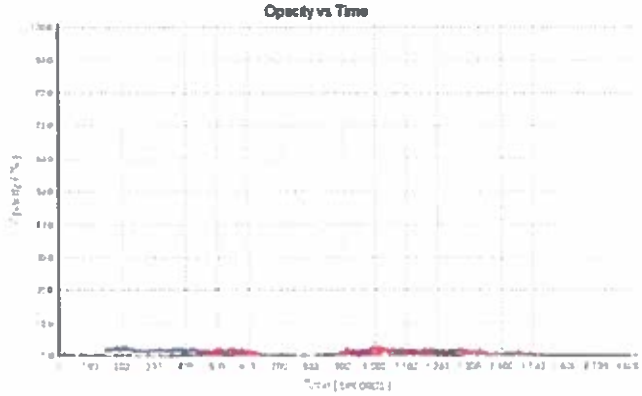
Differential Pressure vs Time



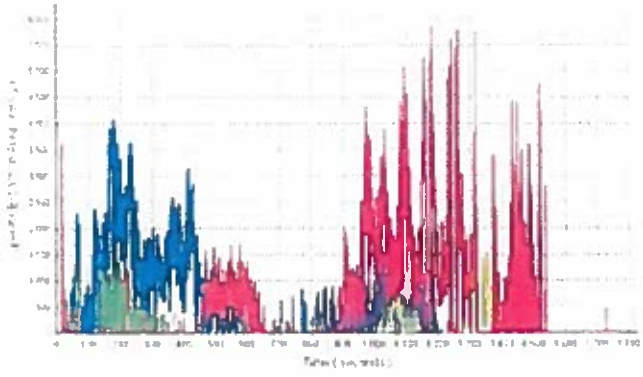
Mass Loss Rate vs Time



Opacity vs Time



Specific Extinction Area vs Time



Neutral Density vs Time