

REFERENCE

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APPENDIX A

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

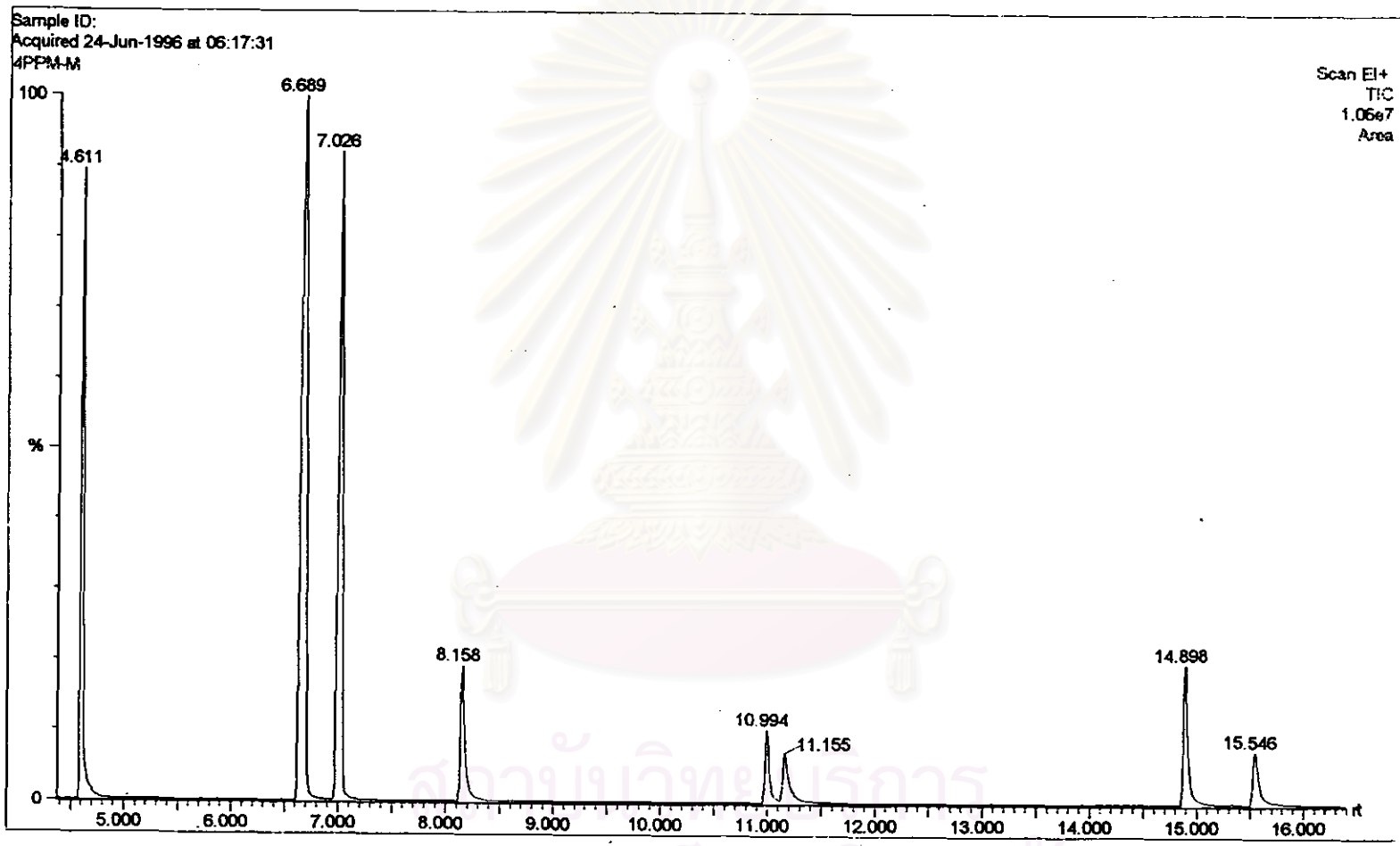


Figure A 1 Gas chromatogram of standard PAHs

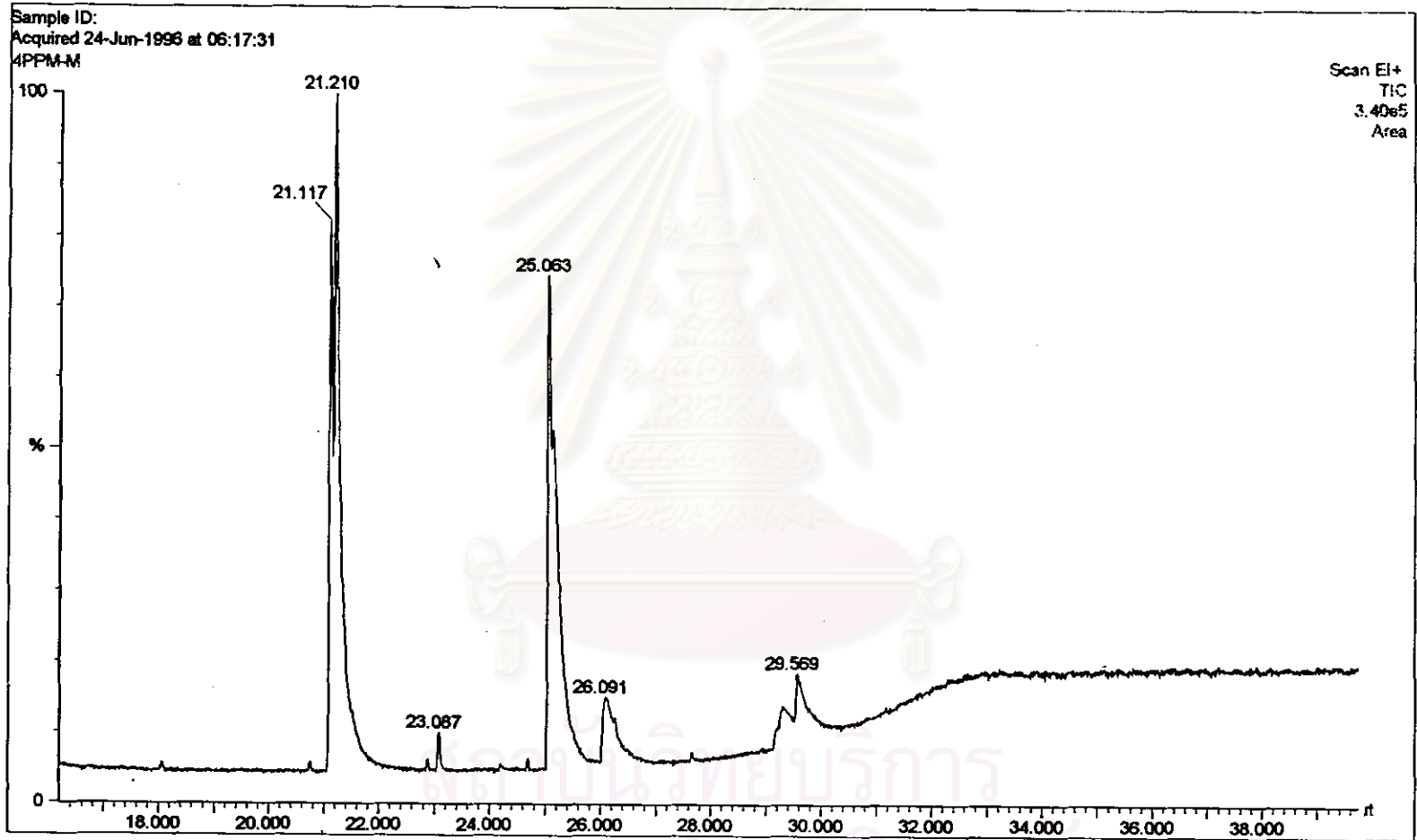
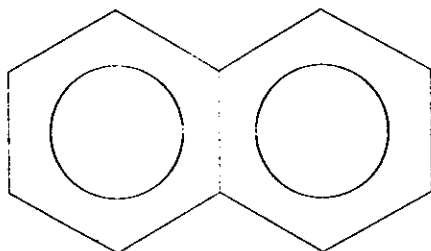


Figure A 1 Gas chromatogram of standard PAHs (continued)

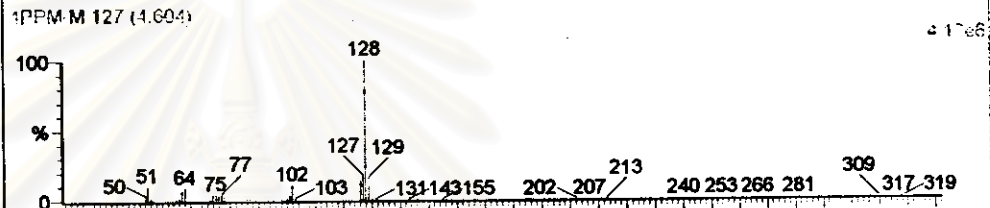


Compound Name: NAPHTHALENE
 Synonym: Albocarbon
 MW : 128



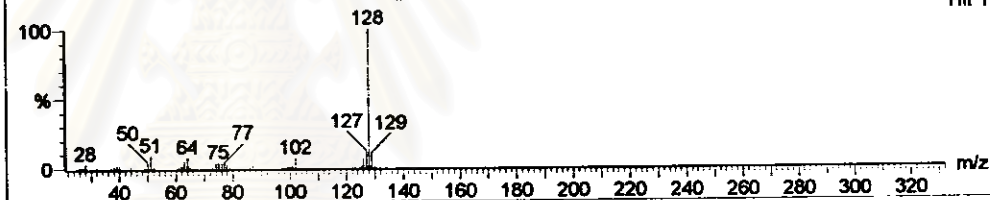
Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 973, Reverse Fit: 977



R:977 NIST 5167: NAPHTHALENE

Hit 1



Acquired 06:17:31 at 06:17:31

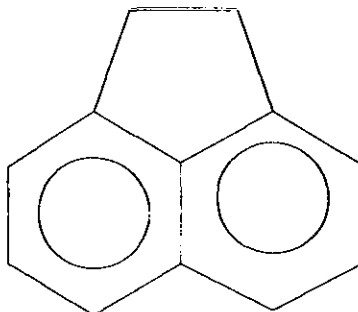
Data File: 4PPM-M

Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	NAPHTHALENE	128	C10H8	973	977	NIST	5167	91-20-
2	1H-INDENE, 1-METHYLENE-	128	C10H8	935	971	NIST	5168	2471-8
3	AZULENE	128	C10H8	954	958	NIST	5168	275-51
4	4.2.2 PROPELLA-2,4,7,9-TETRAENE	128	C10H8	913	918	NIST	5169	88090-
5	1H-INDENE-1-METHANOL, ACETATE	188	C12H12O2	688	756	NIST	19906	51926-
6	CYCLOPROP A INDENE, 6-BROMO-1,1A,6,6	208	C10H9Br	708	715	NIST	24774	55780-
7	1,4-METHANONAPHTHALEN-9-OL, 1,4-DIHY	158	C11H10O	619	633	NIST	12092	4796-3
8	2H-THIETE, 2-METHYLENE-4-PHENYL-, 1,1-	192	C10H8O2S	599	619	NIST	20649	16793-
9	BENZENE, 1,3-BUTADIENYL-	130	C10H10	501	566	NIST	5567	1515-7
10	1H-INDENE, 1,1-DIMETHYL-	144	C11H12	554	562	NIST	8563	18636-
11	BENZENE, (CYCLOPROPYLIDENEMETHYL)	130	C10H10	481	558	NIST	5572	7555-6
12	CYCLOPROP A INDENE, 1,1A,8,8A-TETRAH	130	C10H10	543	549	NIST	5579	15677-
13	BENZENE, (1-METHYLENE-2-PROPENYL)-	130	C10H10	528	536	NIST	5571	2288-1
14	BENZENE, DIETHENYL-	130	C10H10	530	533	NIST	5568	1321-7

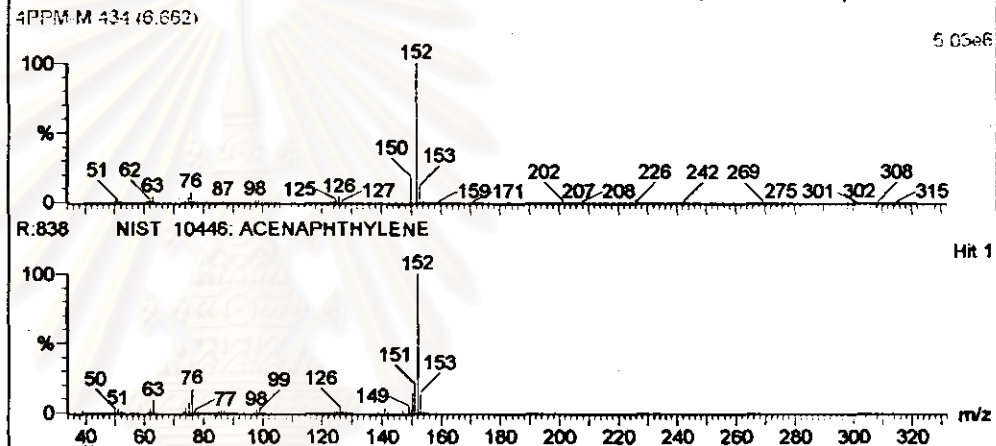
Figure A 2 Comparison of mass spectrum of standard naphthalene with mass spectra in NIST library

Compound Name: ACENAPHTHYLENE
 Synonym: Cyclopenta[de]naphthalene
 MW : 152



Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 834, Reverse Fit: 838



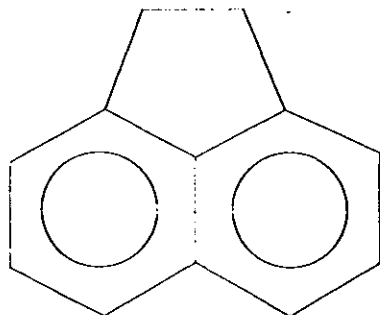
Data File: 4PPM-M
 Sample ID:

Acquired 06:17:31 at 06:17:31

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	ACENAPHTHYLENE	152	C12H8	834	838	NIST	10446	208-96
2	BIPHENYLENE	152	C12H8	764	769	NIST	10447	259-79
3	1H-PHENALEN-1-ONE	180	C13H8O	656	663	NIST	17920	548-39
4	4,4'-DIODODIPHENYL	406	C12H8I2	616	629	NIST	54348	3001-1
5	ACENAPHTHYLENE, 5-BROMO-1,2-DIHYDR	232	C12H9Br	597	602	NIST	30279	2051-9
6	BENZO C CINNOLINE	180	C12H8N2	549	559	NIST	17854	230-17
7	BIPHENYL, 2,6-DIBROMO-	310	C12H8Br2	539	542	NIST	44164	59080-
8	2,5-DIBROMOBIPHENYL	310	C12H8Br2	515	518	NIST	44165	57422-
9	1,1'-BIPHENYL, 2-BROMO-	232	C12H9Br	499	505	NIST	30280	2052-0
10	BENZO H CINNOLINE	180	C12H8N2	381	495	NIST	17853	0-00-0
11	ACENAPHTHENE	154	C12H10	490	493	NIST	11096	83-32-
12	1,1'-BIPHENYL, 4-IODO-	280	C12H9I	478	482	NIST	39359	1591-3
13	9H-FLUOREN-9-ONE	180	C13H8O	467	474	NIST	17921	486-25
14	1,1'-BIPHENYL, 2-IODO-	280	C12H9I	463	466	NIST	39360	2113-5

Figure A 3 Comparison of mass spectrum of standard acenaphthylene with mass spectra in NIST library

Compound Name: ACENAPHTHENE
 Synonym: Acenaphthylene, 1,2-dihydro-
 MW : 154

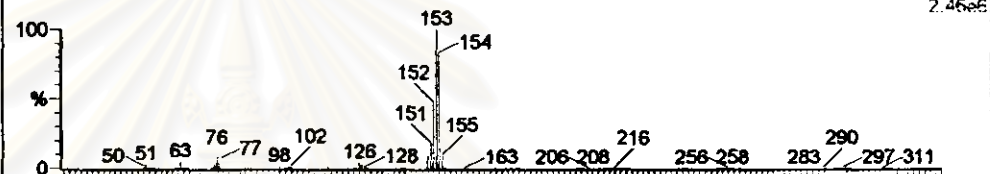


Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 961, Reverse Fit: 963

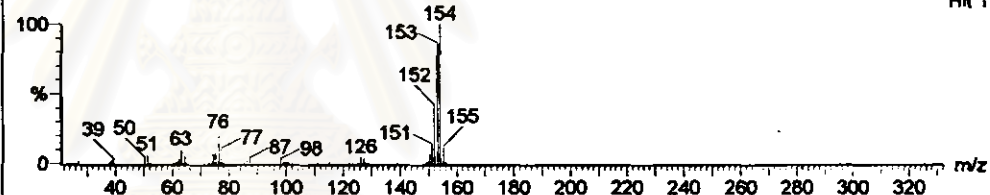
4PPM-M 486 (7.013)

2.46e6



R.963 NIST 11096: ACENAPHTHENE

Hit 1



Data File: 4PPM-M

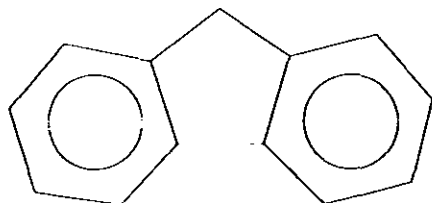
Acquired 06:17:31 at 06:17:31

Sample ID:

HR	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	ACENAPHTHENE	154	C12H10	961	963	NIST	11098	83-32-
2	BENZENE, (2,4-CYCLOPENTADIEN-1-YLIDE	154	C12H10	790	924	NIST	11092	7338-5
3	1,4-ETHENONAPHTHALENE, 1,4-DIHYDRO-	154	C12H10	889	914	NIST	11095	7322-4
4	NAPHTHALENE, 2-ETHENYL-	154	C12H10	904	906	NIST	11097	827-54
5	BIPHENYL	154	C12H10	863	869	NIST	11094	92-52-
6	ACENAPHTHYLENE, 5-BROMO-1,2-DIHYDR	232	C12H9Br	696	703	NIST	30279	2051-9
7	CHLORODIPHENYLARSINE	284	C12H10ClAs	613	655	NIST	36506	712-48
8	PHENYLTRIS(TRIMETHYLSILOXYL)SILANE	372	C15H32O3Si4	606	636	NIST	51503	2116-8
9	5,10-METHANOBENZOCYCLOOCTEN-11-O	216	C13H9OC1	811	624	NIST	26755	33655-
10	ARSINE, (PENTAFLUOROPHENYL)DIPHEN	396	C18H10F5As	550	570	NIST	53521	20901-
11	1,1'-BIPHENYL, 3-NITRO-	199	C12H9O2N	563	565	NIST	22640	2113-5
12	NAPHTHALENE, 1,8-BIS(BROMOMETHYL)-	312	C12H10Br2	537	558	NIST	44410	2025-9
13	ARSINE, OXOPHENYL-	168	C6H5OAs	476	502	NIST	14355	637-03
14	5-IODOACENAPHTHENE	280	C12H8I	462	492	NIST	39358	0-00-0

Figure A 4 Comparison of mass spectrum of standard acenaphthene with mass spectra in NIST library

Compound Name: FLUORENE
 Synonym: 9H-Fluorene
 MW: 166

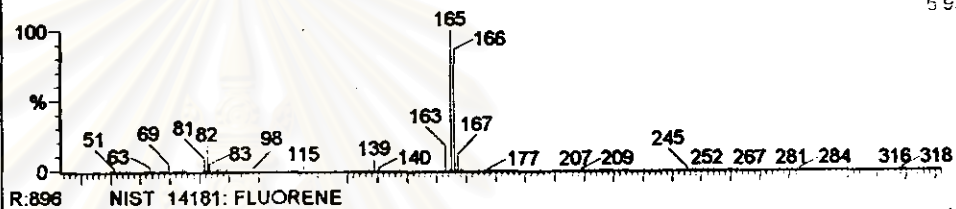


Sample Description:
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 890, Reverse Fit: 896

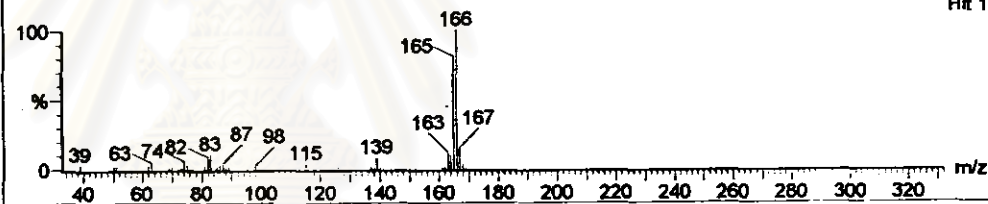
4PPM-M 655 (8.145)

6.95e5



R:896 NIST 14181: FLUORENE

Hit 1



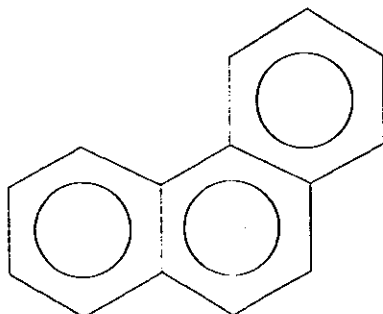
Data File: 4PPM-M
 Sample ID:

Acquired 06:17:31 at 06:17:31

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	FLUORENE	166	C ₁₃ H ₁₀	890	896	NIST	14181	88-73-
2	9H-FLUORENE-9-CARBOXYLIC ACID	210	C ₁₄ H ₁₀ O ₂	805	892	NIST	25424	1989-3
3	1H-PHENALENE	166	C ₁₃ H ₁₀	859	884	NIST	14180	203-80
4	BENZENE, 1,1'-(DIAZOMETHYLENE)BIS-	194	C ₁₃ H ₁₀ N ₂	699	809	NIST	21363	883-40
5	9H-FLUORENE, 9-BROMO-	244	C ₁₃ H ₉ Br	747	780	NIST	32662	1940-5
6	FLUORENE-9-METHANOL	198	C ₁₄ H ₁₂ O	734	773	NIST	21953	24324-
7	2-FLUORENECARBOXALDEHYDE	194	C ₁₄ H ₁₀ O	727	736	NIST	21400	30084-
8	ETHANONE, DIAZODIPHENYL-	222	C ₁₄ H ₁₀ O _N ₂	635	679	NIST	28140	3469-1
9	ETHENONE, 2,2-DIPHENYL-	194	C ₁₄ H ₁₀ O	629	678	NIST	21398	525-08
10	FLUORENE, 9-CHLORO-	200	C ₁₃ H ₉ Cl	631	672	NIST	22959	6630-6
11	FLUORENE, 2,4A-DIHYDRO-	168	C ₁₃ H ₁₂	568	632	NIST	14805	58247-
12	9-PHENANTHRENOL	194	C ₁₄ H ₁₀ O	581	614	NIST	21401	484-17
13	4,5-DIPHENYL-1,3-DIOXOL-2-ONE	238	C ₁₅ H ₁₀ O ₃	544	580	NIST	31539	21240-
14	BENZO C CINNOLINE, 4-METHYL-	194	C ₁₃ H ₁₀ N ₂	516	580	NIST	21358	19174-

Figure A 5 Comparison of mass spectrum of standard fluorene with mass spectra in NIST library

Compound Name: PHENANTHRENE
 Synonym: Phenanthren
 MW : 178

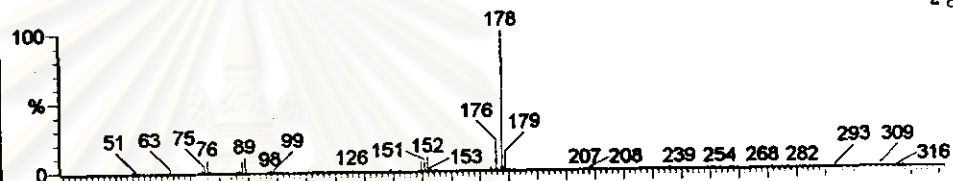


Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 829, Reverse Fit: 853

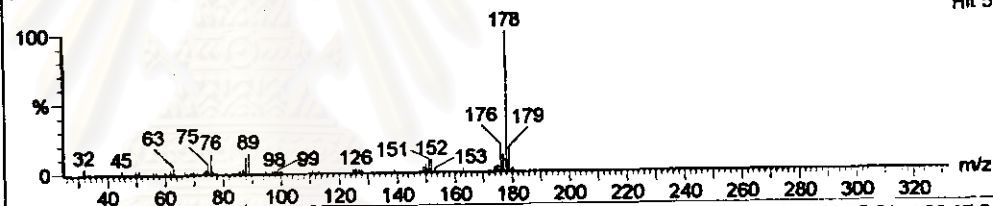
4PPM-M 1080 (10.989)

4.87e5



R:853 NIST 17367: PHENANTHRENE

Hit 5



Acquired 06:17:31 at 06:17:31

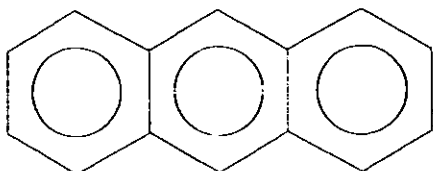
Data File: 4PPM-M

Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	9H-FLUORENE, 9-METHYLENE-	178	C14H10	879	941	NIST	17369	4425-8
2	ANTHRACENE	178	C14H10	926	930	NIST	17368	120-12
3	DIPHENYLETHYNE	178	C14H10	864	867	NIST	17370	501-85
4	4-HYDROXY-5-METHYL-3-PHENYL-.DELTA.	178	C9H10O2N2	720	867	NIST	17115	16227-
5	PHENANTHRENE	178	C14H10	840	853	NIST	17367	85-01-
6	2-CYCLOPROPEN-1-ONE, 2,3-DIPHENYL-	208	C15H10O	825	848	NIST	24438	886-38
7	7,8-DIPHENYLBICYCLO 4.2.1 NONA-2,4,7-T	270	C21H18	829	839	NIST	37880	54049-
8	9,10-ETHANOANTHRACENE, 9,10-DIHYDR	208	C16H14	765	815	NIST	24479	5675-6
9	BENZENE, 1,1'-(1,2-DIODO-1,2-ETHENEDIY	432	C14H10I2	744	761	NIST	56041	74752-
10	5H-OIBENZO A,D CYCLOHEPTEN-5-ONE	206	C15H10O	713	717	NIST	24438	2222-3
11	CINNOLINE, 3-PHENYL-	206	C14H10N2	586	632	NIST	24393	10604-
12	BENZENE, 1,1'-(1-NITRO-1,2-ETHENEDIYL)	225	C14H10O2N	599	617	NIST	28907	1215-0
13	BENZO H QUINOLINE	179	C13H9N	582	614	NIST	17507	230-27
14	ANTHRACENE, 9,10-DIHYDRO-	180	C14H12	596	602	NIST	17960	613-31

Figure A 6 Comparison of mass spectrum of standard phenanthrene with mass spectra in NIST library

Compound Name: ANTHRACENE
 Synonym: Anthracin
 MW : 178

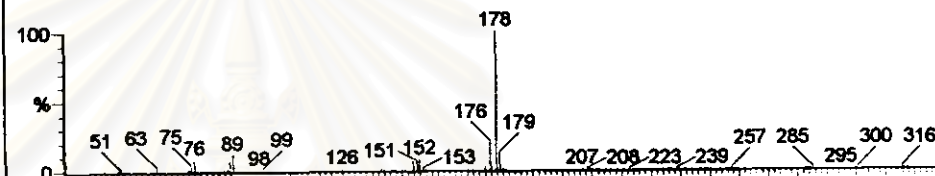


Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

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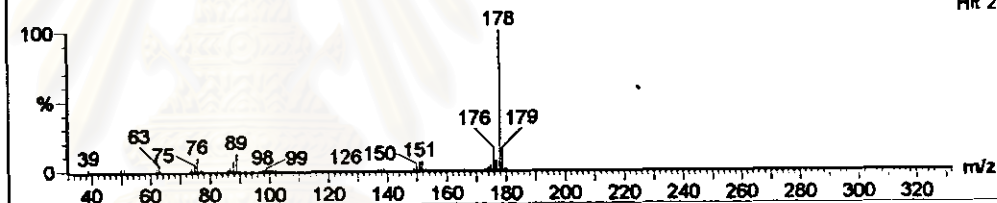
4PPM-M 1105 (11.155)

3.57e5



R:931 NIST 17368: ANTHRACENE

HR 2



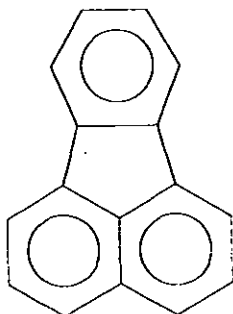
Acquired 06:17:31 at 06:17:31

Data File: 4PPM-M
 Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	9H-FLUORENE, 9-METHYLENE-	178	C14H10	878	941	NIST	17369	4425-8
2	ANTHRACENE	178	C14H10	928	931	NIST	17368	120-12
3	4-HYDROXY-5-METHYL-3-PHENYL-.DELTA.	178	C9H10O2N2	722	866	NIST	17115	16227-
4	DIPHENYLETHYNE	178	C14H10	861	865	NIST	17370	501-65
5	PHENANTHRENE	178	C14H10	844	858	NIST	17367	85-01-
6	2-CYCLOPROPEN-1-ONE, 2,3-DIPHENYL-	206	C15H10O	824	847	NIST	24438	886-38
7	7,8-DIPHENYLBICYCLO 4.2.1 NONA-2,4,7-T	270	C21H18	829	840	NIST	37860	54049-
8	9,10-ETHANOANTHRACENE, 9,10-DIHYDR	208	C16H14	772	823	NIST	24479	5675-6
9	BENZENE, 1,1'-(1,2-DIODO-1,2-ETHENEDIY	432	C14H10I2	744	762	NIST	56041	74752-
10	5H-DIBENZO A,D CYCLOHEPTEN-5-ONE	208	C15H10O	711	715	NIST	24438	2222-3
11	CINNOLINE, 3-PHENYL-	208	C14H10N2	586	631	NIST	24393	10604-
12	BENZENE, 1,1'-(1-NITRO-1,2-ETHENEDIYL)	225	C14H11O2N	601	618	NIST	28907	1215-0
13	BENZO H QUINOLINE	179	C13H9N	584	614	NIST	17507	230-27
14	ANTHRACENE, 9,10-DIHYDRO-	180	C14H12	599	608	NIST	17960	613-31

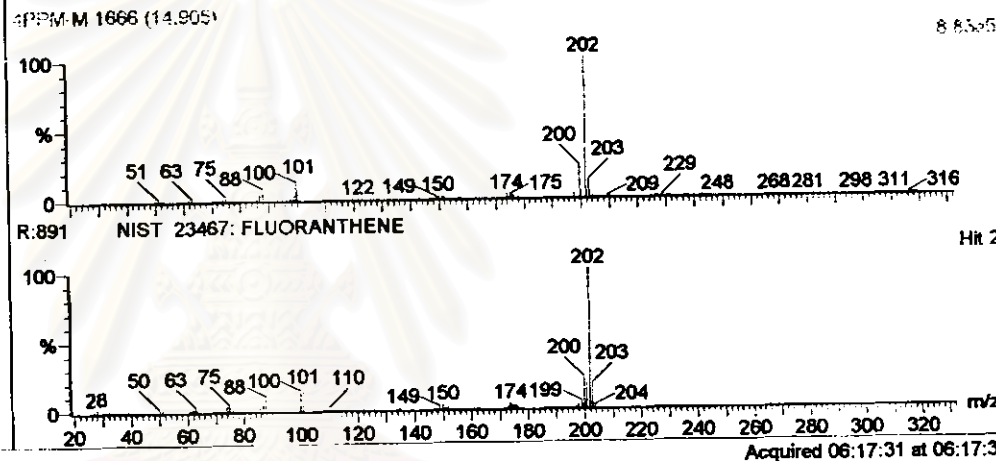
Figure A 7 Comparison of mass spectrum of standard anthracene with mass spectra in NIST library

Compound Name: FLUORANTHENE
 Synonym: Benzene, 1,2-(1,8-naphthalenediyl)-
 MW : 202



Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 875, Reverse Fit: 891

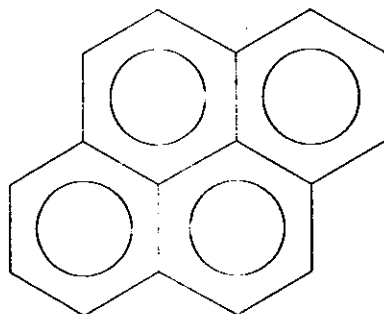


Data File: 4PPM-M
 Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	PYRENE	202	C16H10	881	898	NIST	23469	129-00
2	FLUORANTHENE	202	C16H10	875	891	NIST	23467	206-44
3	BENZENE, 1,1'-(1,3-BUTADIENE-1,4-DIYL)BI	202	C16H10	845	849	NIST	23468	886-68
4	ANTHRACENE, 9-(2-NITROETHENYL)-	249	C18H11O2N	758	802	NIST	33709	58349-
5	3,10B-DIHYDROFLUORANTHENE	204	C16H12	637	759	NIST	23993	37980-
6	2,3-DIHYDROFLUORANTHENE	204	C16H12	664	754	NIST	23987	30339-
7	1,9-DIHYDROPYRENE	204	C16H12	575	657	NIST	23986	0-00-0
8	PYRENE, 4,5-DIHYDRO-	204	C16H12	561	623	NIST	23991	6628-9
9	ANTHRACENE, 9-ETHENYL-	204	C16H12	605	611	NIST	23992	2444-6
10	1H-INDENE, 1-(PHENYLMETHYLENE)-	204	C16H12	477	551	NIST	23994	5394-8
11	7H-BENZ DE ANTHRACEN-7-ONE	230	C17H10O	544	548	NIST	30040	82-05-
12	INDENO 2,1-A INDENE, 5,10-DIHYDRO-	204	C16H12	513	546	NIST	23995	6543-2
13	THERENIDINE-	203	C15H9N	493	540	NIST	23615	194-03
14	NAPHTHALENE, 1-PHENYL-	204	C16H12	501	519	NIST	23990	605-02

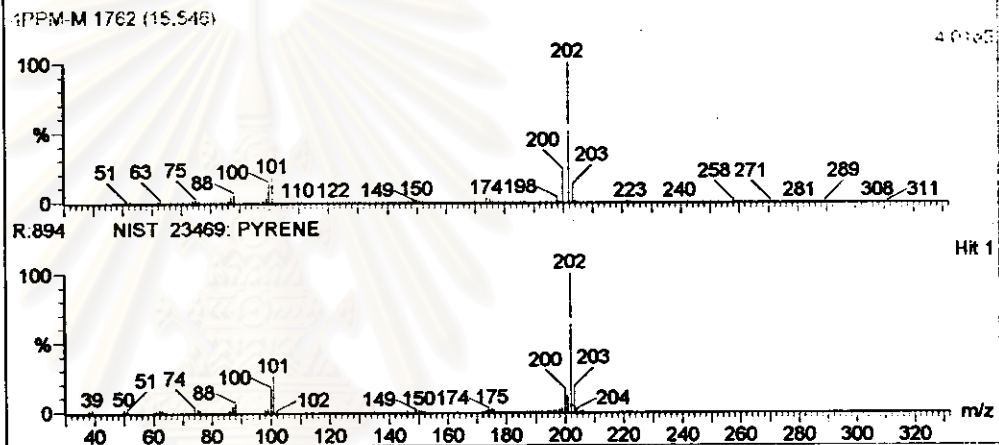
Figure A 8 Comparison of mass spectrum of standard fluoranthene with mass spectra in NIST library

Compound Name: PYRENE
 Synonym: β -Pyrene
 MW : 202



Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 878, Reverse Fit: 894

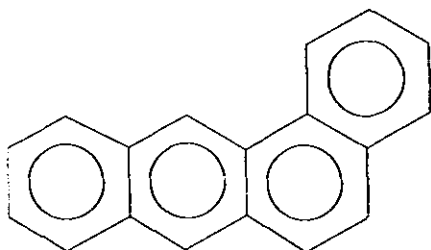


Data File: 4PPM-M
 Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	PYRENE	202	C ₁₆ H ₁₀	878	894	NIST	23469	129-00
2	FLUORANTHENE	202	C ₁₆ H ₁₀	856	874	NIST	23467	206-44
3	BENZENE, 1,1'-(1,3-BUTADIENE-1,4-DIYL)BI	202	C ₁₆ H ₁₀	813	818	NIST	23468	886-66
4	ANTHRACENE, 9-(2-NITROETHENYL)-	249	C ₁₆ H ₁₁ O ₂ N	759	797	NIST	33709	58349-
5	3,10B-DIHYDROFLUORANTHENE	204	C ₁₆ H ₁₂	652	748	NIST	23993	37980-
6	2,3-DIHYDROFLUORANTHENE	204	C ₁₆ H ₁₂	678	748	NIST	23987	30339-
7	1,8-DIHYDROPYRENE	204	C ₁₆ H ₁₂	589	651	NIST	23986	0-00-0
8	PYRENE, 4,5-DIHYDRO-	204	C ₁₆ H ₁₂	568	617	NIST	23991	6628-9
9	ANTHRACENE, 9-ETHENYL-	204	C ₁₆ H ₁₂	580	588	NIST	23992	2444-6
10	1H-INDENE, 1-(PHENYLMETHYLENE)-	204	C ₁₆ H ₁₂	477	538	NIST	23994	5394-8
11	7H-BENZ DE ANTHRACEN-7-ONE	230	C ₁₇ H ₁₀ O	529	533	NIST	30040	82-05-
12	INDENO 2,1-A INDENE, 5,10-DIHYDRO-	204	C ₁₆ H ₁₂	501	531	NIST	23995	6543-2
13	THEBENIDINE-	203	C ₁₅ H ₉ N	460	509	NIST	23615	194-03
14	NAPHTHALENE, 1-PHENYL-	204	C ₁₆ H ₁₂	481	498	NIST	23990	605-02

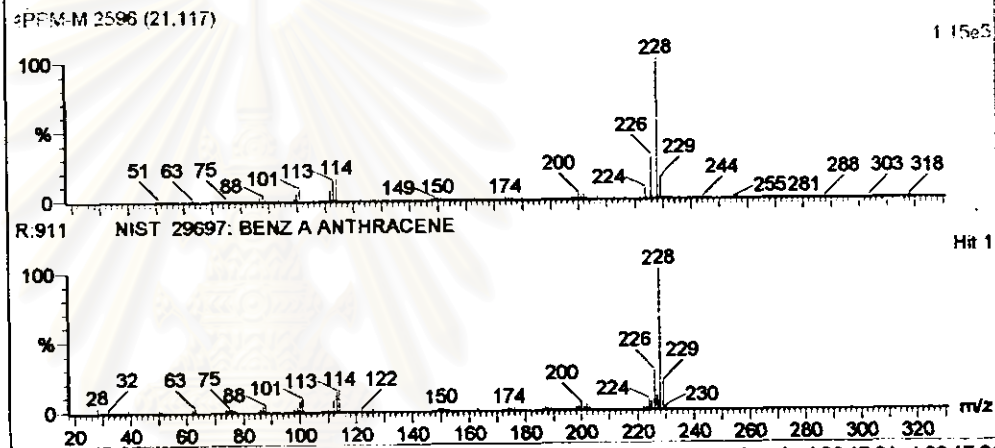
Figure A 9 Comparison of mass spectrum of standard pyrene with mass spectra in NIST library

Compound Name: BENZ A ANTHRACENE
 Synonym: Benzantracene
 MW : 228



Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 895, Reverse Fit: 911

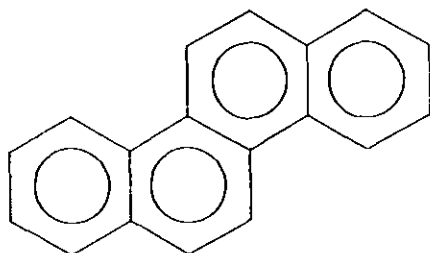


Data File: 4PPM-M
 Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	BENZ A ANTHRACENE	228	C ₁₈ H ₁₂	895	911	NIST	29697	56-55-
2	NAPHTHACENE	228	C ₁₈ H ₁₂	863	862	NIST	29693	92-24-
3	CHRYSENE	228	C ₁₈ H ₁₂	823	871	NIST	29696	218-01
4	TRIPHENYLENE	228	C ₁₈ H ₁₂	815	838	NIST	29698	217-59
5	BENZO C PHENANTHRENE	228	C ₁₈ H ₁₂	788	805	NIST	29694	195-19
6	3,8-PHENANTHRENEDICARBONITRILE	228	C ₁₆ H ₈ N ₂	641	759	NIST	29681	18930-
7	3,4-DIHYDROCYCLOPENTA(CD)PYRENE (A	228	C ₁₈ H ₁₂	669	752	NIST	29695	25732-
8	NAPHTHACENE, 5,12-DIHYDRO-	230	C ₁₈ H ₁₄	609	621	NIST	30045	959-02
9	1,1,3,3-TETRACHLORO-1,3-DISILACYCLOB	224	C ₂ H ₄ Cl ₄ Si ₂	480	582	NIST	28448	2146-9
10	5,6-DIHYDROCHRYSENE	230	C ₁₈ H ₁₄	495	533	NIST	30048	2091-9
11	BENZO(A)ACRIDINE	229	C ₁₇ H ₁₁ N	441	519	NIST	29607	225-11
12	BENZENE, 2-BROMO-1,4-DICHLORO-	224	C ₆ H ₃ Cl ₂ Br	397	469	NIST	28464	1435-5
13	L-5-PROPYLTHIOMETHYLHYDANTOIN (+)-S	204	C ₇ H ₁₂ O ₃ N ₂ S	111	468	NIST	23650	79846-
14	O-TERPHENYL	230	C ₁₈ H ₁₄	442	466	NIST	30052	84-15-

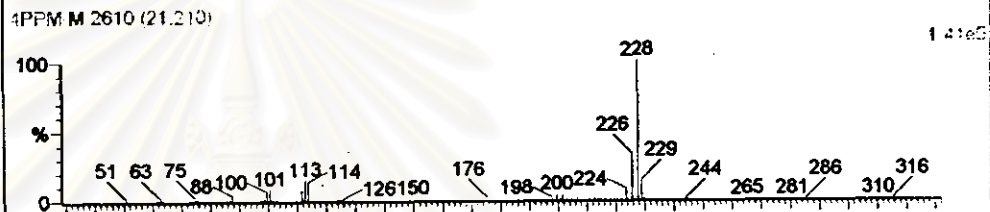
Figure A 10 Comparison of mass spectrum of standard benzo[a]anthracene with mass spectra in NIST library

Compound Name: CHRYSENE
 Synonym: Benzo[a]phenanthrene
 MW : 228

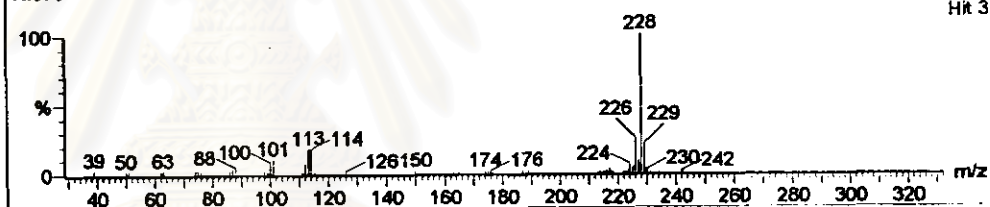


Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 825, Reverse Fit: 875



R:875 NIST 29696: CHRYSENE



Data File: 4PPM-M

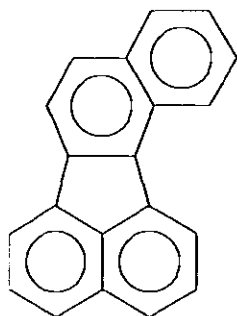
Acquired 06:17:31 at 06:17:31

Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	BENZ A ANTHRACENE	228	C18H12	898	912	NIST	29697	56-55-
2	NAPHTHACENE	228	C18H12	859	877	NIST	29693	92-24-
3	CHRYSENE	228	C18H12	825	875	NIST	29696	218-01
4	TRIPHENYLENE	228	C18H12	809	833	NIST	29698	217-59
5	BENZO C PHENANTHRENE	228	C18H12	795	811	NIST	29694	195-19
6	3,4-DIHYDROCYCLOPENTA(CD)PYRENE (A	228	C18H12	663	750	NIST	29695	25732-
7	3,6-PHENANTHRENE DICARBONITRILE	228	C16H8N2	625	745	NIST	29681	18930-
8	NAPHTHACENE, 5,12-DIHYDRO-	230	C18H14	602	614	NIST	30045	959-02
9	1,1,3,3-TETRACHLORO-1,3-DISILACYCLOB	224	C2H4Cl4Si2	479	584	NIST	28448	2148-9
10	5,6-DIHYDROCHRYSENE	230	C18H14	490	527	NIST	30048	2091-9
11	BENZO(A)ACRIDINE	229	C17H11N	436	513	NIST	29807	225-11
12	L-5-PROPYLTHIOMETHYLHYDANTOIN (+)-S	204	C7H12O3N2S	121	508	NIST	23650	79645-
13	BENZENE, 2-BROMO-1,4-DICHLORO-	224	C6H3Cl2Br	396	472	NIST	28464	1435-5
14	BENZENE, 4-BROMO-1,2-DICHLORO-	224	C6H3Cl2Br	392	465	NIST	28462	18282-

Figure A 11 Comparison of mass spectrum of standard chrysene with mass spectra in NIST library

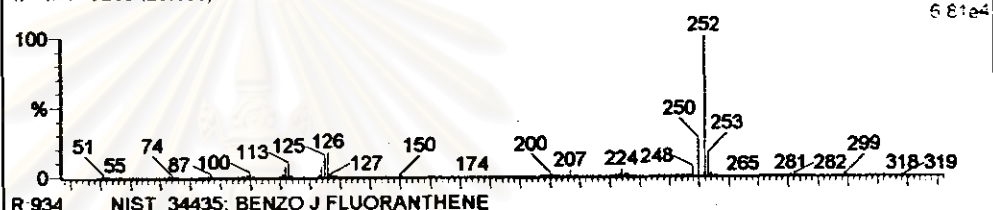
Compound Name: BENZO J FLUORANTHENE
 Synonym: Benzo-10,11-fluoranthene
 MW : 252



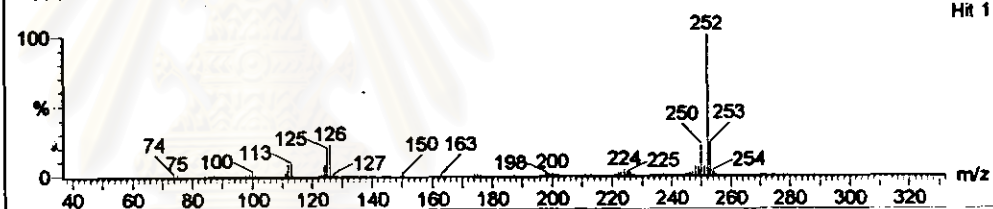
Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

4PPM-M 3200 (25.150)

Forward Fit: 902, Reverse Fit: 934



R:934 NIST 34435: BENZO J FLUORANTHENE



Data File: 4PPM-M

Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	BENZO J FLUORANTHENE	252	C20H12	902	934	NIST	34435	205-82
2	BENZO K FLUORANTHENE	252	C20H12	872	929	NIST	34434	207-08
3	BENZ E ACEPHENANTHRYLENE	252	C20H12	889	922	NIST	34432	205-99
4	BENZO E PYRENE	252	C20H12	880	912	NIST	34433	192-97
5	PERYLENE	252	C20H12	851	899	NIST	34430	198-55
6	BENZO A PYRENE	252	C20H12	751	784	NIST	34431	50-32-
7	1H-INDENE, 1,1'-(1,2-ETHANEDIYLIDENE)BI	254	C20H14	600	697	NIST	34834	72088-
8	9-(M-NITROBENZYLIDENE)FLUORENE	299	C20H13O2N	636	676	NIST	42643	4421-5
9	9-(P-NITROBENZYLIDENE)FLUORENE	299	C20H13O2N	604	648	NIST	42648	6954-7
10	BENZO A PYRENE, 4,5-DIHYDRO-	254	C20H14	592	637	NIST	34832	57652-
11	1,1'-BINAPHTHALENE	254	C20H14	570	627	NIST	34830	604-53
12	4,8-BIAZULENYL	254	C20H14	489	625	NIST	34825	0-00-0
13	1,2-DIHYDROBENZO B FLUORANTHENE	254	C20H14	471	623	NIST	34824	0-00-0
14	4,6-BIAZULENYL	254	C20H14	487	622	NIST	34835	94154-

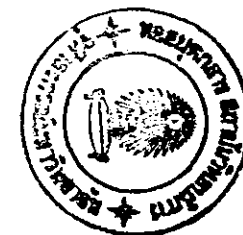
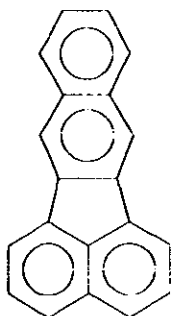


Figure A 12 Comparison of mass spectrum of standard benzo[b]fluoranthene with mass spectra in NIST library

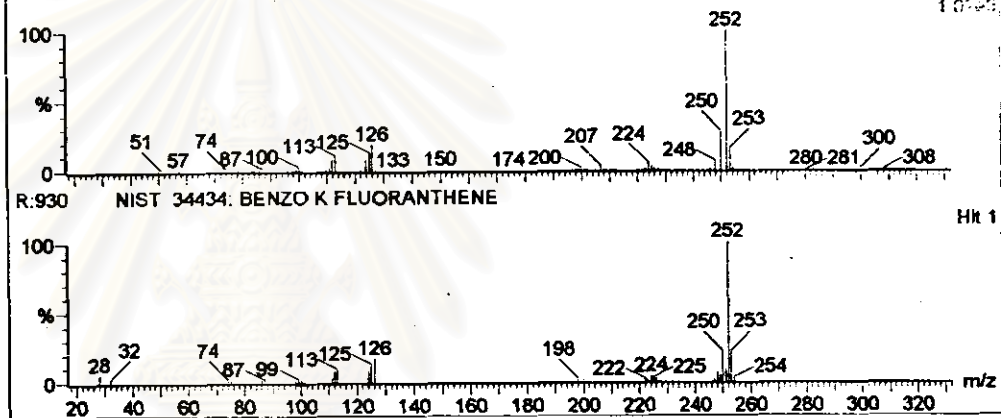
Compound Name: BENZO K FLUORANTHENE
 Synonym: Dibenzo[b,jk]fluorene
 MW : 252



Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 901, Reverse Fit: 930

4PPM-M 3187 (25.063)

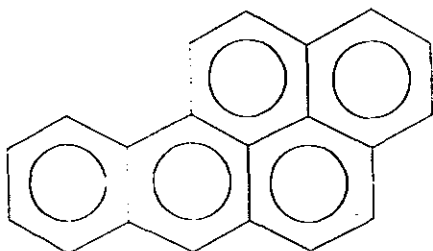


Data File: 4PPM-M
 Sample ID:

Hr	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	BENZO K FLUORANTHENE	252	C20H12	893	930	NIST	34434	207-08
2	BENZO J FLUORANTHENE	252	C20H12	901	925	NIST	34435	205-82
3	BENZ E ACEPHENANTHRYLENE	252	C20H12	886	913	NIST	34432	205-89
4	PERYLENE	252	C20H12	871	901	NIST	34430	198-55
5	BENZO E PYRENE	252	C20H12	872	894	NIST	34433	192-87
6	BENZO A PYRENE	252	C20H12	734	759	NIST	34431	50-32-
7	1H-INDENE, 1,1'-(1,2-ETHANEDIYLIDENE)BI	254	C20H14	592	677	NIST	34834	72088-
8	9-(M-NITROBENZYLIDENE)FLUORENE	299	C20H13O2N	629	661	NIST	42643	4421-5
9	BENZO A PYRENE, 4,5-DIHYDRO-	254	C20H14	599	635	NIST	34832	57652-
10	1,1'-BINAPHTHALENE	254	C20H14	587	634	NIST	34830	604-53
11	9-(P-NITROBENZYLIDENE)FLUORENE	299	C20H13O2N	598	632	NIST	42646	6954-7
12	4,8'-BIAZULENYL	254	C20H14	500	629	NIST	34825	0-00-0
13	4,6'-BIAZULENYL	254	C20H14	498	626	NIST	34835	94154-
14	1,2-DIHYDROBENZO B FLUORANTHENE	254	C20H14	482	626	NIST	34824	0-00-0

Figure A 13 Comparison of mass spectrum of standard benzo[k]fluoranthene with mass spectra in NIST library

Compound Name: BENZO A PYRENE
 Synonym: Benz[a]pyrene
 MW: 252

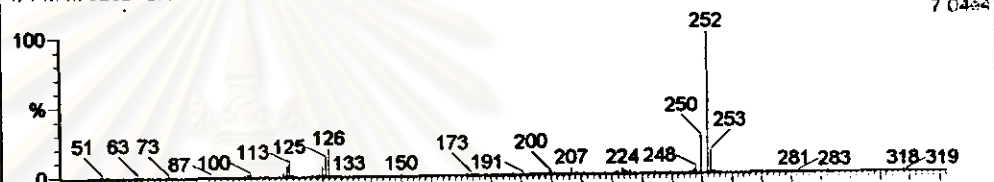


Sample Description:
 Acquired 24-Jun-1996 at 06:17:31

4PPM-M 3202 (25.163)

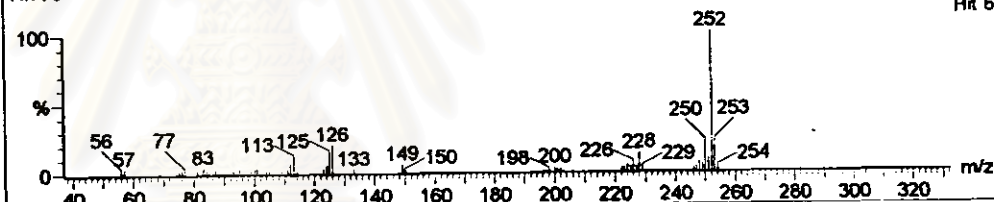
Forward Fit: 740, Reverse Fit: 775

7 04:04



R:775 NIST 34431: BENZO A PYRENE

Hit 6



Acquired 06:17:31 at 06:17:31

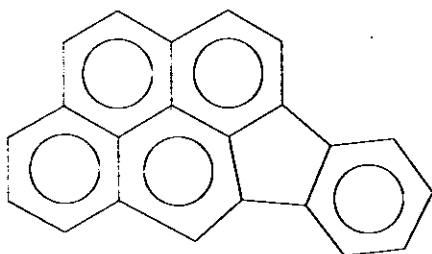
Data File: 4PPM-M

Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	BENZO J FLUORANTHENE	252	C ₂₀ H ₁₂	884	923	NIST	34435	205-82
2	BENZO K FLUORANTHENE	252	C ₂₀ H ₁₂	868	923	NIST	34434	207-08
3	BENZ E ACEPHENANTHRYLENE	252	C ₂₀ H ₁₂	873	914	NIST	34432	205-89
4	BENZO E PYRENE	252	C ₂₀ H ₁₂	854	892	NIST	34433	192-87
5	PERYLENE	252	C ₂₀ H ₁₂	844	892	NIST	34430	198-55
6	BENZO A PYRENE	252	C ₂₀ H ₁₂	740	775	NIST	34431	50-32-
7	1H-INDENE, 1,1'-(1,2-ETHANEDIYLIDENE)BI	254	C ₂₀ H ₁₄	586	679	NIST	34834	72088-
8	9-(M-NITROBENZYLIDENE)FLUORENE	299	C ₂₀ H ₁₃ O ₂ N	602	654	NIST	42843	4421-5
9	9-(P-NITROBENZYLIDENE)FLUORENE	299	C ₂₀ H ₁₃ O ₂ N	582	631	NIST	42846	6954-7
10	BENZO A PYRENE, 4,5-DIHYDRO-	254	C ₂₀ H ₁₄	576	629	NIST	34832	57652-
11	4,8'-BIAZULENYL	254	C ₂₀ H ₁₄	493	623	NIST	34825	0-00-0
12	4,6'-BIAZULENYL	254	C ₂₀ H ₁₄	491	619	NIST	34835	94154-
13	1,1'-BINAPHTHALENE	254	C ₂₀ H ₁₄	557	619	NIST	34830	604-53
14	9H-FLUORENE, 9-(PHENYLMETHYLENE)-	254	C ₂₀ H ₁₄	521	567	NIST	34828	1836-8

Figure A 14 Comparison of mass spectrum of standard benzo[a]pyrene with mass spectra in NIST library

Compound Name: INDENO 1,2,3-CD PYRENE
 Synonym: o-Phenylene-pyrene
 MW : 276

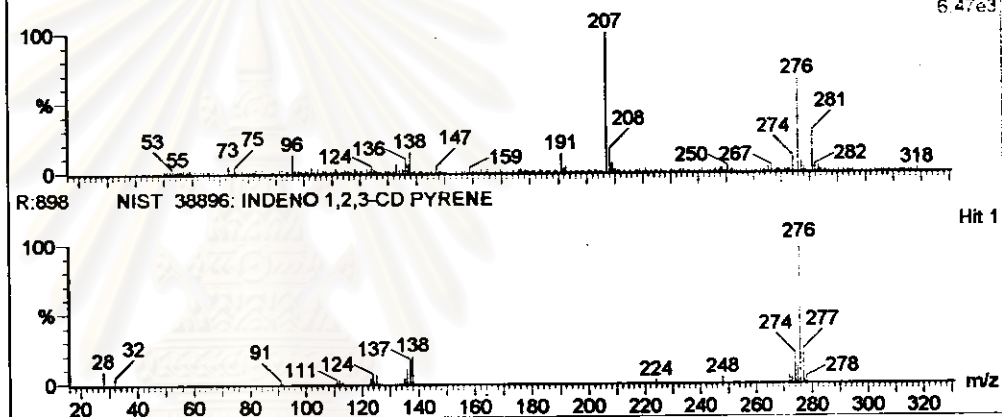


Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

4PPM-M 3806 (29.195)

Forward Fit: 398, Reverse Fit: 898

6.47e3



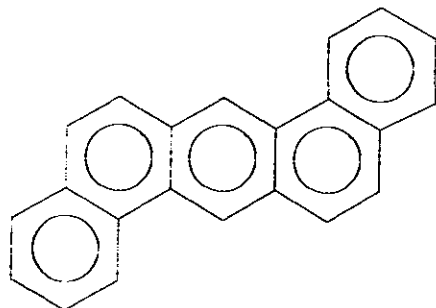
Hit 1

Data File: 4PPM-M
 Sample-ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	INDENO 1,2,3-CD PYRENE	276	C ₂₂ H ₁₂	303	898	NIST	38896	193-39
2	BENZO GHI PERYLENE	276	C ₂₂ H ₁₂	308	824	NIST	38894	191-24
3	1,12-BENZPERYLENE	276	C ₂₂ H ₁₂	290	778	NIST	38893	0-00-0
4	DIBENZO DEF,MNO CHRYSENE	276	C ₂₂ H ₁₂	282	739	NIST	38895	191-28
5	1,1,1,3,5,7,7,7-OCTAMETHYLTETRASILOXA	282	C ₈ H ₂₆ O ₃ Si ₄	347	707	NIST	39662	0-00-0
6	3,3-DIETHOXY-1,1,1,5,5,5-HEXAMETHYLTRI	296	C ₁₀ H ₂₈ O ₄ Si ₃	398	703	NIST	41981	0-00-0
7	METHYLTRIS(TRIMETHYLSILOXY)SILANE	310	C ₁₀ H ₃₀ O ₃ Si ₄	272	556	NIST	44156	17928-
8	CYCLOPROPANECARBONITRILE, 2- P-(DIM	276	C ₁₉ H ₂₀ N ₂	142	474	NIST	38875	32589-
9	BENZO B CHRYSENE	278	C ₂₂ H ₁₄	186	427	NIST	39241	214-17
10	DIBENZ A,H ANTHRACENE	278	C ₂₂ H ₁₄	125	365	NIST	39243	53-70-
11	3-(P-TRIMETHYLSILOXYPHENYL)-1-TRIM	296	C ₁₅ H ₂₈ O ₂ Si ₂	180	331	NIST	42033	0-00-0
12	1,2:7,8-DIBENZPHENANTHRENE	278	C ₂₂ H ₁₄	132	314	NIST	39237	0-00-0
13	DIBENZ A,J ANTHRACENE	278	C ₂₂ H ₁₄	85	307	NIST	39242	224-41
14	9-PHENANTHRENEMETHYL 3-BUTENOATE	276	C ₁₉ H ₁₆ O ₂	156	307	NIST	38858	92174-

Figure A 15 Comparison of mass spectrum of standard indeno[1,2,3-cd]pyrene with mass spectra in NIST library

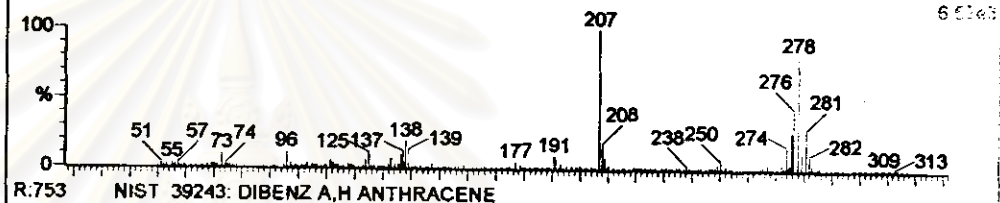
Compound Name: DIBENZ A,H ANTHRACENE
 Synonym: Dibenzo[a,h]anthracene
 MW : 278



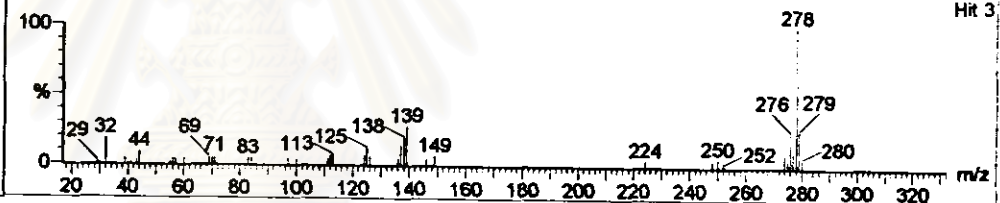
Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

4PPM-M 3821 (23.296)

Forward Fit: 327, Reverse Fit: 753



R:753 NIST 39243: DIBENZ A,H ANTHRACENE



Data File: 4PPM-M

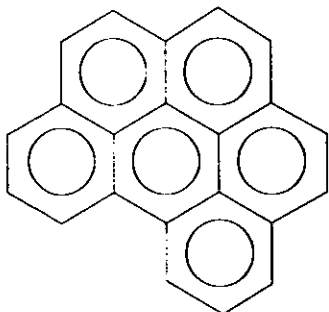
Sample ID:

Acquired 06:17:31 at 06:17:31

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	BENZO A NAPHTHACENE	278	C22H14	324	903	NIST	39240	226-88
2	DIBENZ A,J ANTHRACENE	278	C22H14	323	886	NIST	39242	224-41
3	DIBENZ A,H ANTHRACENE	278	C22H14	323	753	NIST	39243	53-70-
4	1,2,7,8-DIBENZPHENANTHRENE	278	C22H14	355	717	NIST	39237	0-00-0
5	PENTACENE	278	C22H14	295	656	NIST	39239	135-48
6	BENZO B CHRYSENE	278	C22H14	327	648	NIST	39241	214-17
7	BENZO B TRIPHENYLENE	278	C22H14	423	579	NIST	39238	215-58
8	INDENO 1,2,3-CD PYRENE	276	C22H12	199	541	NIST	38896	193-39
9	BENZO GHI PERYLENE	276	C22H12	233	523	NIST	38894	191-24
10	1,12-BENZPERYLENE	276	C22H12	213	509	NIST	38893	0-00-0
11	DIBENZO.DEF,MNO-CHRYSENE	276	C22H12	204	476	NIST	38895	191-26
12	TRIPROLIQINE	276	C19H22N2	210	387	NIST	39215	486-12
13	1,4-DICHLORO-3-(TRICHLOROVINYL)BENZ	274	C8H3Cl5	131	387	NIST	38356	0-00-0
14	1,2-DICHLORO-5-(TRICHLOROVINYL)BENZ	274	C8H3Cl5	163	329	NIST	38355	0-00-0

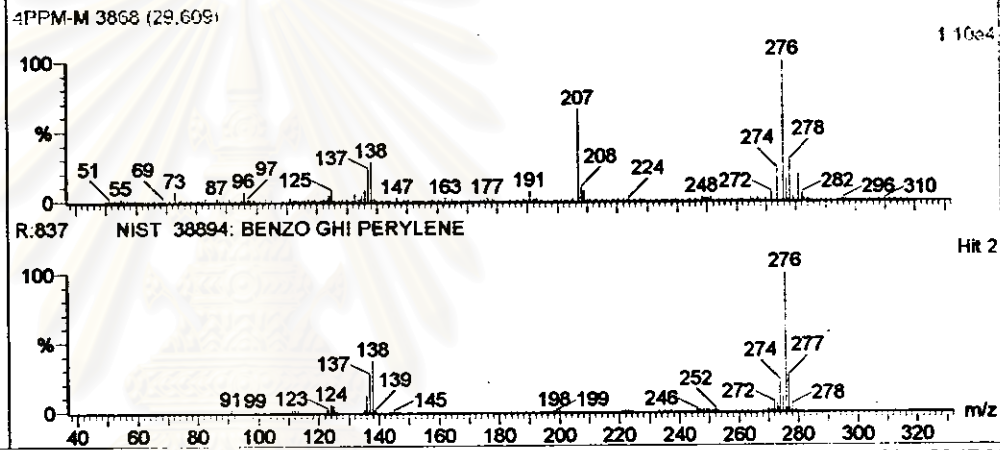
Figure A 16 Comparison of mass spectrum of standard dibenzo[a,h]anthracene with mass spectra in NIST library

Compound Name: BENZO GHI PERYLENE
 Synonym: Benzo-1,12-perylene
 MW : 276



Sample Description :
 Acquired 24-Jun-1996 at 06:17:31

Forward Fit: 505, Reverse Fit: 837



Data File: 4PPM-M

Sample ID:

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	INDENO 1,2,3-CD PYRENE	276	C22H12	505	859	NIST	38896	193-39
2	BENZO GHI PERYLENE	276	C22H12	515	837	NIST	38894	191-24
3	1,2-DIHYDROINDENO 1,2,3-CD PYRENE	278	C22H14	343	812	NIST	39238	0-00-0
4	1,12-BENZPERYLENE	276	C22H12	483	789	NIST	38893	0-00-0
5	DIBENZO DEF,MNO CHRYSENE	276	C22H12	462	749	NIST	38895	191-26
6	BENZO B CHRYSENE	278	C22H14	423	641	NIST	39241	214-17
7	BENZO A NAPHTHACENE	278	C22H14	304	570	NIST	39240	226-88
8	DIBENZ A,J ANTHRACENE	278	C22H14	303	569	NIST	39242	224-41
9	DIBENZ A,H ANTHRACENE	278	C22H14	333	568	NIST	39243	53-70-
10	1,2:7,8-DIBENZPHENANTHRENE	278	C22H14	359	557	NIST	39237	0-00-0
11	BENZO B TRIPHENYLENE	278	C22H14	423	501	NIST	39238	215-58
12	PENTACENE	278	C22H14	256	426	NIST	39239	135-48
13	1,2-DICHLORO-5-(TRICHLOROVINYL)BENZ	274	C8H3Cl5	242	424	NIST	38355	0-00-0
14	CYCLOPROPANECARBONITRILE, 2- P-(DIM	276	C19H20N2	221	421	NIST	38875	32589-

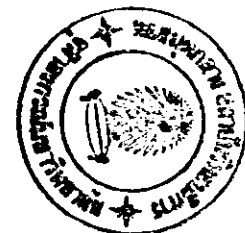
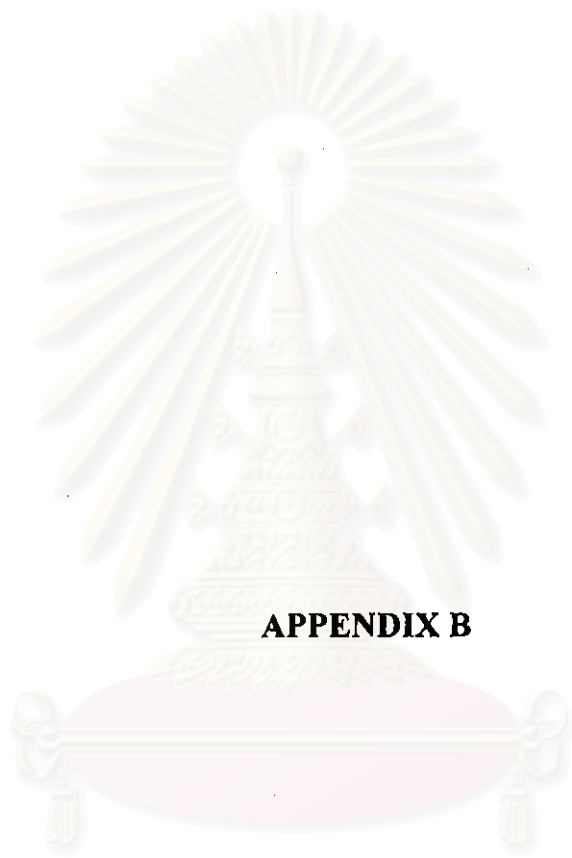


Figure A 17 Comparison of mass spectrum of standard benzo[ghi]perylene with mass spectra in NIST library



APPENDIX B

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

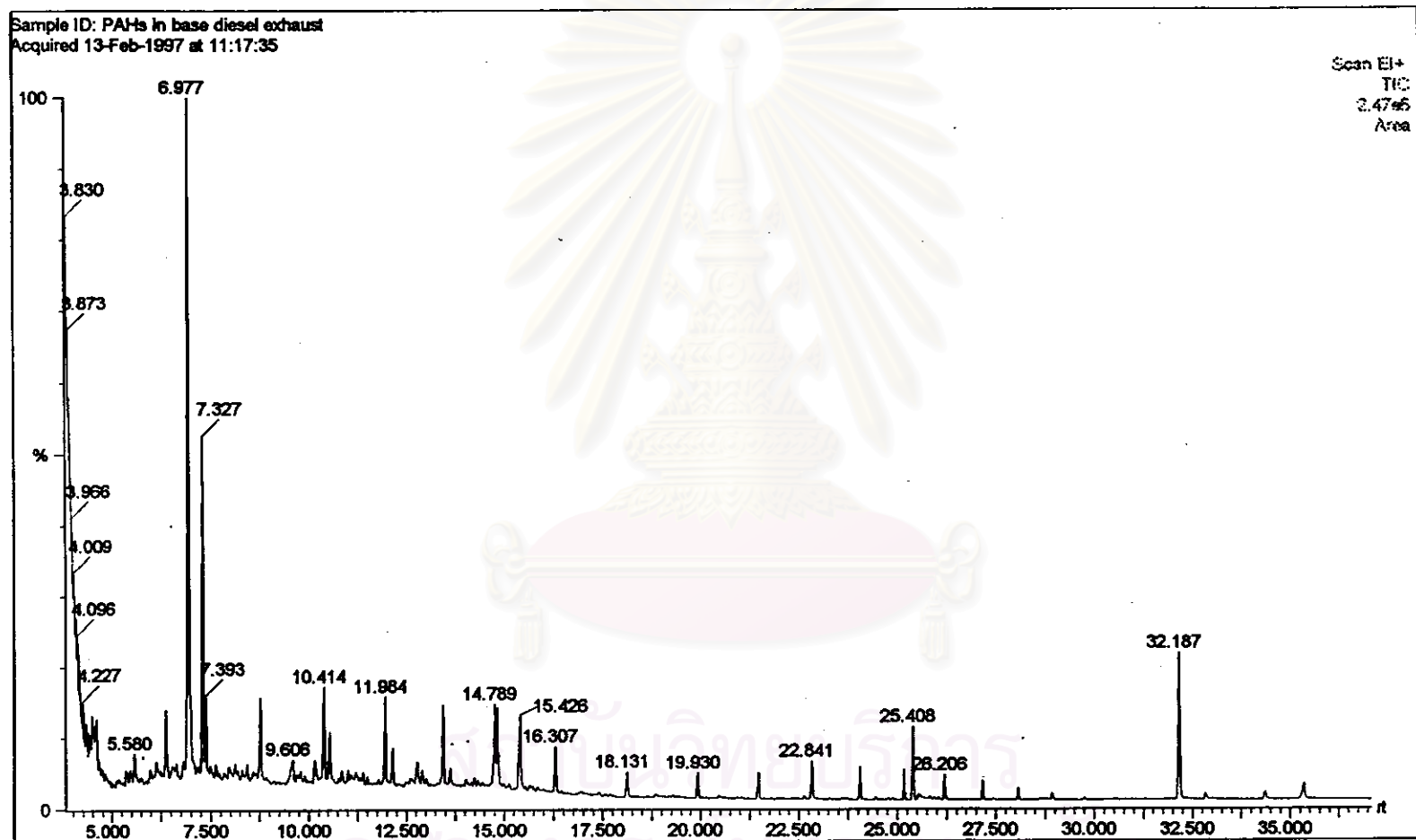


Figure B 1 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 800 rpm.

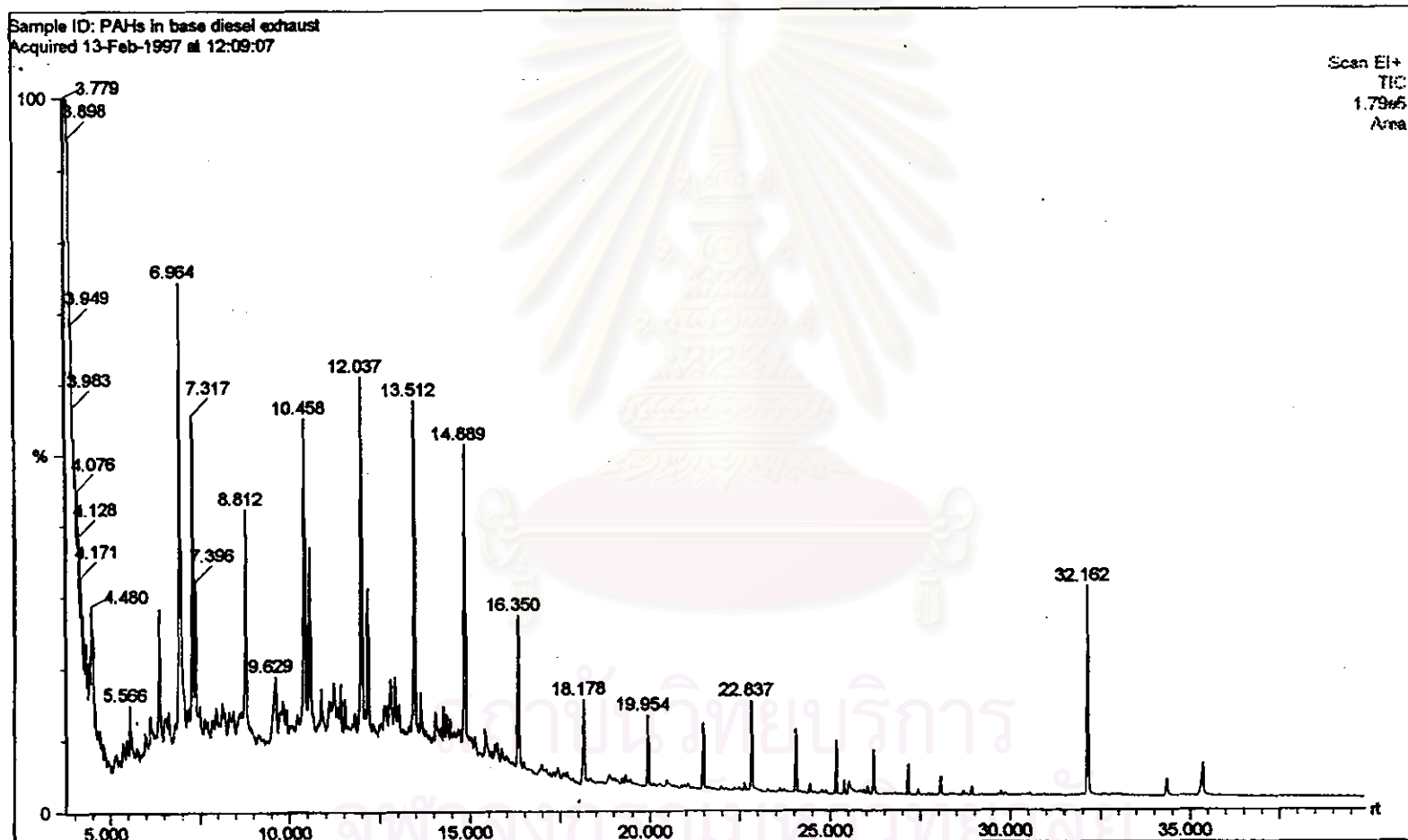


Figure B 2 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 1600 rpm

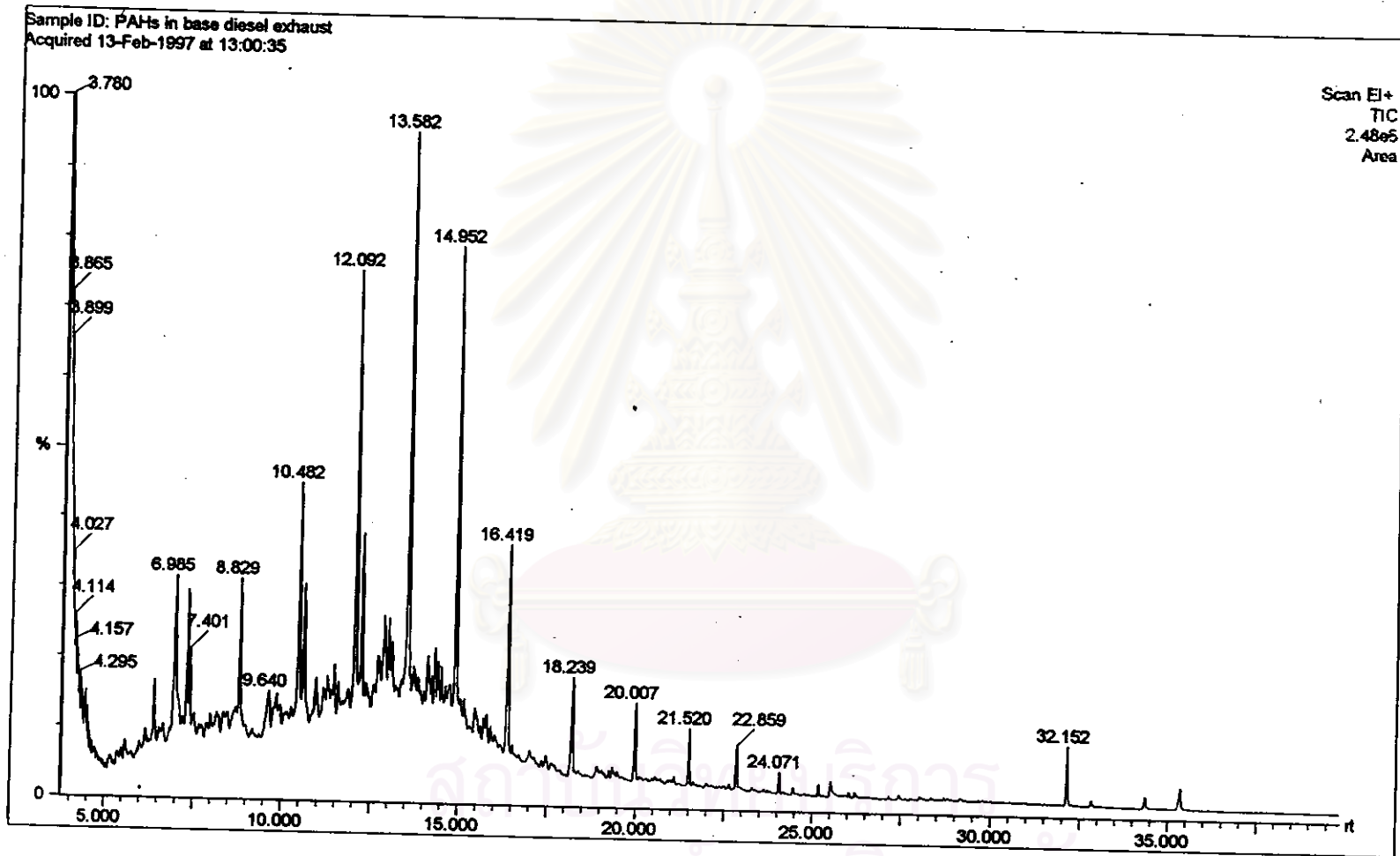


Figure B 3 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 2400 rpm

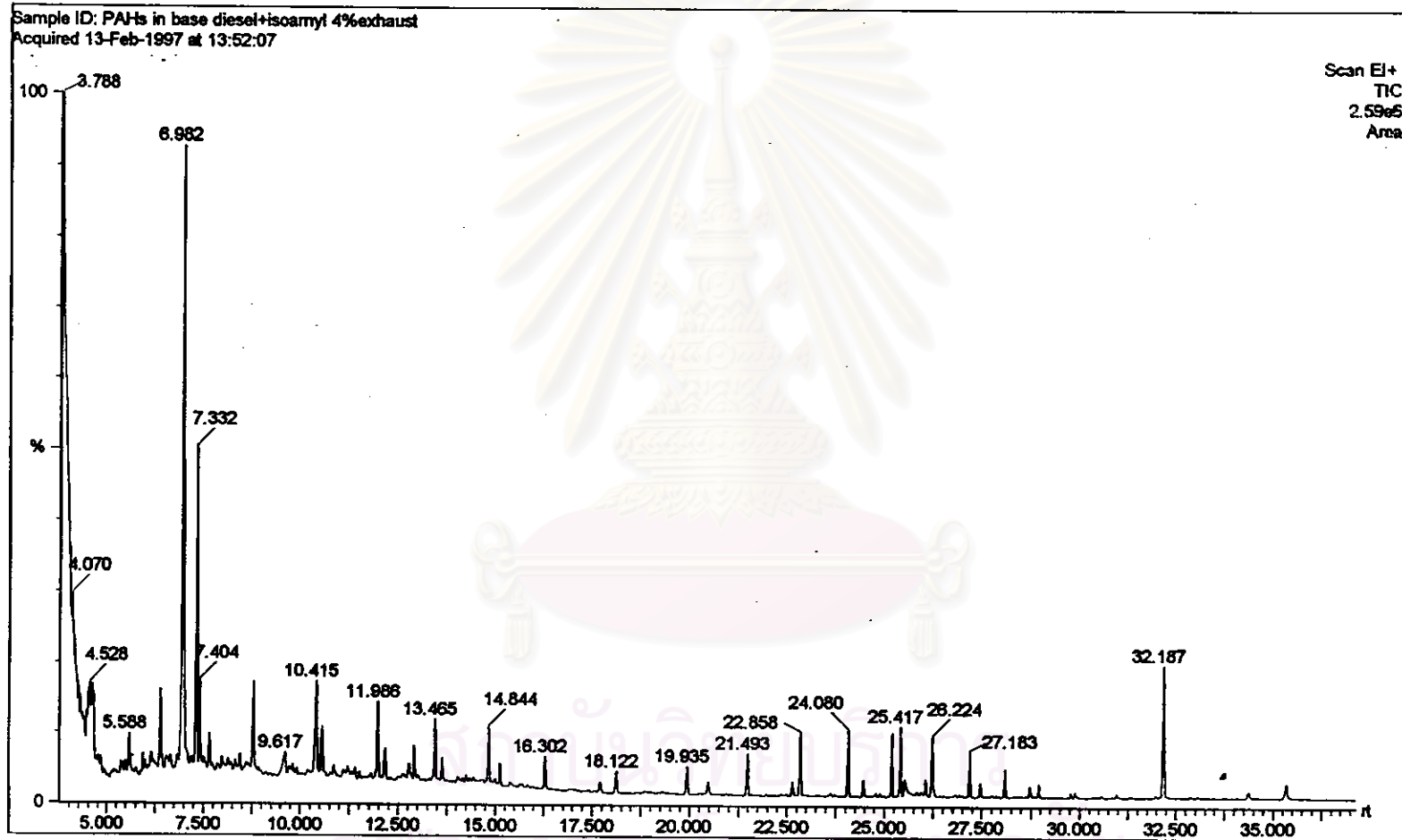


Figure B 4 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 4% isoamyl alcohol at 800 rpm.

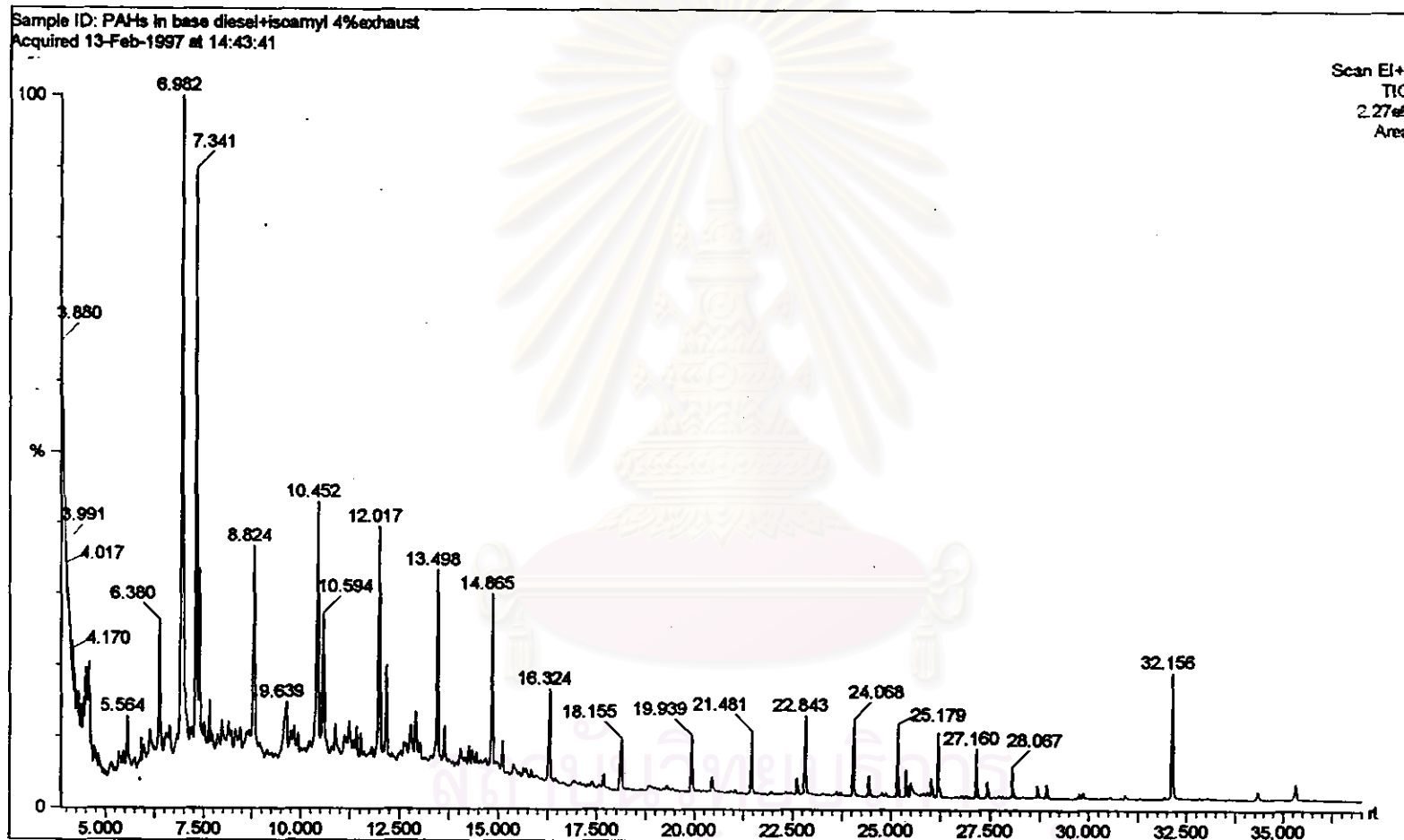


Figure B 5 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 4% isoamyl alcohol at 1600 rpm.

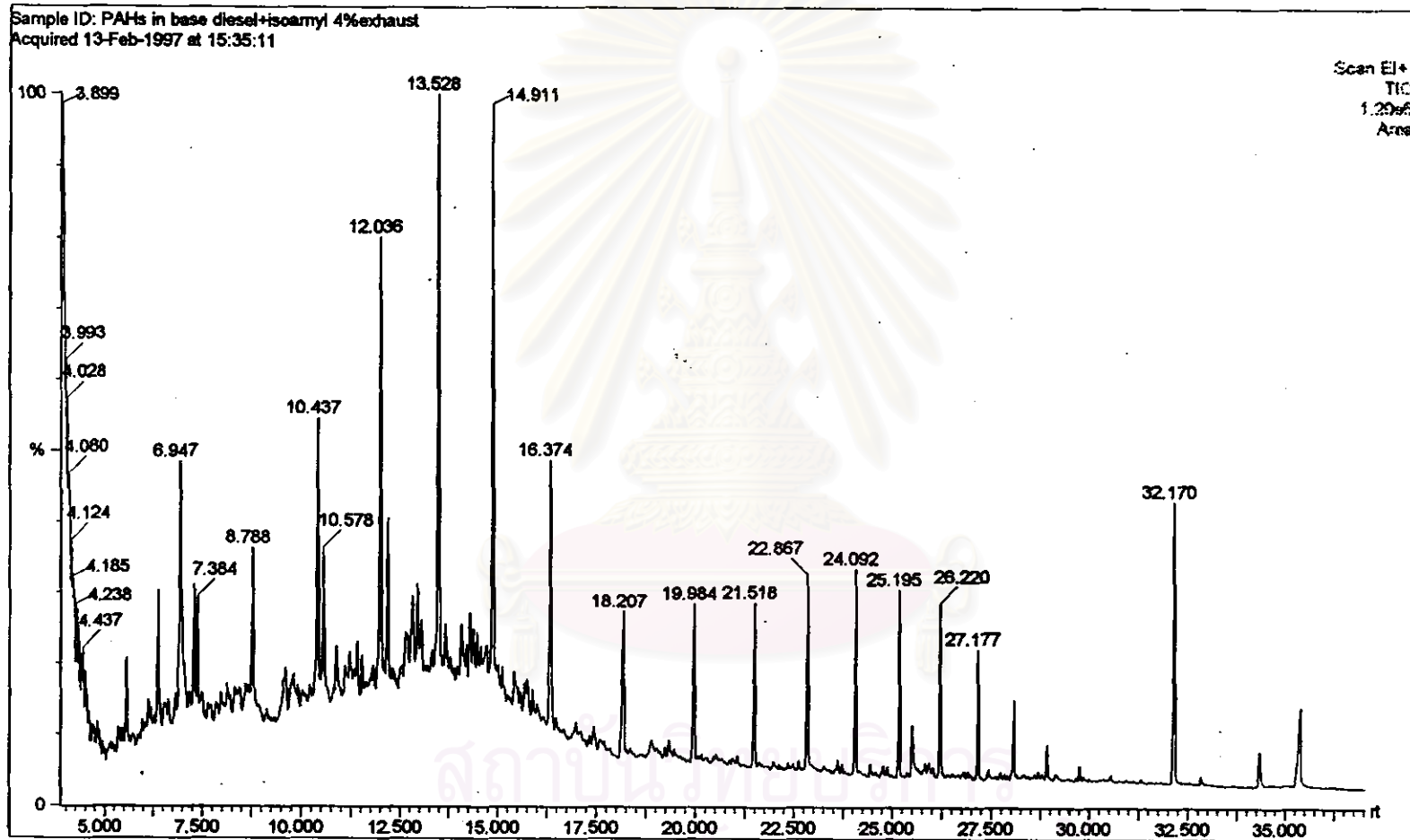


Figure B 6 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 4% isoamyl alcohol at 2400 rpm.

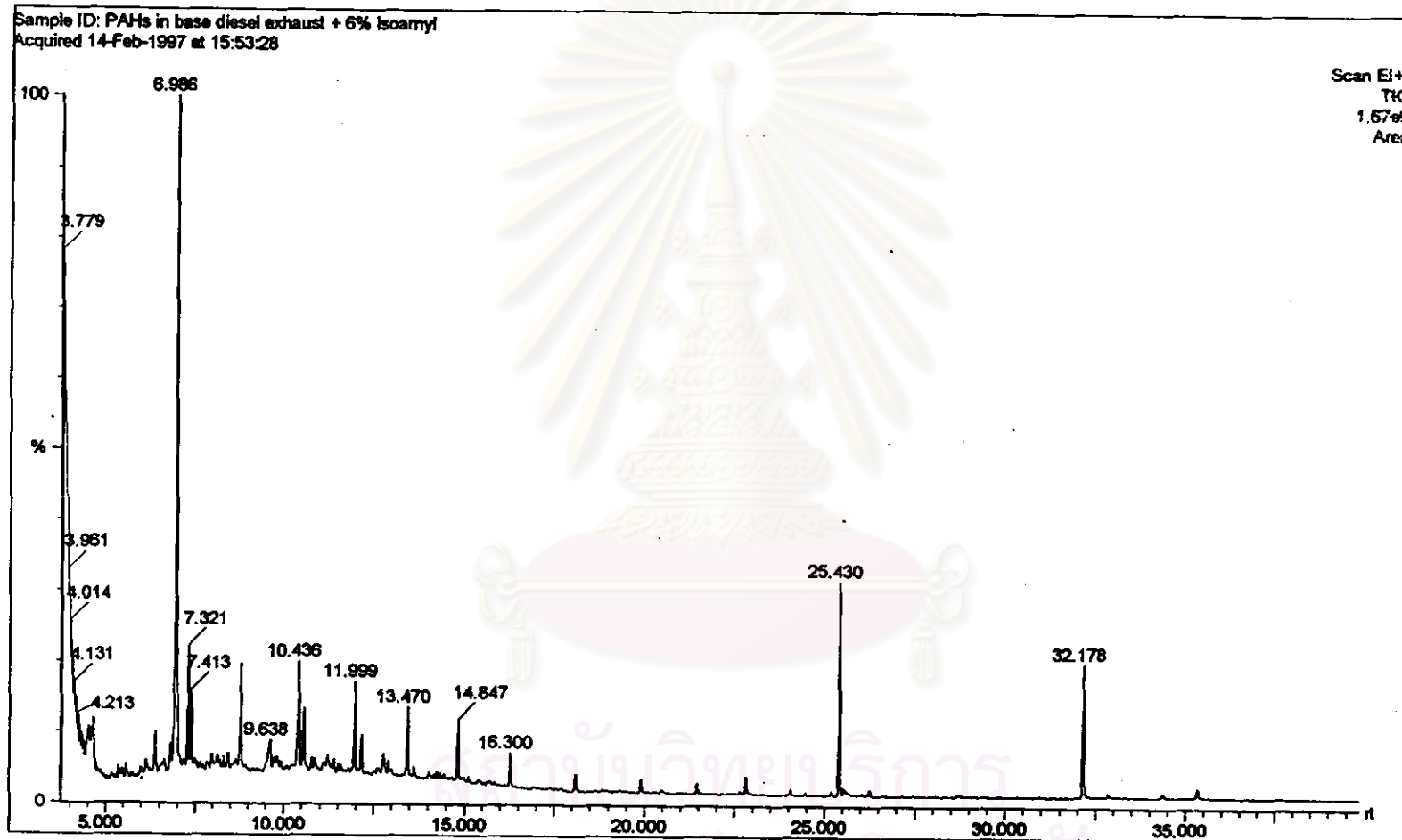


Figure B 7 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 6% isoamyl alcohol at 800 rpm.

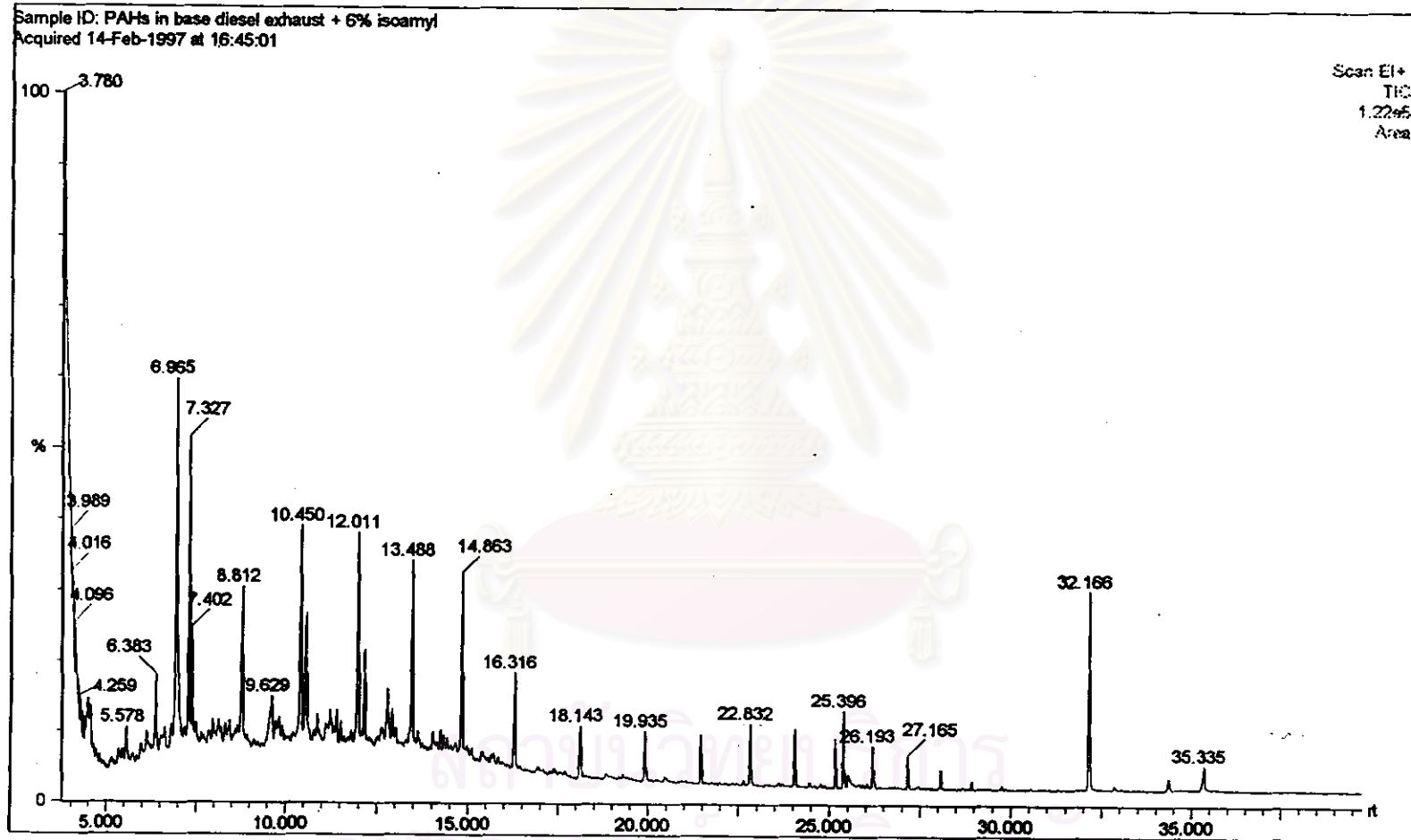


Figure B 8 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 6% isoamyl alcohol at 1600 rpm.

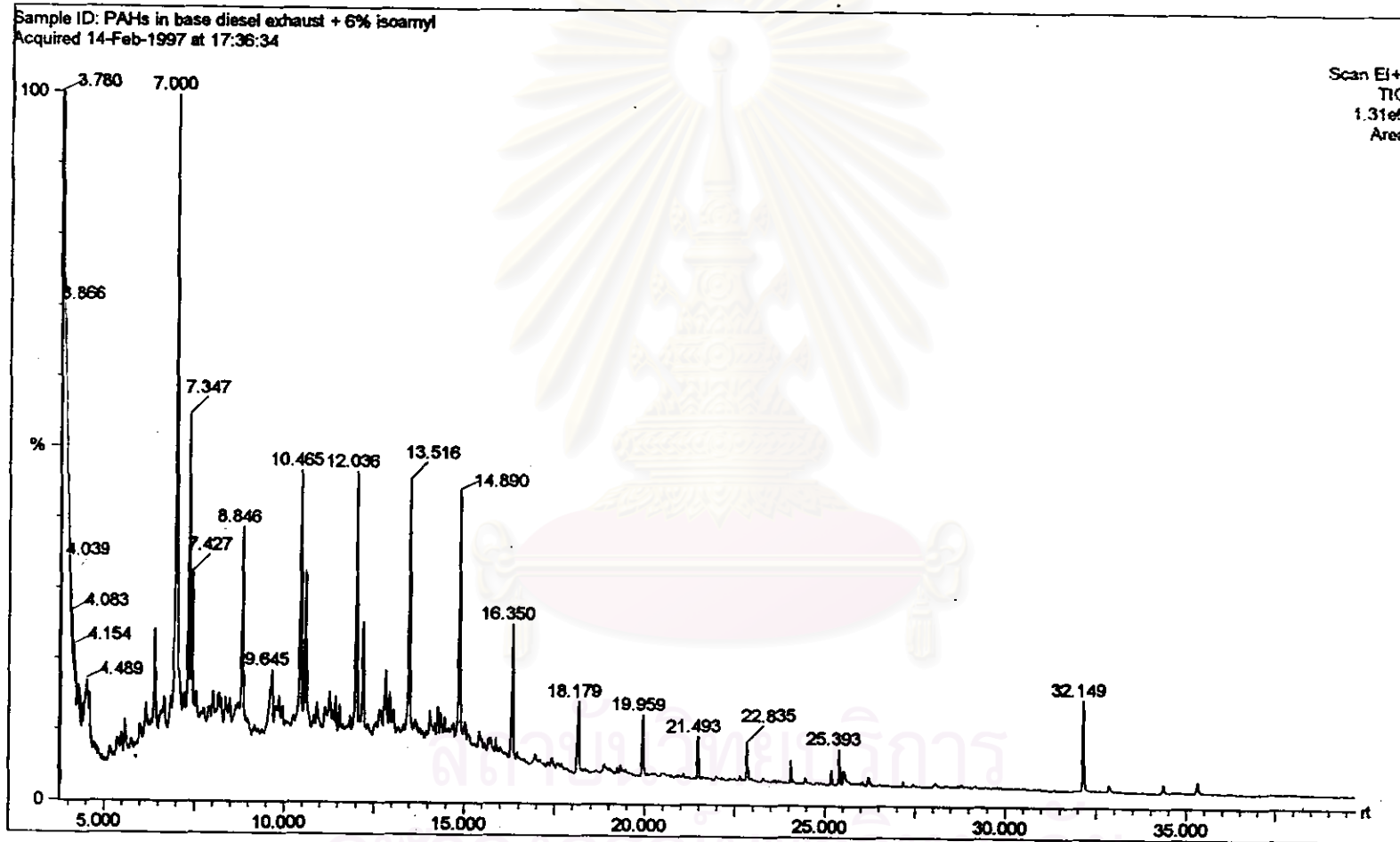


Figure B 9 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 6% isoamyl alcohol at 2400 rpm.

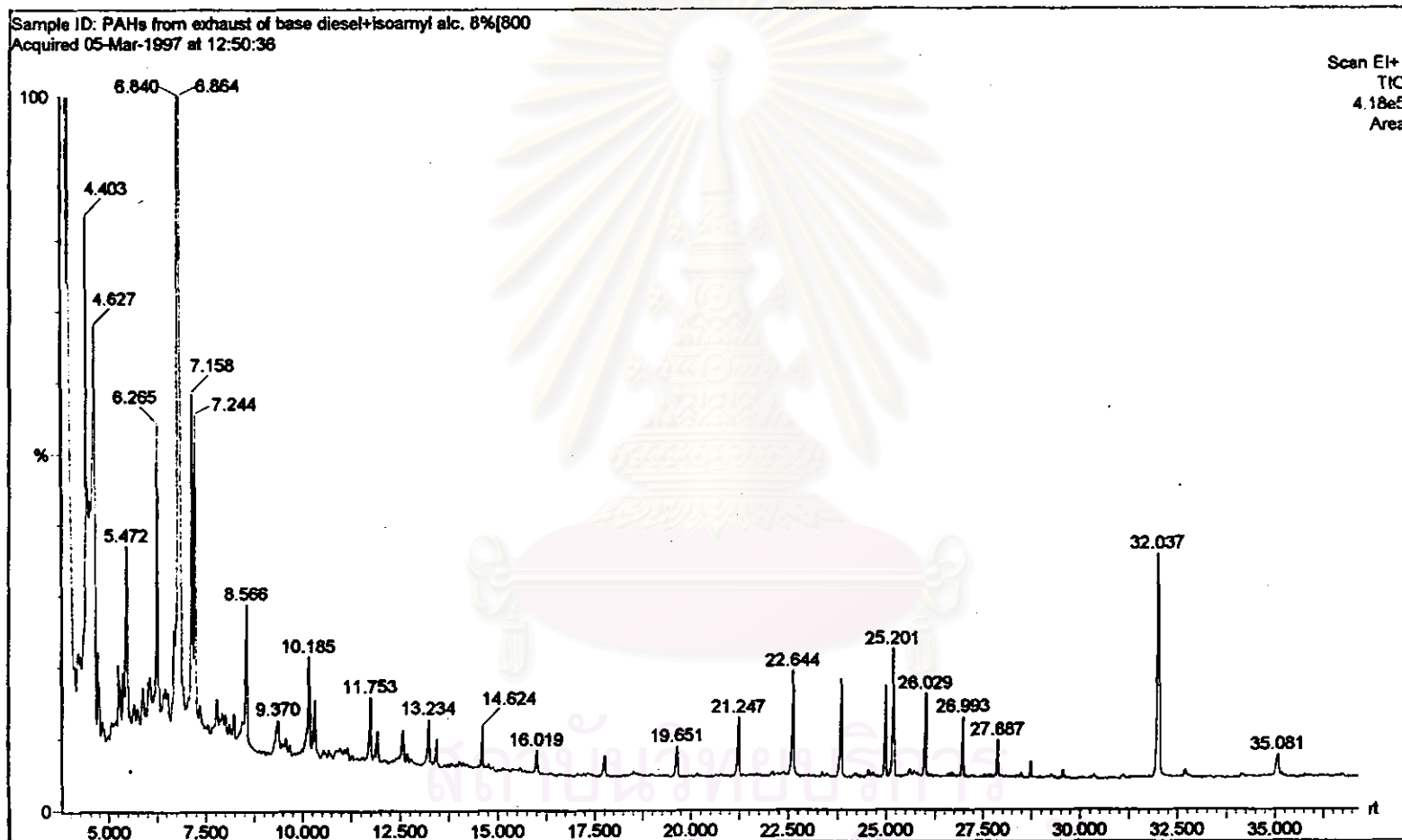


Figure B 10 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 8% isoamyl alcohol at 800 rpm.

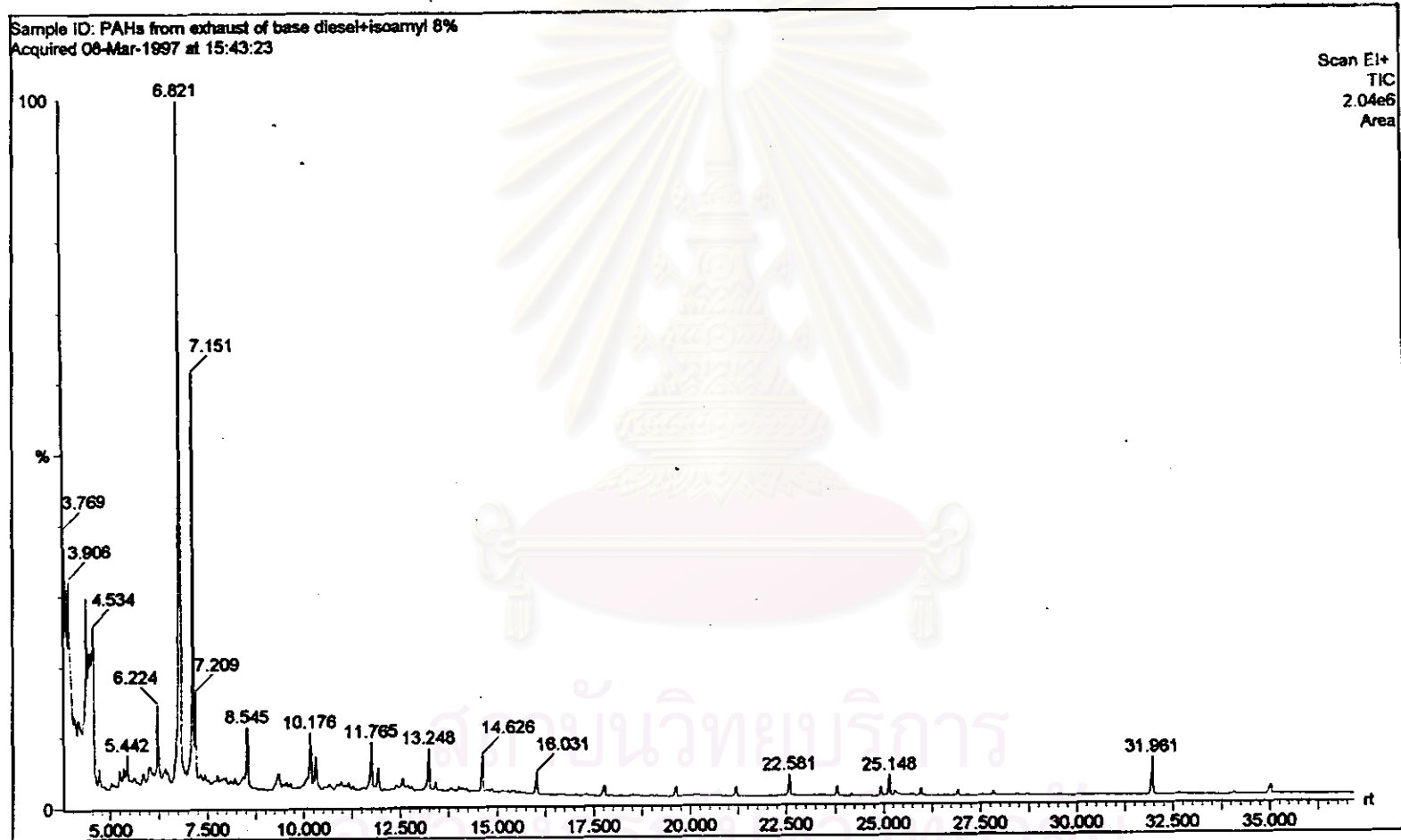


Figure B 11 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 8% isoamyl alcohol at 1600 rpm.

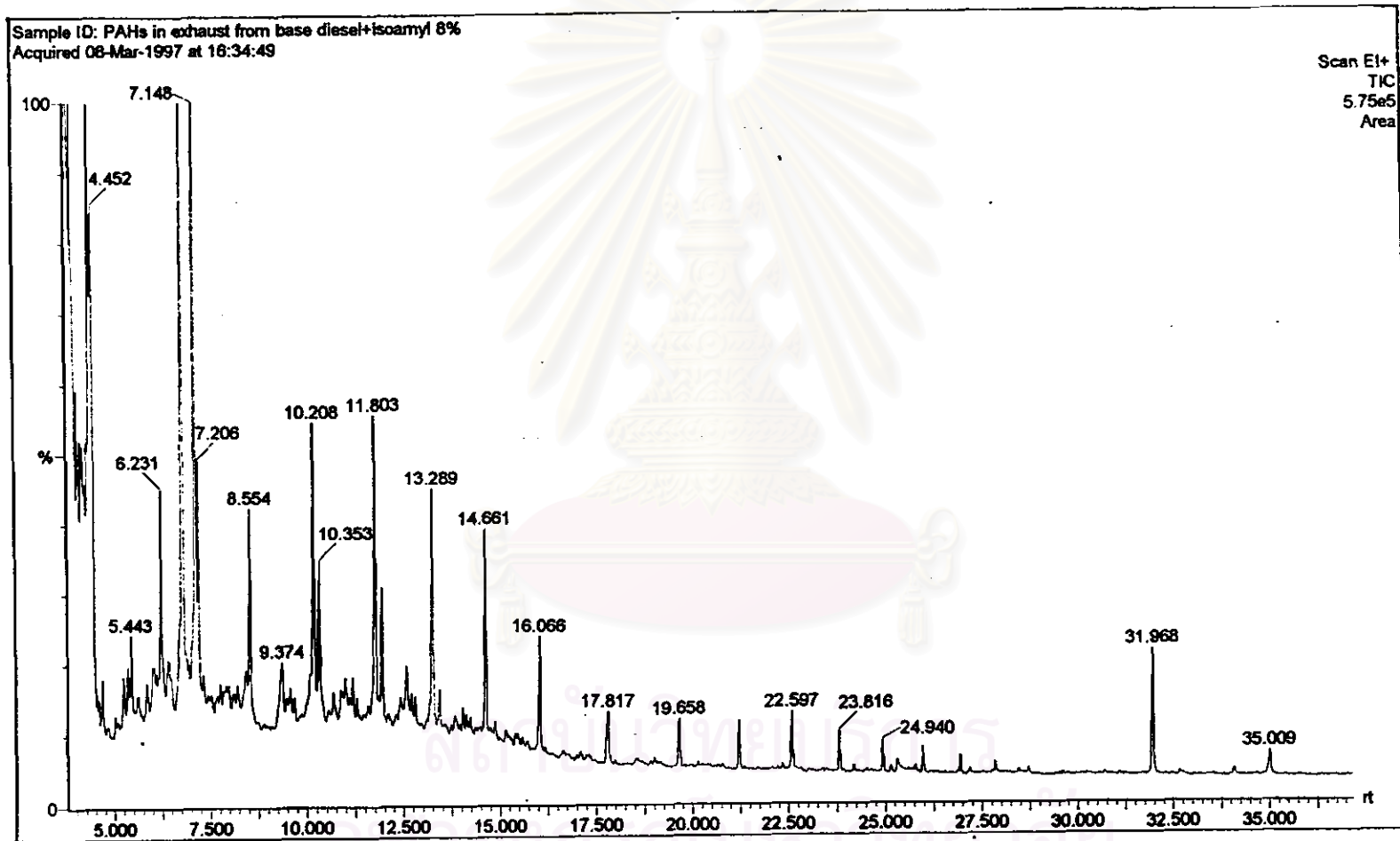


Figure B 12 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 8% isoamyl alcohol at 2400 rpm.

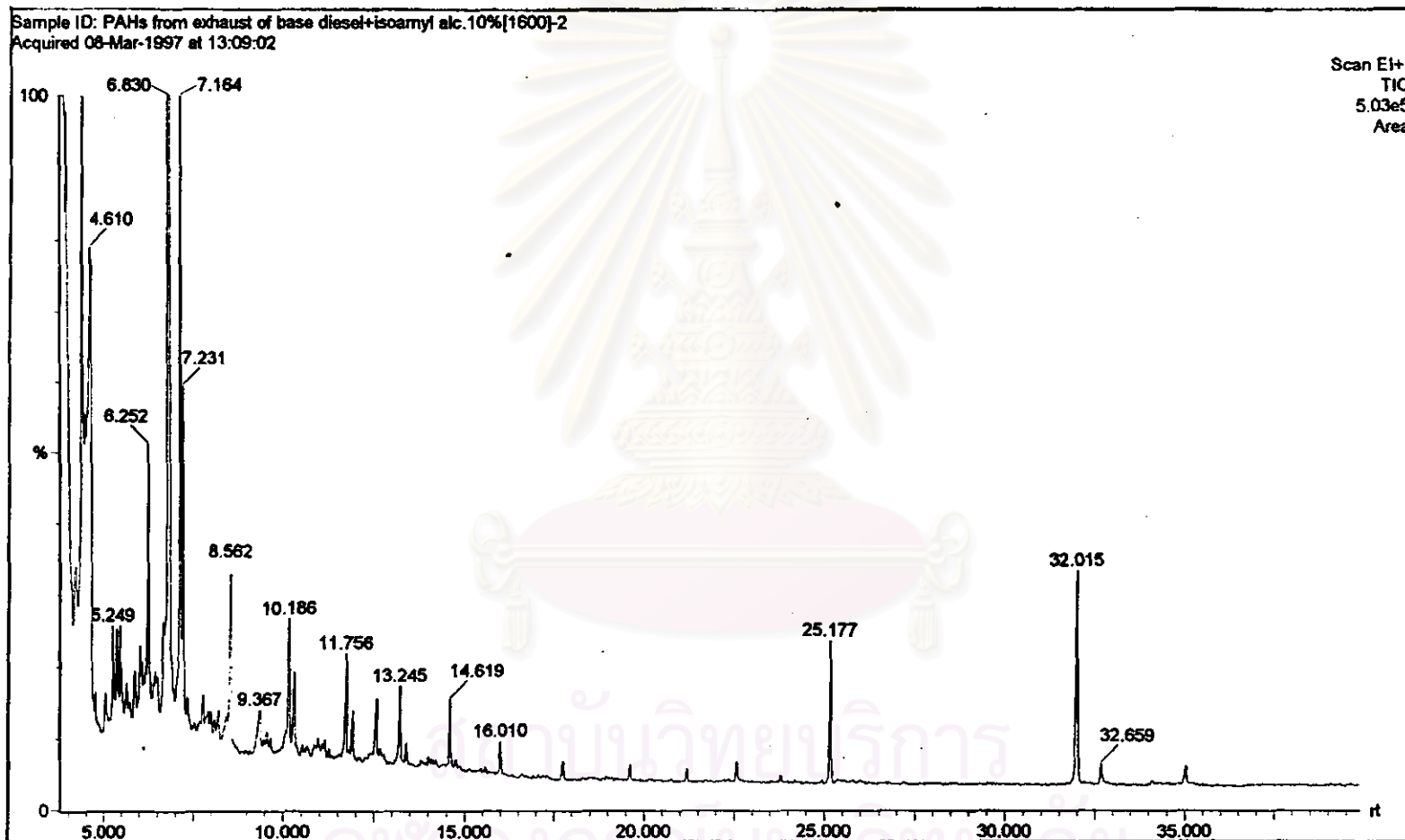


Figure B 13 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 10% isoamyl alcohol at 800 rpm.

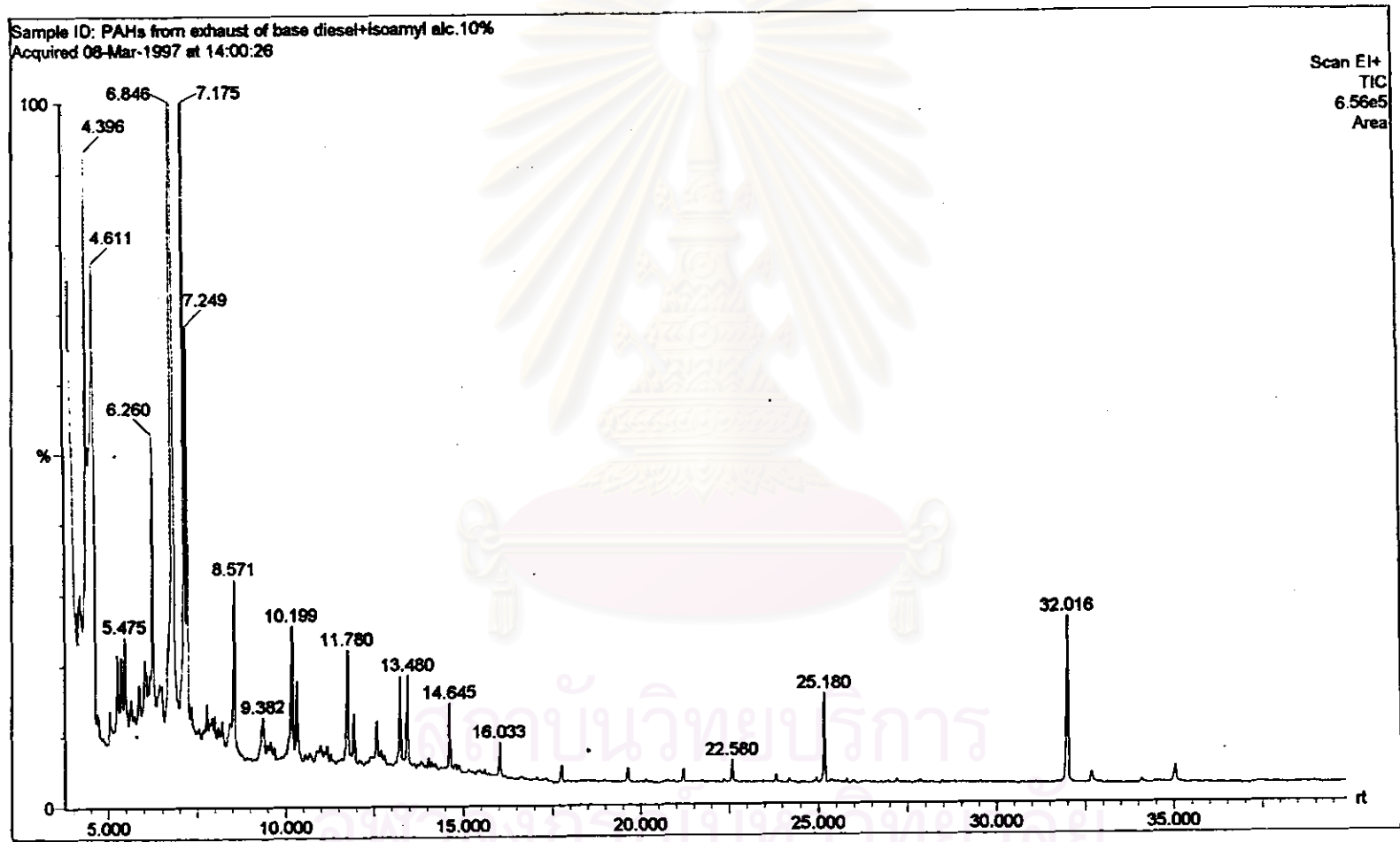


Figure B 14 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 10% isoamyl alcohol at 1600 rpm.

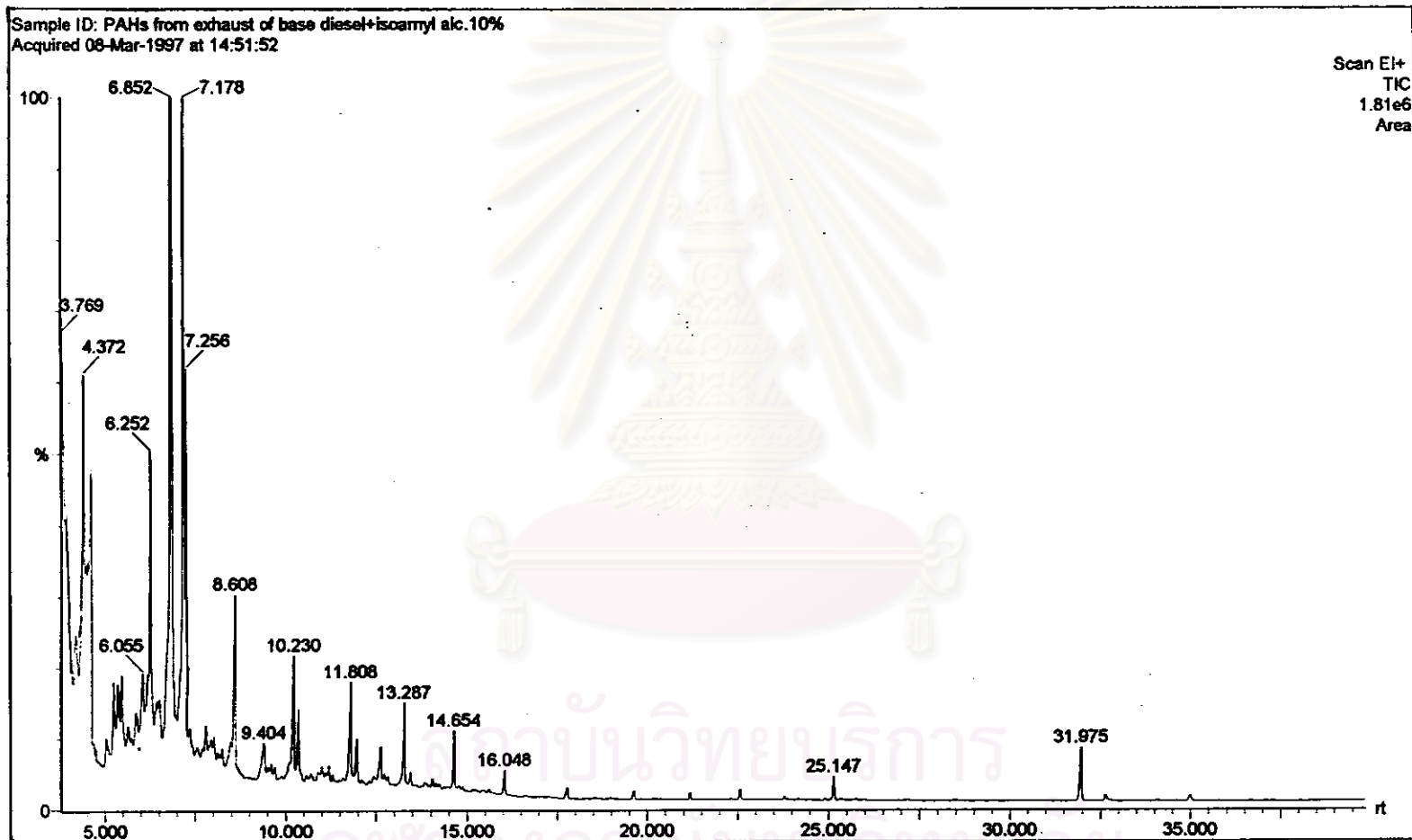


Figure B 15 Gas chromatogram of hydrocarbons fraction of blended fuel between base diesel exhaust and 10% isoamyl alcohol at 2400 rpm.

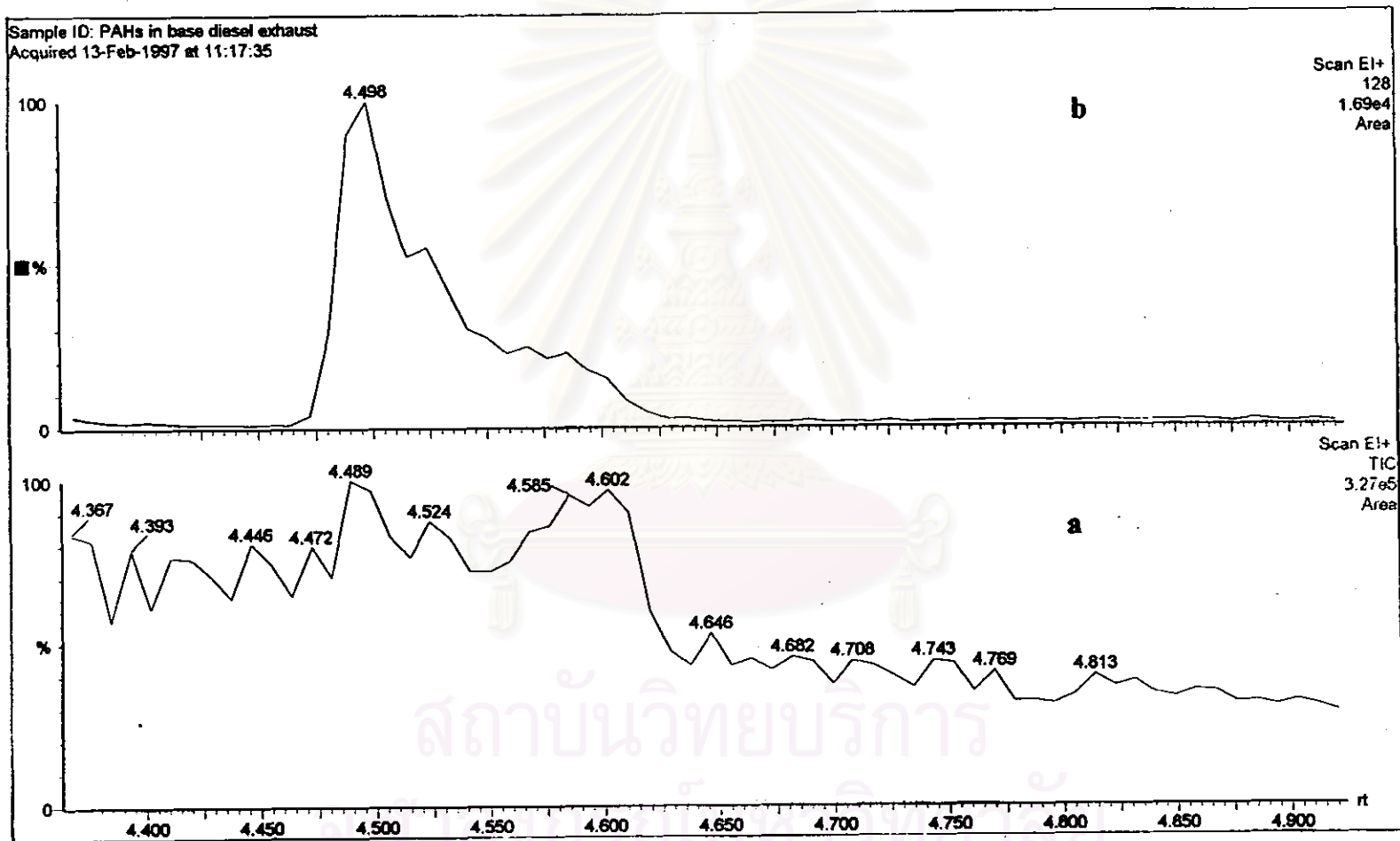


Figure B 16 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 2400 rpm (a) Gas chromatogram of naphthalene and (b) selected ion chromatograms of m/z 128

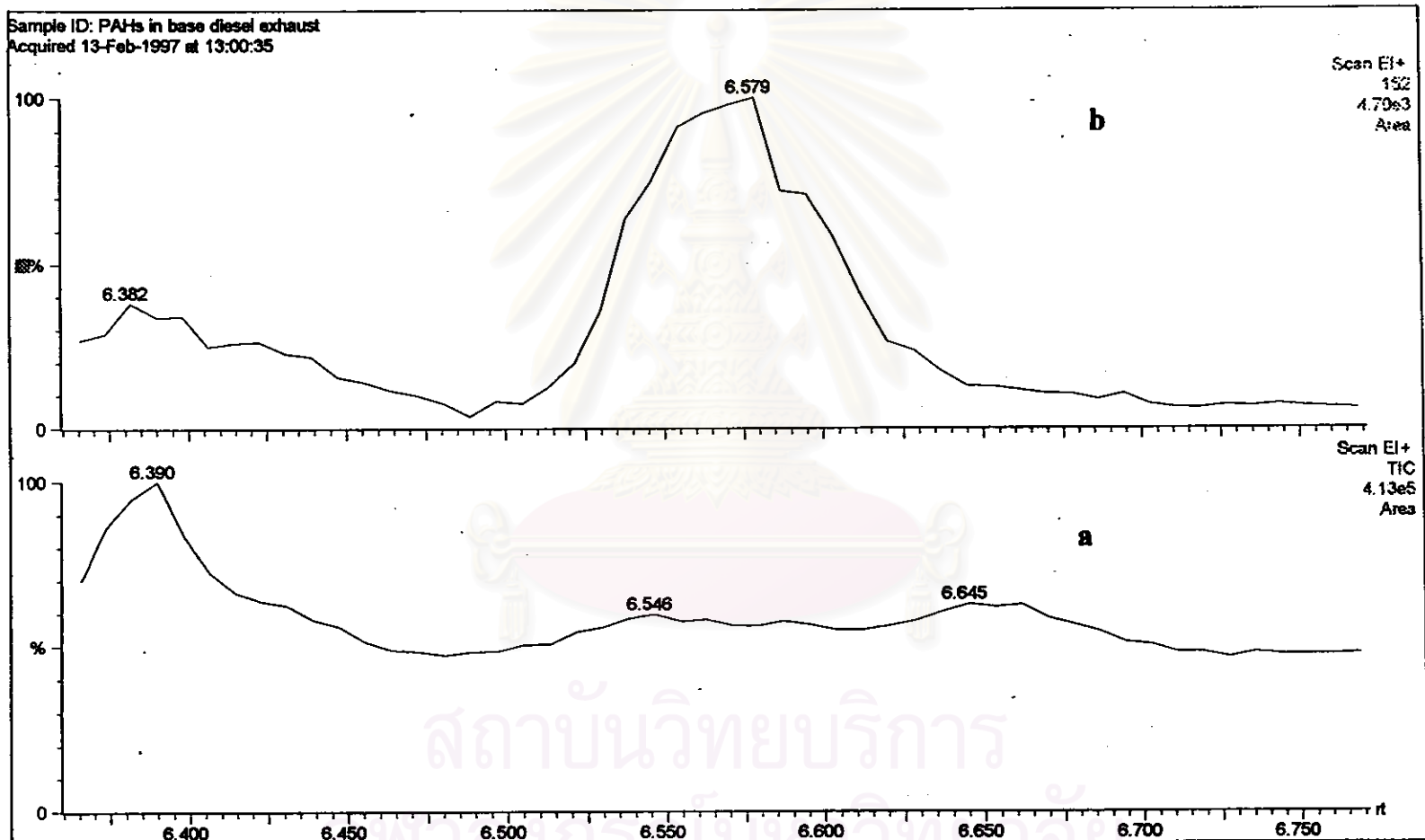


Figure B 17 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 2400 rpm (a) Gas chromatogram of acenaphthylene and (b) selected ion chromatograms of m/z 152

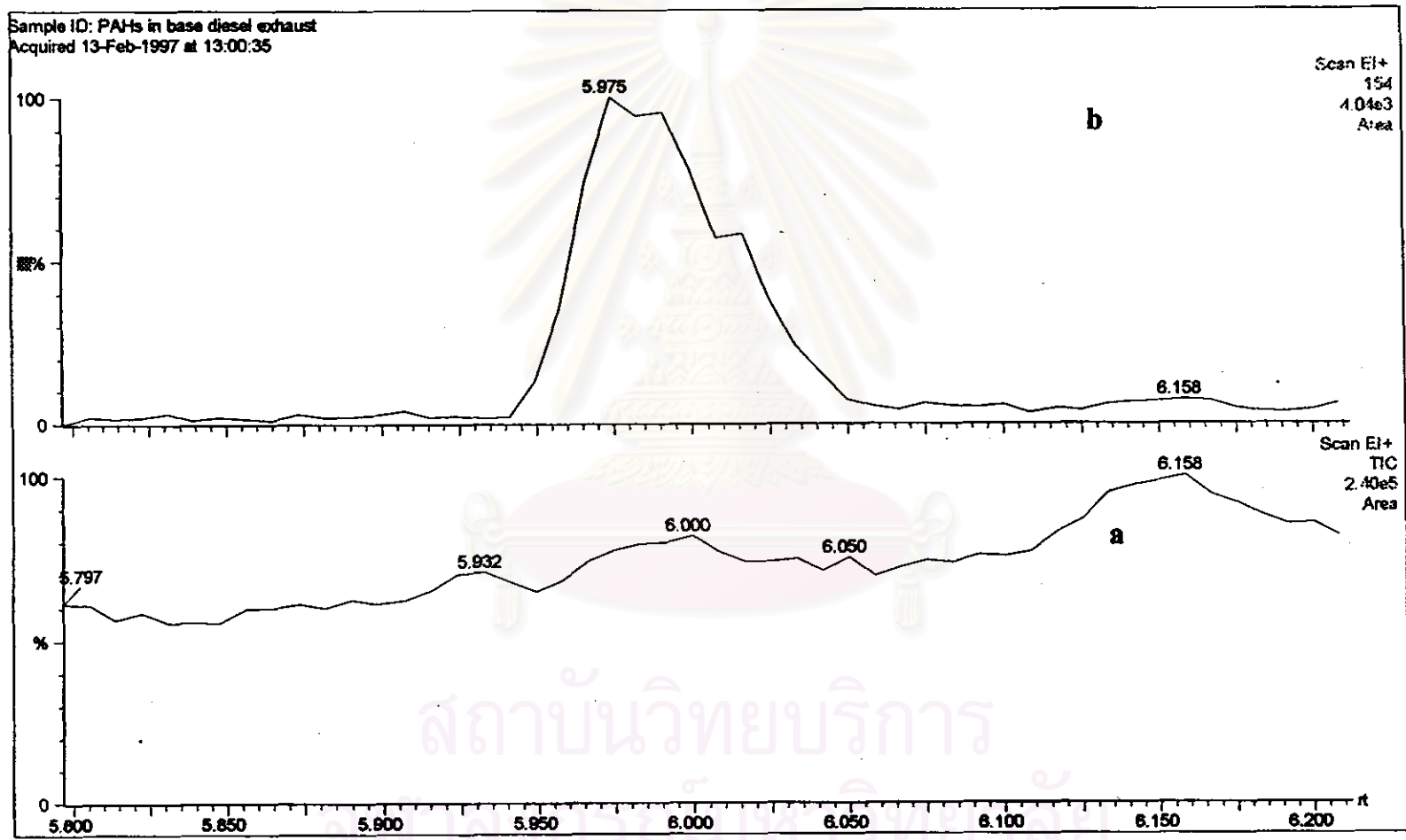


Figure B 18 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 2400 rpm (a) Gas chromatogram of acenaphthene and (b) selected ion chromatograms of m/z 154

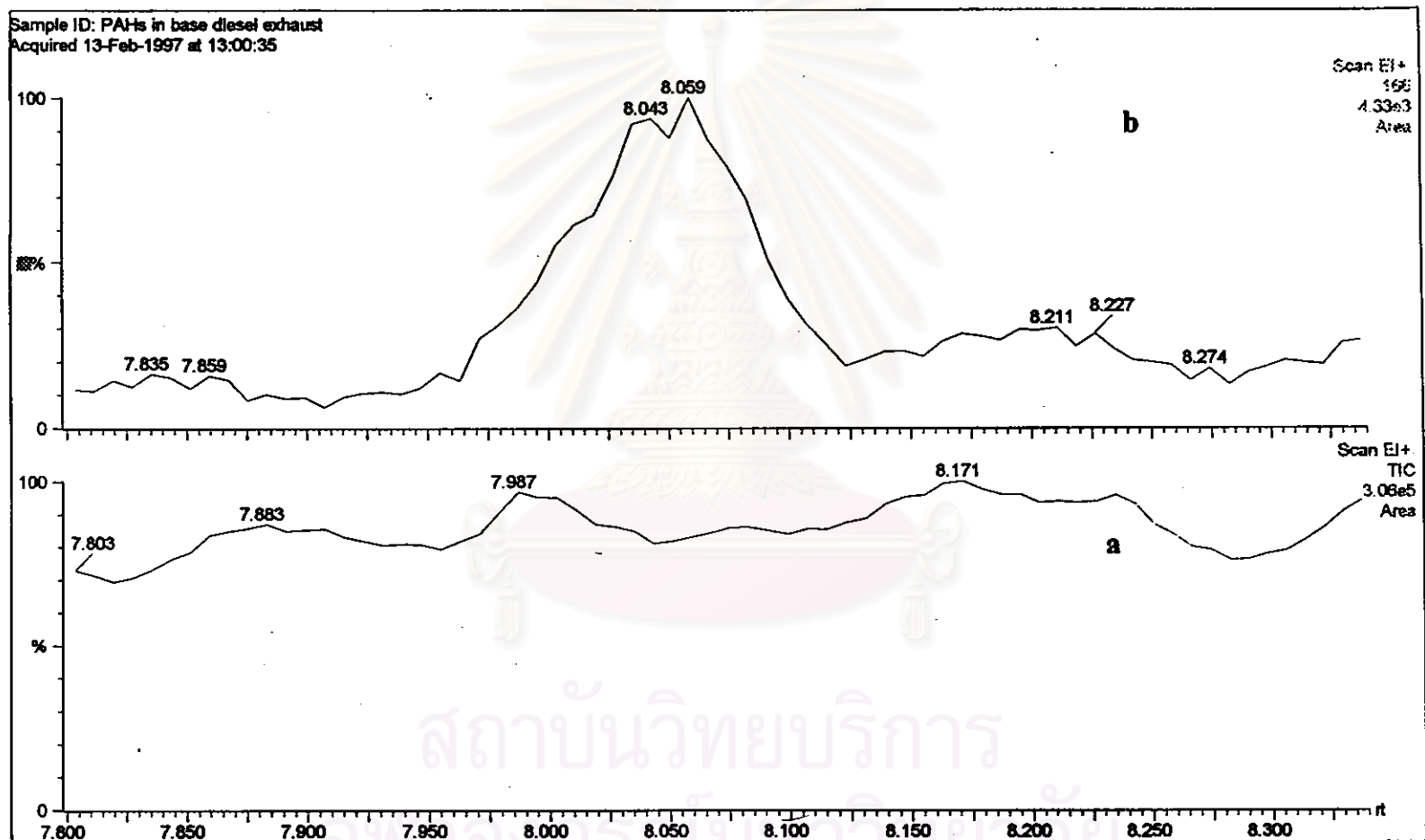


Figure B 19 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 2400 rpm (a) Gas chromatogram of fluorene and (b) selected ion chromatograms of m/z 166

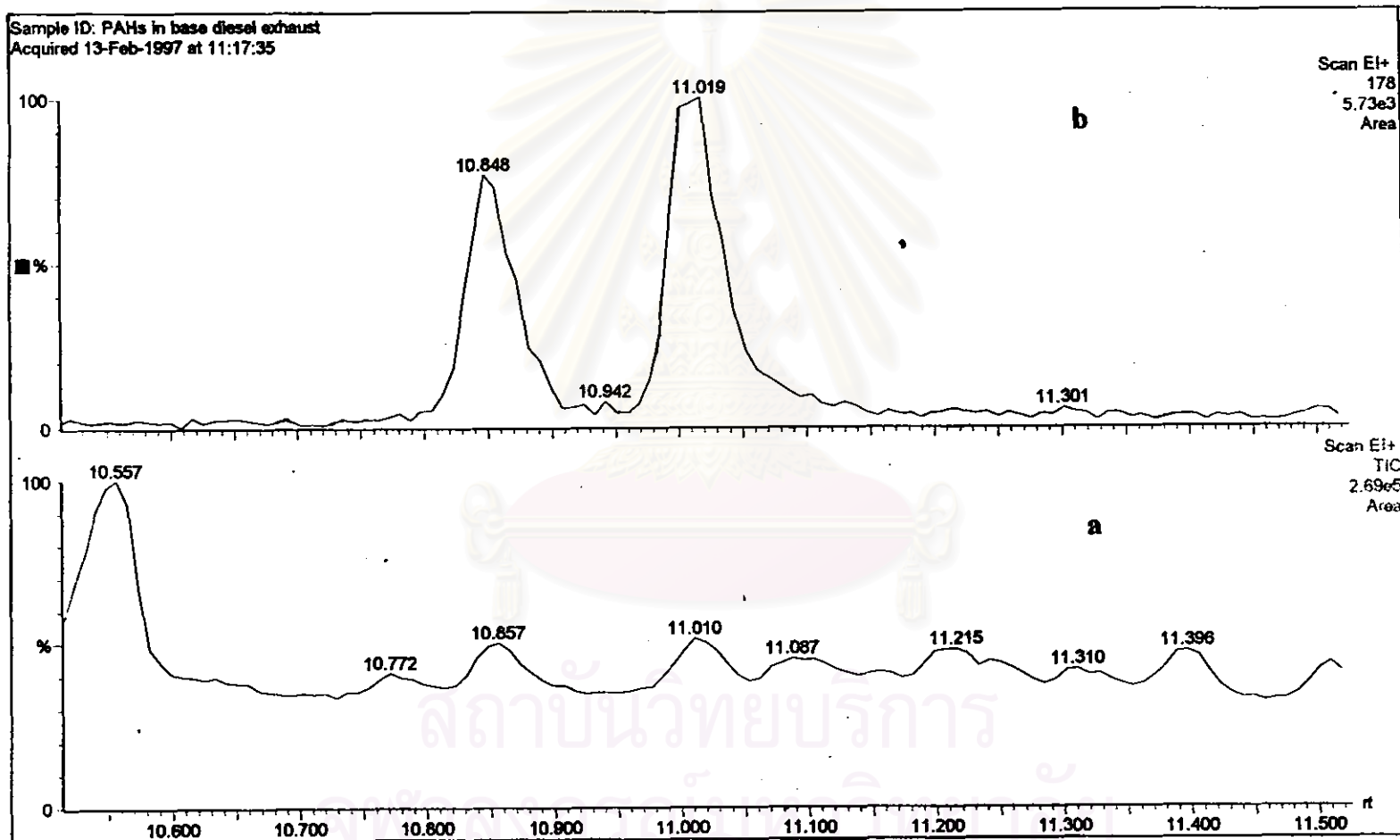


Figure B 20 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 2400 rpm (a) Gas chromatogram of phenanthrene and anthracene and (b) selected ion chromatograms of m/z 178

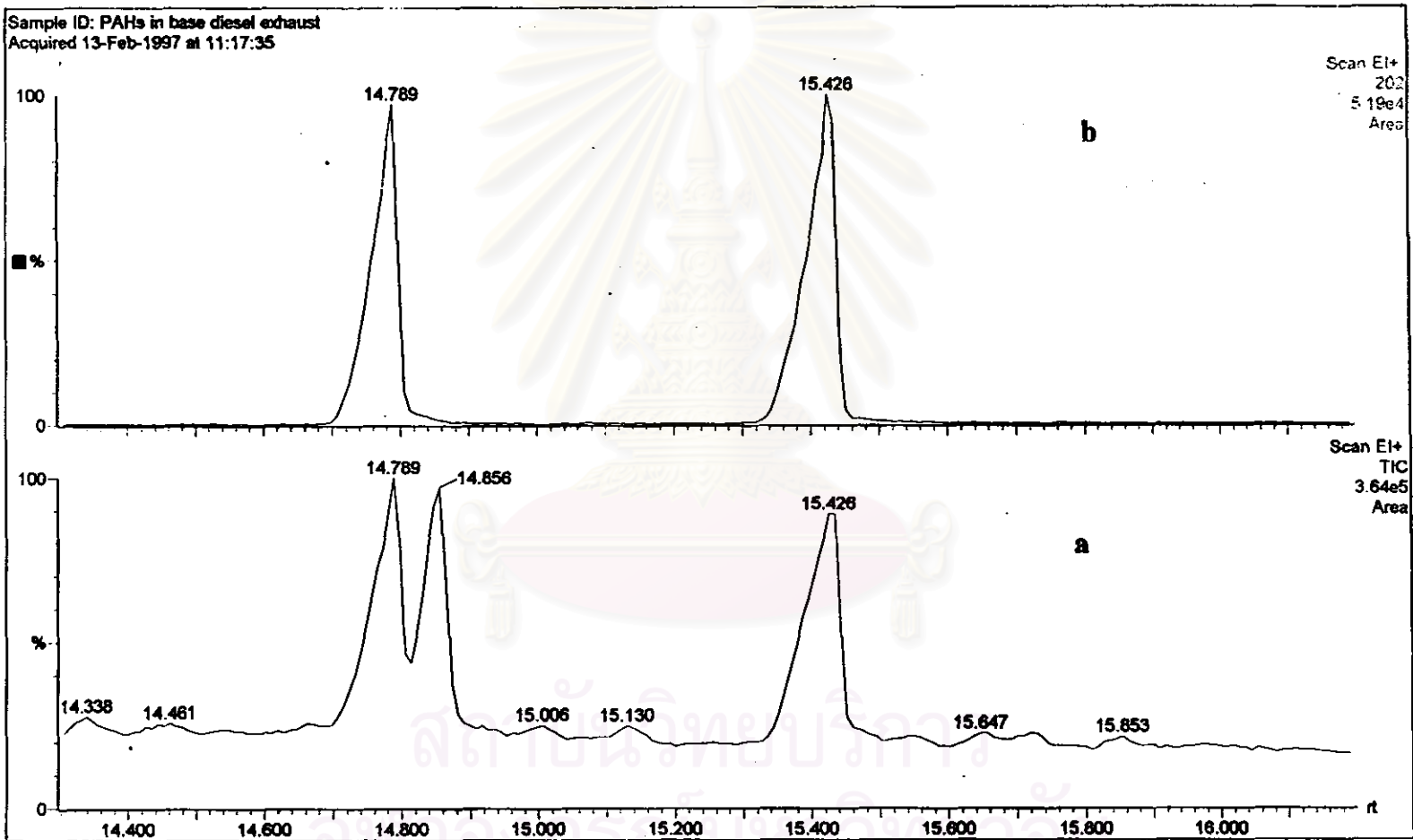
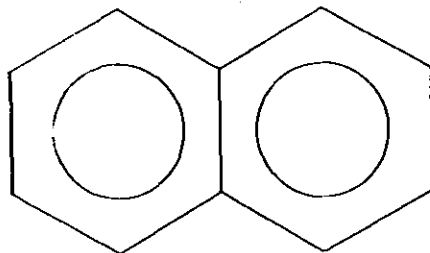


Figure B 21 Gas chromatogram of hydrocarbons fraction of base diesel exhaust at 2400 rpm (a) Gas chromatogram of fluoranthene and pyrene and (b) selected ion chromatograms of m/z 202

Compound Name: NAPHTHALENE
 Synonym: Albocarbon
 MW: 128

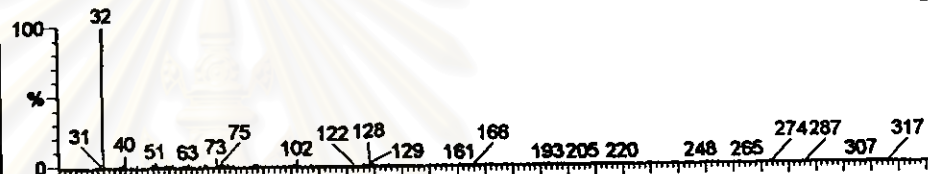


Sample Description : PAHs in base diesel exhaust
 Acquired 13-Feb-1997 at 11:17:35

Forward Fit: 576, Reverse Fit: 749

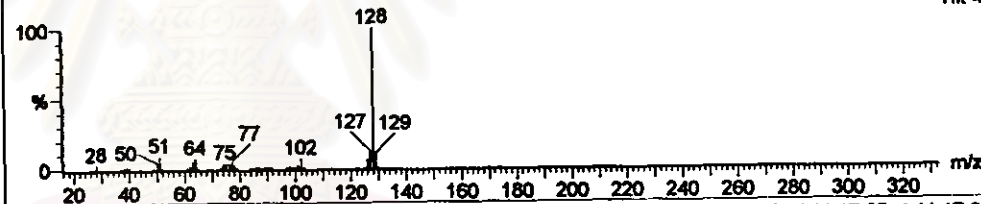
BAI0-1 86 (4.498) Rf (2.4.000)

6.16e4



R:749 NIST 5167: NAPHTHALENE

Hit 4



Acquired 11:17:35 at 11:17:35

Data File: BAI0-1
 Sample ID: PAHs in base diesel exhaust

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	1H-INDENE, 1-METHYLENE-	128	C10H8	576	913	NIST	5168	2471-8
2	4.2.2 PROPELLA-2,4,7,9-TETRAENE	128	C10H8	639	805	NIST	5169	88090-
3	AZULENE	128	C10H8	642	785	NIST	5168	275-51
4	NAPHTHALENE	128	C10H8	625	749	NIST	5167	91-20-
5	1,2-BENZENEDICARBONITRILE	128	C8H4N2	529	743	NIST	5012	91-15-
6	1,3-BENZENEDICARBONITRILE	128	C8H4N2	551	714	NIST	5014	628-17
7	QUINOLINE, 2-iodo-	255	C9H6NI	526	712	NIST	34850	6560-8
8	1,4-BENZENEDICARBONITRILE	128	C8H4N2	570	704	NIST	5013	623-28
9	2-PROPENITRILE, 3-PHENYL-, (E)-	129	C9H7N	431	701	NIST	5296	1885-3
10	QUINOLINIUM, 1-BUTYL-, IODIDE	313	C13H18NI	419	674	NIST	44818	1203-8
11	2H-THIETE, 2-METHYLENE-4-PHENYL-, 1,1-	192	C10H8O2S	437	664	NIST	20849	18783-
12	1-ACETOXY-1-PHENYLBUT-2-YNE	188	C12H12O2	297	657	NIST	19894	0-00-0
13	QUINOLINE, 5-(PHENYLAZO)-	233	C15H11N3	322	643	NIST	30513	25117-
14	2-QUINOLINECARBOXYLIC ACID	173	C10H7O2N	431	636	NIST	15984	83-10-



Figure B 22 Comparison of mass spectrum of naphthalene with mass spectra in NIST library

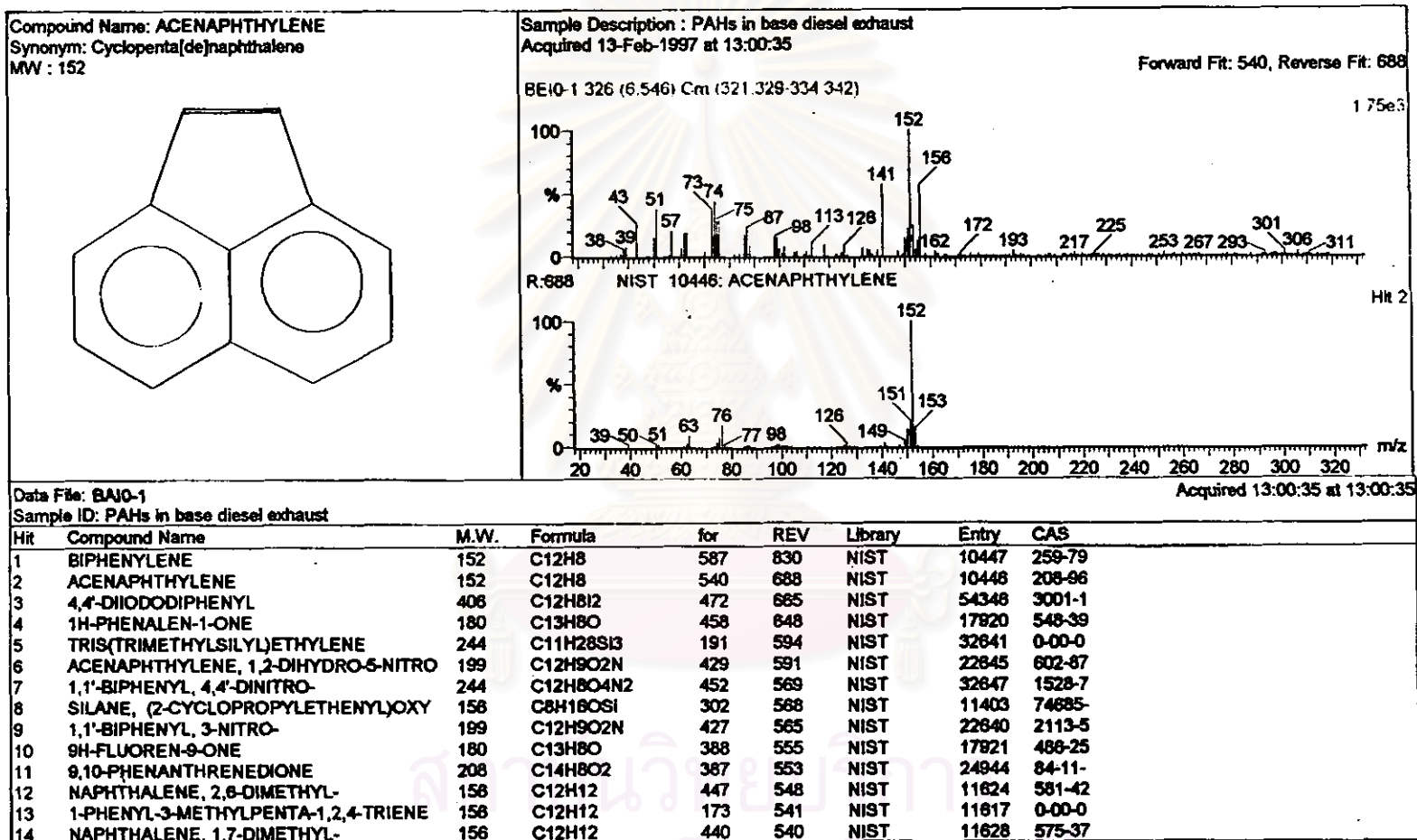
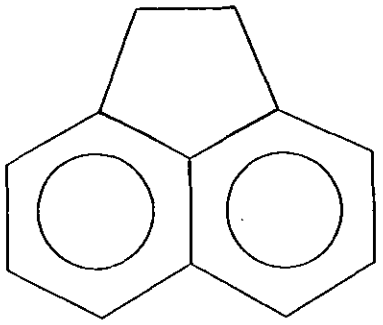


Figure B 23 Comparison of mass spectrum of acenaphthylene with mass spectra in NIST library

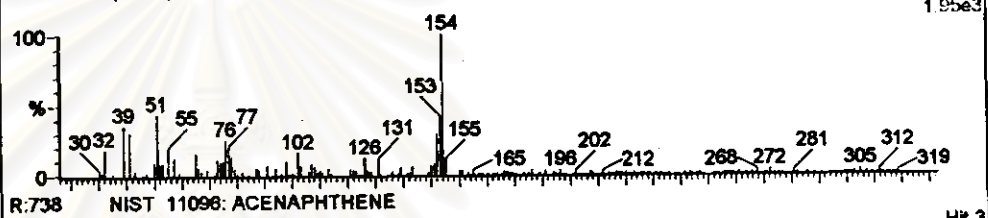
Compound Name: ACENAPHTHENE
 Synonym: Acenaphthylene, 1,2-dihydro-
 MW : 154



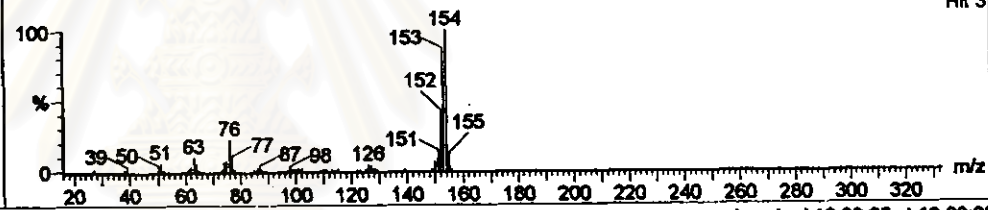
Sample Description : PAHs in base diesel exhaust
 Acquired 13-Feb-1997 at 13:00:35

Forward Fit: 568, Reverse Fit: 738

BE10-1 260 (6.000) Cm (254.260-262.268)



R:738 NIST 11096: ACENAPHTHENE



Data File: BAJ0-1
 Sample ID: PAHs in base diesel exhaust

Acquired 13:00:35 at 13:00:35

Hit	Compound Name	M.W.	Formula	for	REV	Library	Entry	CAS
1	BIPHENYL	154	C12H10	582	768	NIST	11094	92-52-
2	CHLORODIPHENYLARSINE	264	C12H10ClAs	482	742	NIST	36508	712-48
3	ACENAPHTHENE	154	C12H10	568	738	NIST	11096	83-32-
4	NAPHTHALENE, 2-ETHENYL-	154	C12H10	569	733	NIST	11097	827-54
5	1,4-ETHENONAPHTHALENE, 1,4-DIHYDRO-	154	C12H10	472	690	NIST	11095	7322-4
6	2-QUINOLINECARBONITRILE	154	C10H6N2	338	690	NIST	10848	1436-4
7	2,5-ETHENO 4,2,2 PROPELLA-3,7,9-TRIENE	154	C12H10	540	687	NIST	11093	88090-
8	1-ISOQUINOLINECARBONITRILE	154	C10H6N2	423	683	NIST	10850	1186-3
9	ARSINE, (PENTAFLUOROPHENYL)DIPHEN	396	C18H10F5As	428	642	NIST	53521	20901-
10	PYRIDINIUM, 1-METHYL-2-PHENYL-, IODID	297	C12H12NI	341	553	NIST	42241	52808-
11	PROPANEDINITRILE, (PHENYLMETHYLEN	154	C10H6N2	414	545	NIST	10849	2700-2
12	PYRIDINE, 3-PHENYL-	155	C11H9N	353	544	NIST	11242	1008-6
13	PYRIDINE, 2-PHENYL-	155	C11H9N	406	538	NIST	11243	1008-6
14	4-PHENYL-1-CYCLOPROPYLPYRIDUM BR	275	C14H14NBr	397	536	NIST	38607	0-00-0

Figure B 24 Comparison of mass spectrum of acenaphthene with mass spectra in NIST library

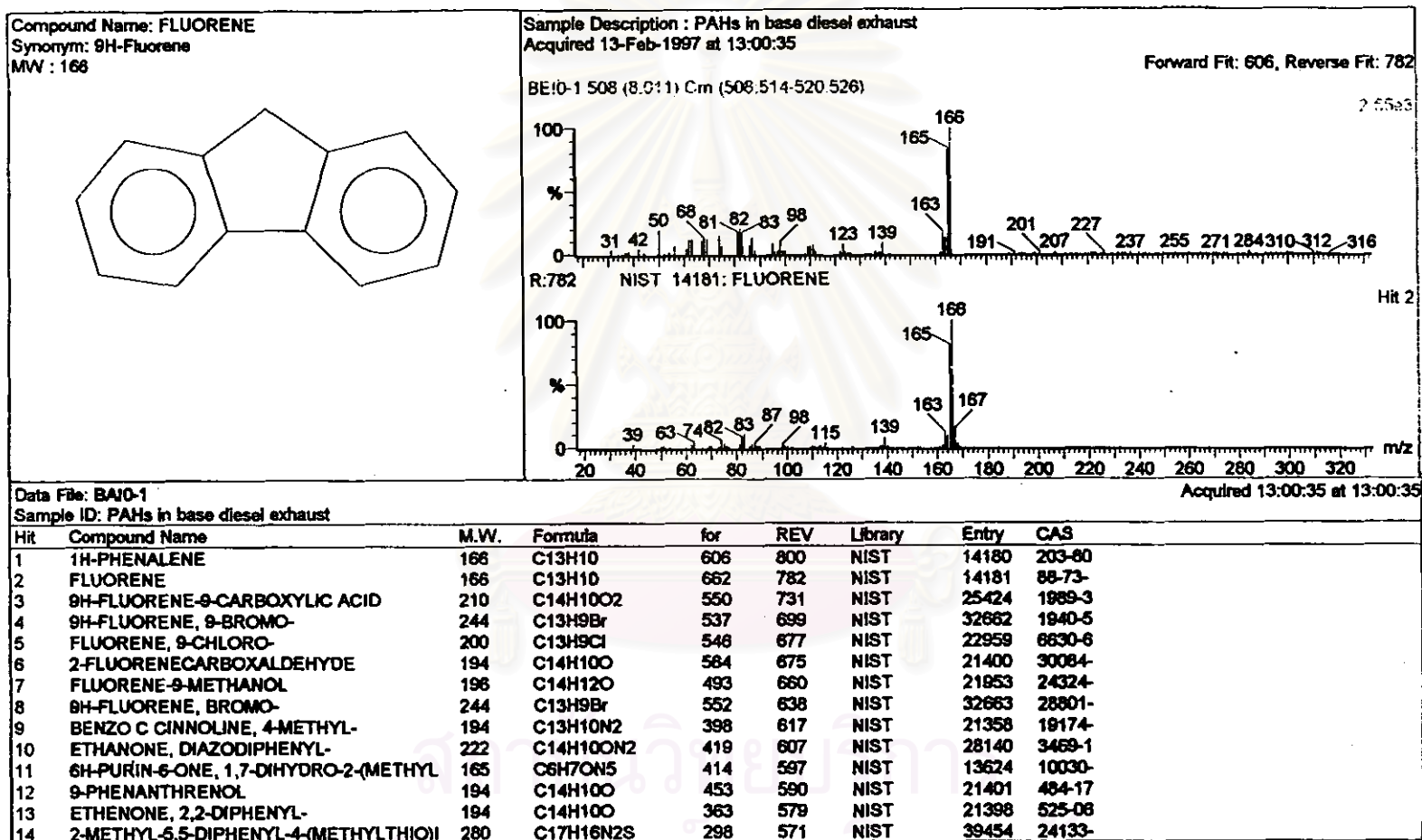


Figure B 25 Comparison of mass spectrum of fluorene with mass spectra in NIST library

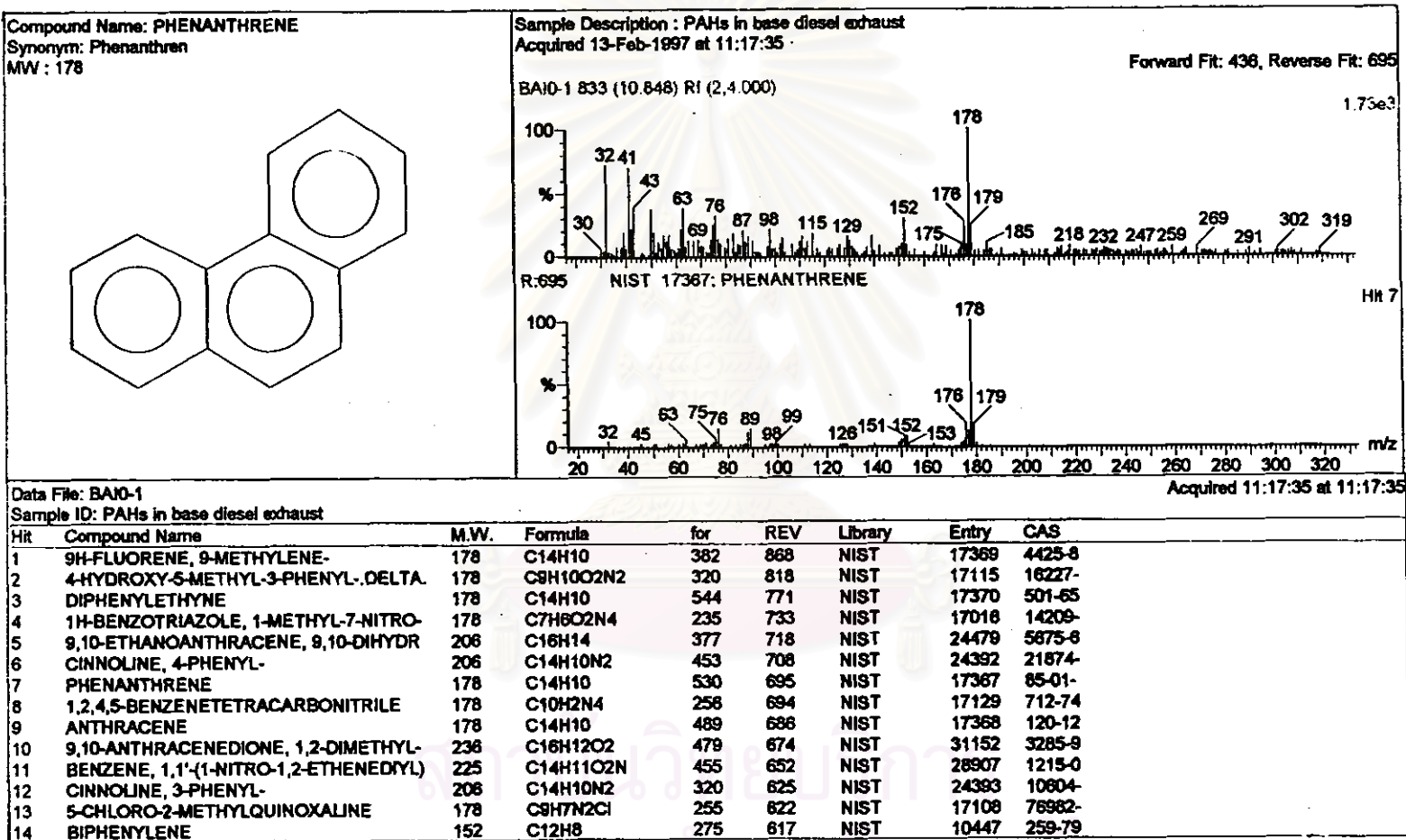


Figure B 26 Comparison of mass spectrum of phenanthrene with mass spectra in NIST library

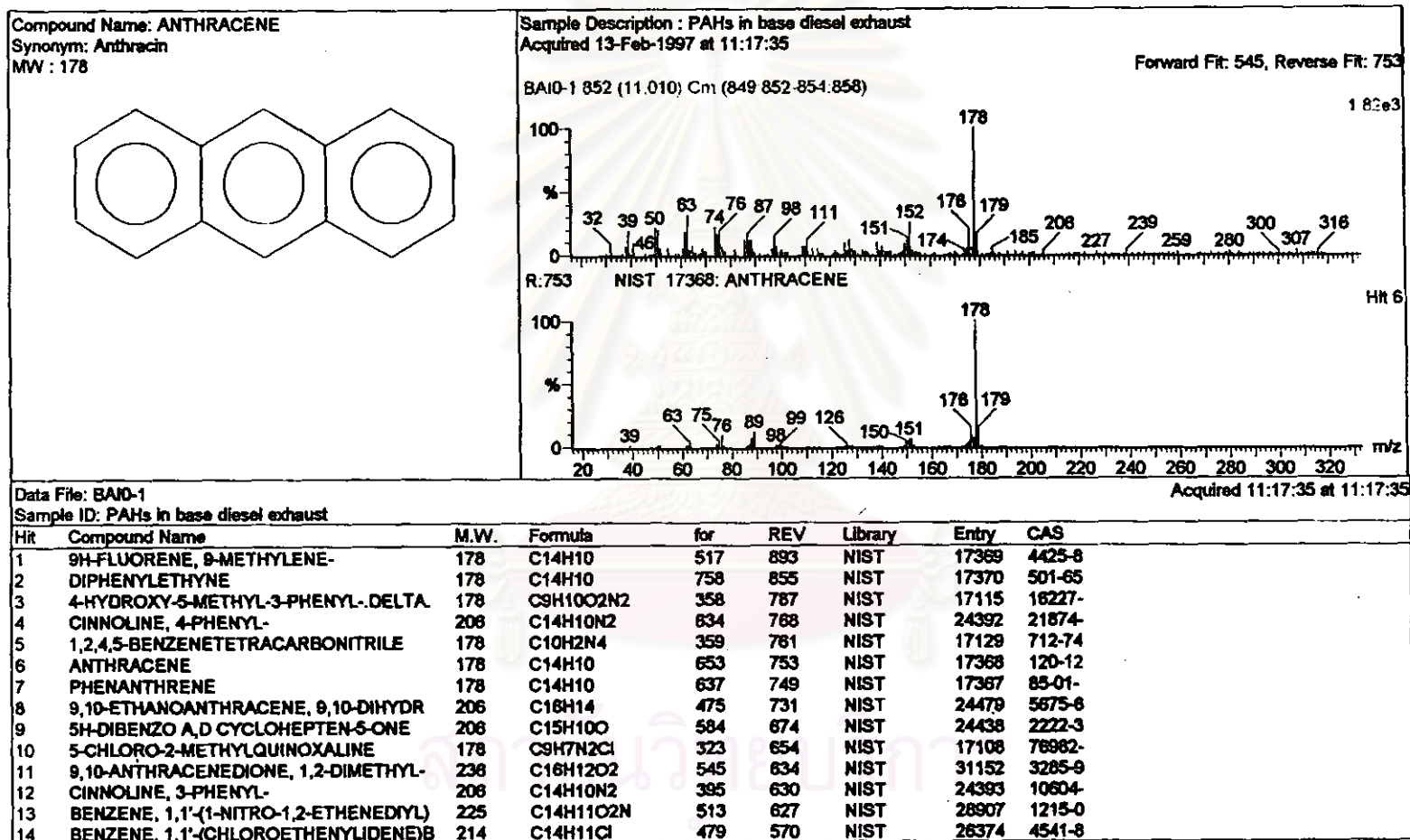


Figure B 27 Comparison of mass spectrum of anthracene with mass spectra in NIST library

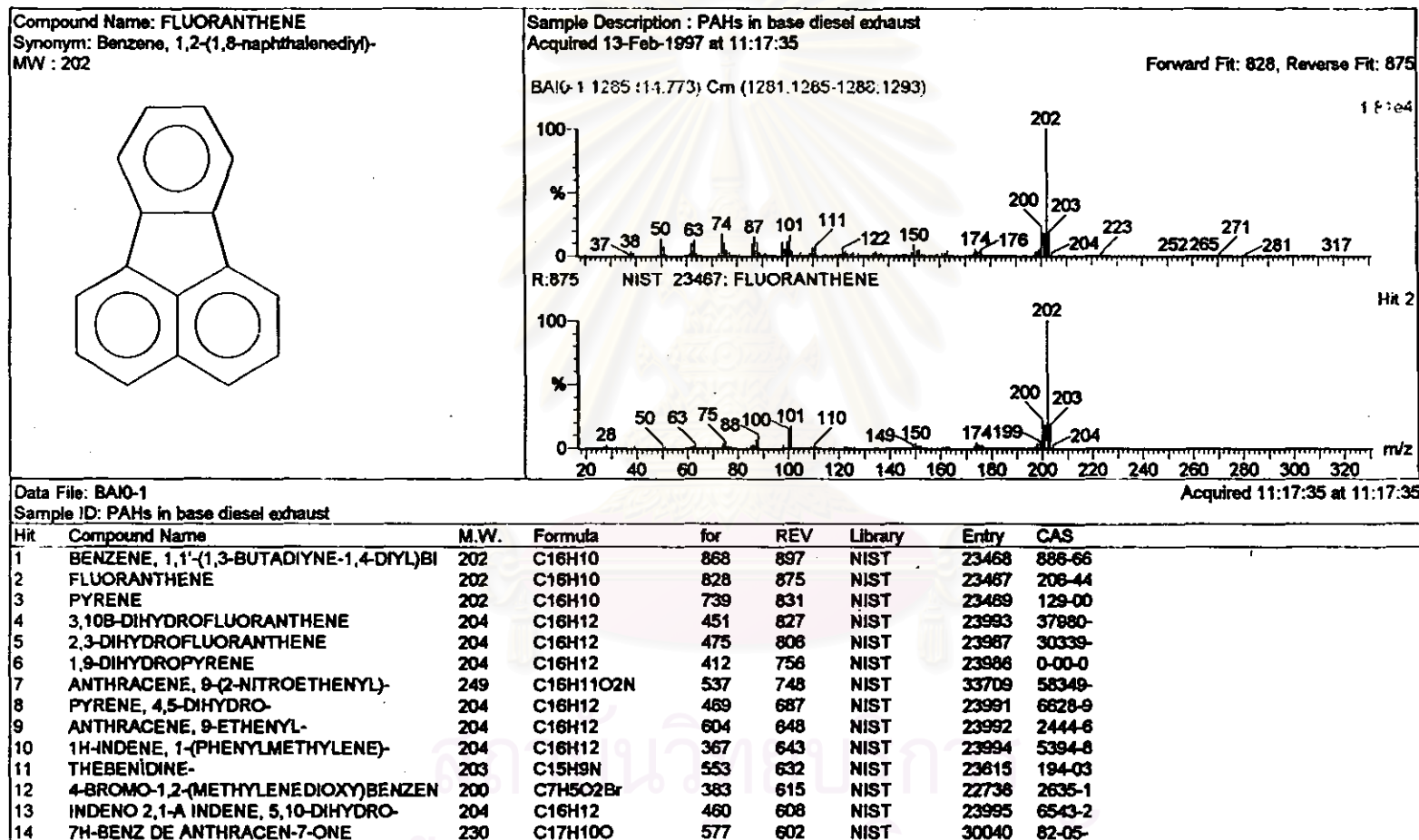


Figure B 28 Comparison of mass spectrum of fluoranthene with mass spectra in NIST library

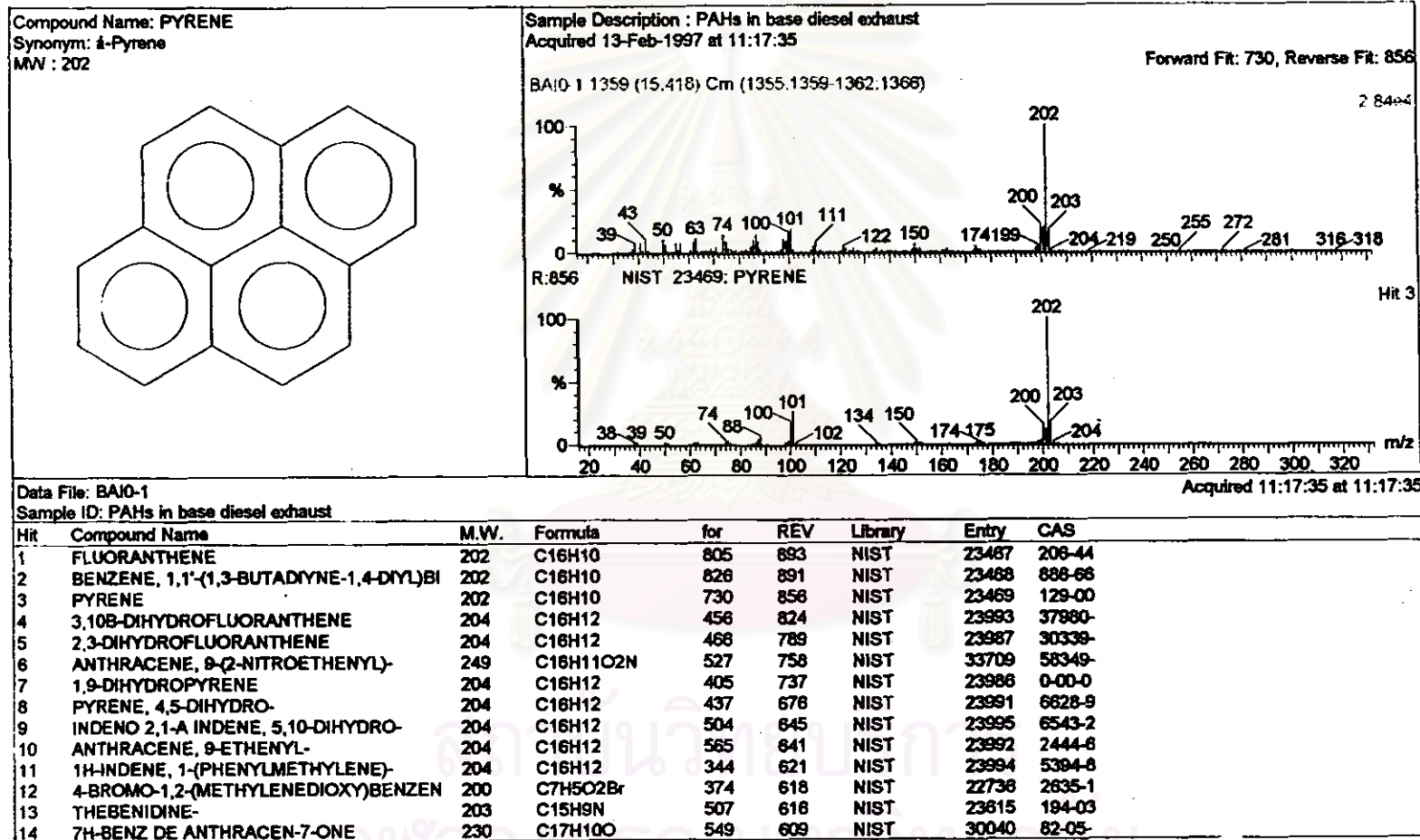


Figure B 29 Comparison of mass spectrum of pyrene with mass spectra in NIST library



APPENDIX C

สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

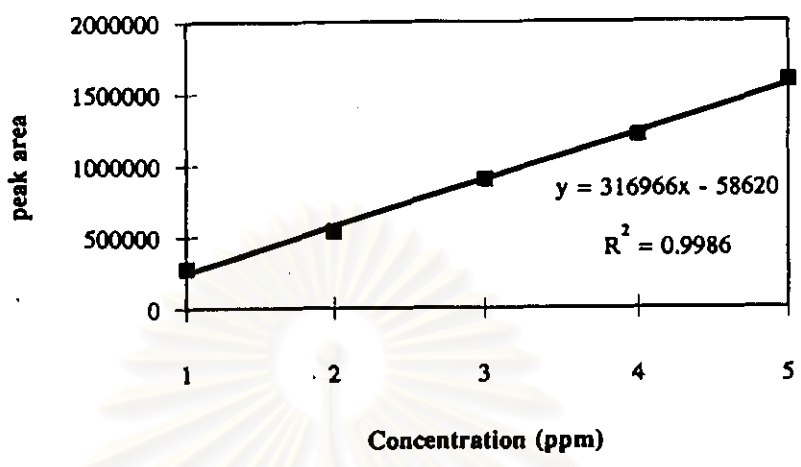


Figure C 1. Calibration curve of Naphthalene

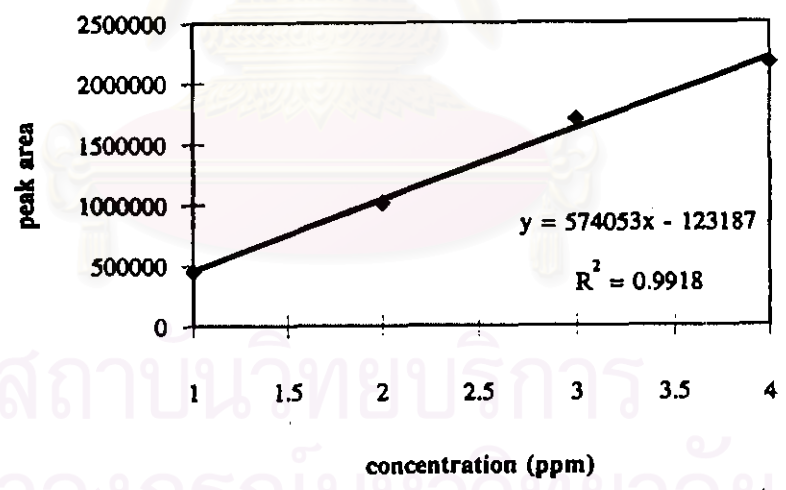


Figure C 2 Calibration curve of Acenaphthylene

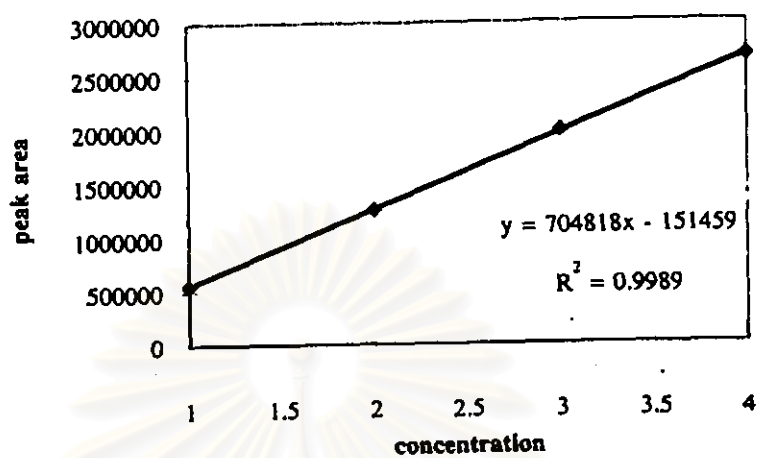


Figure C 3 Calibration curve of Acenaphthene

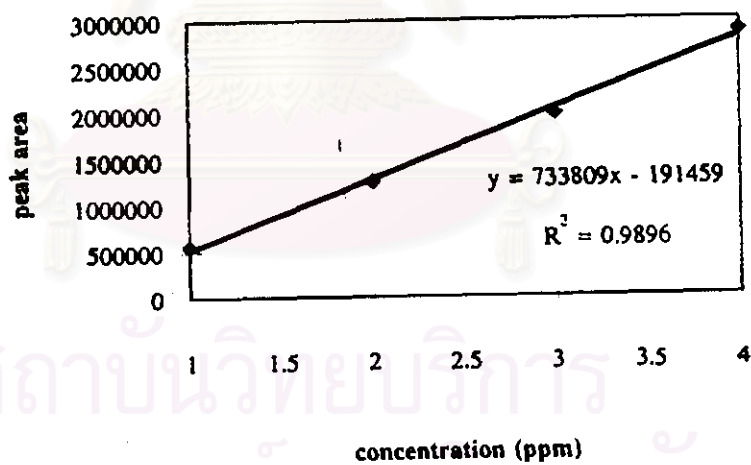


Figure C 4 Calibration curve of Fluorene

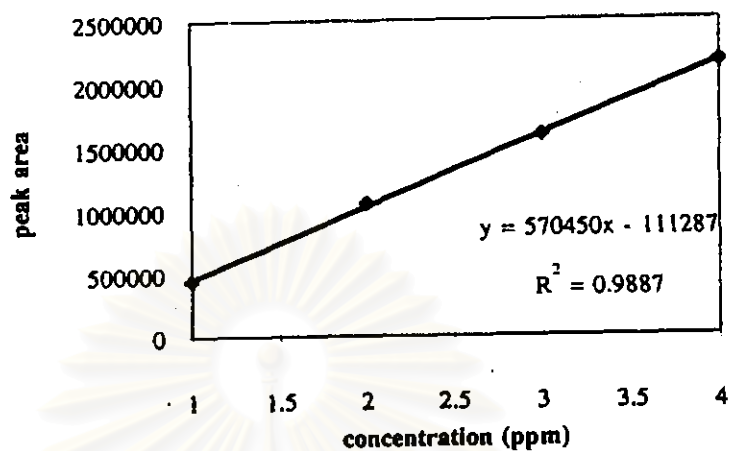


Figure C 5 Calibration curve of Phenanthrene

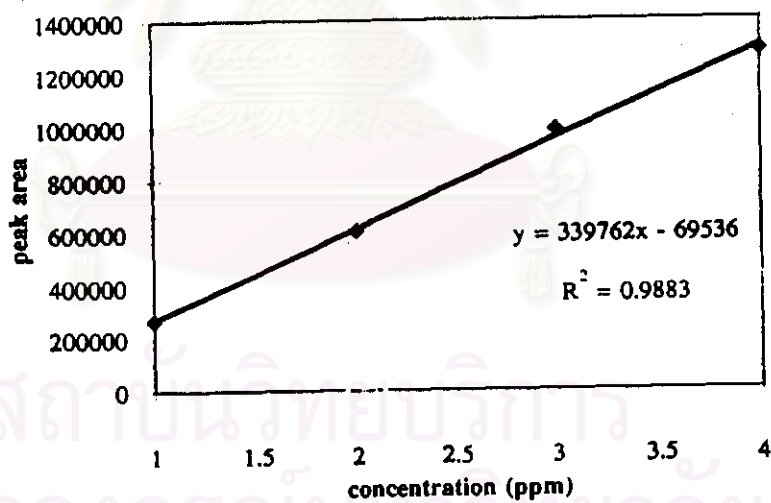


Figure C 6 Calibration curve of Anthracene

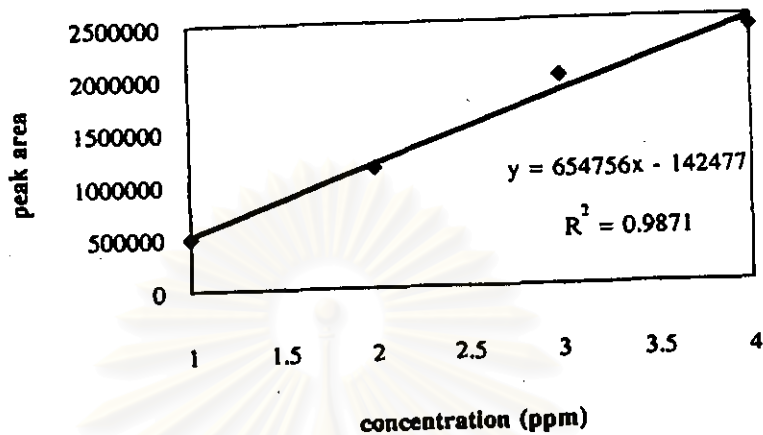


Figure C 7 Calibration curve of Fluoranthene

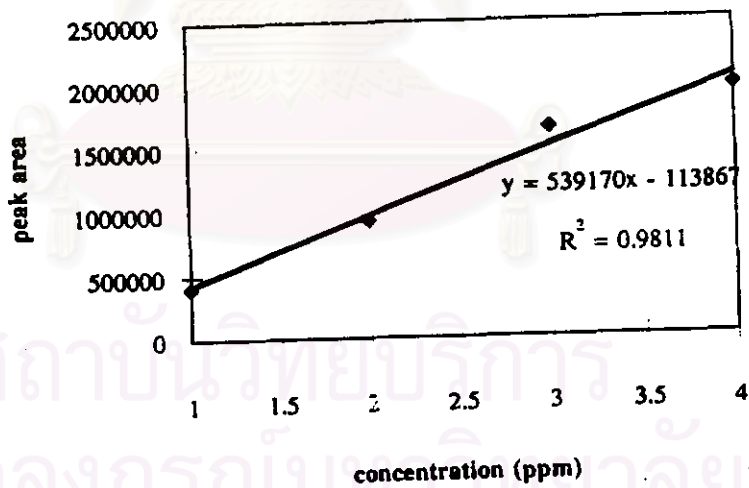


Figure C 8 Calibration curve of Pyrene



VITA

Miss. Supavadee Tuntipisit was born on May 11, 1973 in Nakhonsrethumarat. She received her Bachelor of Science degree from the Department of Chemistry, Faculty of Science, Srinakarinwirot University, Southern Region in 1995. She began her studies in the Multidisciplinary program of Petrochemistry and Polymer, Graduate School, Chulalongkorn University, in 1995 and completed the program in 1997



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