GC Elution Order Data, Design and Employment of 9 PCB Congener Mixtures for Conducting Comprehensive, Quantitative Congener-Specific (QCS) PCB Analyses

by Dr. George M. Frame

Contents

Introduction- It is very laborious and expensive to prepare mixtures of most of the 209 individual PCB congeners to confirm their elution times on a particular GC column. One needs to know in advance which would coelute to distribute them appropriately into different mixes. General Electric Corporate R&D organized a consortium of laboratories to acquire relative retention times of all congeners on a cross-section of the capillary GC phases useful for CQCS analysis. This will be published as a retention database comprising 27 systems incorporating 20 distinct stationary phase materials. From these data it was possible to select 12 of the most promising or most often used phases, and to distribute the 209 congeners among 9 mixtures such that few coelutions would result when using each mixture on any of the 12 selected phases. Tables of the elution order and peak separations for the congeners in each of the 9 mixtures on 24 of the systems have been prepared. One manufacturer (AccuStandard, Inc., 125 Market St., New Haven CT 06513, USA) presently markets these mixtures as nine 1 ml isooctane solutions at 10ppm of each congener (catalog #s C-CS-0 1 through -09). This description, prepared by Dr. G.M. Frame at G.E.- Corporate R&D Center, outlines the composition of the mixtures, the nature of the capillary GC systems for which the retention data were obtained, and provides the tables of elution, order and separation. Some suggestions are made for using the mixtures both for confirming the assignment of congener elution times and for employing them as quantitative standards for QCS PCB analyses. The retention database and copies of papers describing it may eventually be obtained from Dr. Frame at New York State Department of Health, RM D221B ESP, P.O. Box 509, Albany, NY 12201.

GC Systems- Tables INDEX4B and INDEX 5 describe the 27 capillary GC systems for which retention data were obtained. System groups [1,2,3]; [4,5,6,7]; [8,91; and [23,26] represent sets employing the same stationary phase structure. The slight differences in elution behavior among members of each group reflect differences due to column manufacture and operating conditions. This highlights the need for using good calibration solutions and not relying only on published retention data. The coelution statistics are based on an arbitrary criterion that coelution occurs if peaks elute within one peak width at half height of the system in question. Congeners in complex mixtures can often, but not always, be individually detected and quantitated by GC data systems if their separation exceeds this criterion. Minor components will require greater separation to be detected and quantitated reliably. Difficult separations may be improved by adjusting and optimizing the parameters of column length, diameter and phase film thickness, as well as carrier gas composition (e.g. hydrogen instead of helium), linear flow velocity, and the oven temperature program. For all these reasons, the elution spacing and coelution predictions of the attached tables should not be taken as absolutely immutable for a given phase.

The 9 PCB Congener Mixtures- The components of the 9 mixtures are listed in the Distribution Table. As part of the retention database survey, most of the labs in the consortium also quantitated the resolvable congeners in 6 Aroclor mixtures against the 209 individual congener standards. Using the consensus averages of well resolved congeners from various systems, the distribution of congeners in Aroclors was obtained. The division of the congeners into 9 mixtures was structured to include almost all of the congeners thus found in any of Aroclors 1242, 1254 or 1260 above 0.05 weight percent in mixes 1 through 5. Thus persons needing to calibrate analyses only for the congeners generally found in Aroclors need use-only the first 5 mixes. Seven minor Aroclor components had to be relegated to mixes 6, 7 and 8 to suppress excessive coelutions. Some “non-Aroclor” congeners were assigned to the first 5 mixes to likewise suppress coelutions. A number of these, (54, 100, 103, 104 and 154), are important end products of anaerobic bacterial dechlorination and may need to be measured in environmental experiments. Another criterion for the distribution among mixtures was to have most or all congeners elute at least 6 width at half height units from each other. This would allow room for small retention shifts due to differences among column or chromatographic systems. The peaks should still be identifiable by their elution order. However, to minimize the number of mixtures, it was necessary to accept some closer elutions within each GC system. The number of these is summarized in the MIXPERF Table.

Elution Order Tables- The elution order and separation of the congeners for each of the 9 mixtures on 24 of the 27 systems is listed in the 9 pages of the MIXCOMP1 Table. There are 4 columns of data for each system:

1. The mixture number.
2. The number of chlorine atoms in the congener. This is useful for determining if MS detection may be used to identify closely eluting or coeluting congeners.
3. The IUPAC number of each congener. As listed here these are equivalent to the Ballschmiter and Zell numbers in all but 3 cases; namely, congeners 199, 200, 201. See the AccuStandard Catalog or the substitution pattern in the Distribution Table for the correct full names and exact structures for each congener.
4. The separation in System W@1/2H units between the indicated congener and the one that elutes next. If the pair is a close elution (value <6 units), the value is highlighted in a box. The last eluting congener in a mix has a ### value since nothing follows it.

Suggestions for Use-

Internal Standards- The analyst is encouraged to select and use appropriate internal standard(s). It is not difficult to incorporate them into the 9 mixtures. If you choose to use PCB congeners as I.S.'s (presumably ones not found at significant levels in the samples you are analyzing, (e.g. 30, 159, 204, 209 etc.)), then add the appropriate amount to achieve the desired final level to incomplete dilutions of all mixtures not containing the I.S. congener(s) and an appropriately adjusted smaller amount to the mix(es) containing the I.S. congener(s), and dilute to final volume. If using a non-PCB internal standard (e.g. octachloronaphthalene, etc.) remove and inject < lµl of the incompletely diluted mixes to determine the elution times of the PCBs and ensure that the I.S. will not coelute with any standard mixture congener before adding the appropriate amount and diluting to final volume.

Coelutions in the Mixtures- In the event of coelutions of mixture congeners on a column you should see fewer peaks than expected and the coeluting pair may be excessively high. Use the expected spacing of peaks from the MIXCOMP1 Table to guide you to identifying coelutions. If you are using MS detection, and the coeluting pair contains congeners of different Cl#s, you can quantitate against the heavier one without interference, but will need to use one of the techniques below to quantitate for the lighter one. If you have identified a coelution, you can at least assign elution time correctly for each member of the pair - its the same! Quantitation of isomers (same Cl#) will be indeterminate in any event unless you make some assumptions about the relative amounts of each member of the pair expected in the sample. If you have reason to do this, you can compromise by obtaining average relative response factors from the database, and calculating an effective concentration for the combined peak in the standard weighted by the expected distribution of congeners in the sample. If you believe that only one congener will actually be present to be measured at that point, you may purchase and add it to one of the other mixtures if it coelutes with no component in the other mix on your system. You can determine its potential other coelutions on one of the database phases by consulting the database. If you don't have database relative retention times, you can measure retention times and add the PCB in the fashion described above for using non-PCB internal standards.

Calibrating Other GC Columns- Identifying the peaks when the mixtures are run on a column for which elution orders are not available in MIXCOMP1 is difficult but not entirely impossible. You can refer to average relative response factor values from the database, and Cl# information if you employ MS detection. The mixtures are designed to distribute the congeners over a wide range on each column. If you already have independent assignments for many major Aroclor congeners, you may be able to deduce the identity of the remaining ones in each mix. Excepting the 9 hexachlorobiphenyls in mix 9, no mix contains more than 7 isomers of any Cl number. On most columns retention time decreases with the number of ortho-substituted Chlorines. If you have most congeners assigned, you can determine the effect on retention of the difference between two single phenyl ring substitution patterns when the other rings are identical. This could help to assign pairs such as 150 and 155 in mix 9, etc.

Close Elutions of PCB Congeners in 9 Mixes on 12 Phases

#	Phase	Structure	# Aro.**	#non-Aro**
1	DB-1	0% di-Phenyl Si	2,1,1	3,4,1
2	Rtx-5	5% di-Phenyl Si	4	4
3	CP-Sil-13	14% di-Phenyl Si	3	5
4	SPB-20	20% di-Phenyl Si	3	5
5	Rtx-35	35% di-Phenyl Si	5	3
6	SPB-Octyl [4]	50% Octyl,methyl Si	0,1,1,1	2,1,1,1
7	CP-Sil-5 C-18	50% Octadecyl,methyl Si	4	3
8	HP-1301	3% Phenyl,n-Cyanopropyl Si	4	8
9	DB-XLB	Prop. ~30% Phenyl Equiv.	3	6
10	SGE HT-8	Phenyl, m-carborane bridge	5	7
11	J & W Spec. 2	Prop. Milton Lee Phase	6	7
12	Apiezon L	Hydrocarbon Grease	7	7
	CP-Sil-5 C18(2)	50% Octadecyl,methyl Si	6	3
	DB5-MS	5% Si-Phenyl-Si bridge	4	8
	HP-35	35% Total Phenyl Si	9	6
	DB-17	50% di-Phenyl Si	15	6
	AT-1701	7% Phenyl,n-Cyanopropyl Si	19	11
	DB35-MS	35% Total Phenyl Si [+]	9	6
	007-23	78% Cyanopropyl	22	7

** # Aro = The number of pairs of Aroclor and deCl-product. Congeners in the total of Mixes 1,2,3,4 & 5 [144 PCBs] eluting within 6 W@1/2H units

** #non-Aro = The number of pairs of non-Aroclor congeners in the total of Mixes 6,7,8 and 9 [65 PCBs] eluting within 6 W@1/2H units

Capillary GC Systems Characteristics, Researchers, and Aroclor PCB Coelutions and System Resolving Power

	Sys#	Column	Silicone Substitution*	Len. (m)	I.D. (mm)	Film (u)	Analyst	Company	Det.	No. of Coelu.	No. of #	No. of < or >	"TZ#	209IS (min)
*	1	DB1	100% A	30	0.25	0.25	G.Frame	GE	ECD	55	35	20	273	40
	2	DB1	100% A	30	0.25	0.25	G.Frame	GE	MS	55	38	17	297	49
	3	RTX-1	100% A	60	0.25	0.25	J.Cochrane	HWRIC	MS-IT	45	31	14	416	87
*	4	SPB-Octyl	100% E	30	0.25	0.25	G.Frame	GE	ECD	47	23	24	332	45
	5	SPB-Octyl	100% E	30	0.25	0.25	G.Frame	GE	ECD	41	17	24	363	50
*	6	SPB-Octyl	100% E	60	0.25	0.25	J.Cochrane	HWRIC	ECD	36	25	11	330	104
	7	SPB-Octyl	100% E	30	0.25	0.25	N.Erwin	Supelco	MS	51	29	22	296	58
*	8	CP-Sil5-C18	100% D	100	0.25	0.1	E.deWitte	Chrompack	ECD	50	39	11	352	165
	9	CP-Sil5-C18	100% D	100	0.32	0.1	D.Leister	NIST	ECD	35	18	17	355	156
*	10	DB5-MS	5% K	30	0.25	0.5	M.Hastings	J&W	MS	52	35	17	300	73
*	11	RTX-5	5% B	60	0.25	0.25	C.Loope	Restek	MS	60	35	25	367	106
*	12	CP-Sil 13	14% B	50	0.25	0.2	E.deWitte	Chrompack	ECD	39	22	17	346	84
*	13	SPB-20	20% B	30	0.25	0.25	N.Erwin	Supelco	MS	55	30	25	304	57
*	14	HP-35	35% B&C	30	0.25	0.25	I.Chang	H-P	MS	63	41	22	270	35
*	15	RTX-35	35% B	60	0.25	0.25	C.Loope	Restek	MS	52	33	19	389	119
*	16	DB-17	50% B	30	0.25	0.25	M.Hastings	J&W	MS	64	47	17	244	51
*	17	HP-1301	6% G	60	0.25	0.25	I.Chang	H-P	MS	55	25	30	301	41
	18	AT-1701	14% G	30	0.25	0.25	S.Miller	Alltech	MS	68	42	26	248	42
	19	007-ODP	80%D;15%B	50	0.25	0.1	J.Criscio	Quadrex	ECD					118
*	20	DB-XLB	"Prop."	30	0.25	0.5	M.Hastings	J&W	MS	34	12	22	406	77
*	21	DB35-MS	35%B&C+	30	0.25	0.25	M.Hastings	J&W	MS	56	30	26	408	77
*	22	HT-8	XX%L;YY%B	50	0.22	0.25	M.Cumbers	SGE	ECD	60	28	32	236	57
	23	"CBAS"	XX%J	25	0.25	0.25	B.Hillary	NIST	ECD	59	27	32	221	76
*	24	Apiezon L	Hydrocarbon	30	0.25	0.25	E.Barnard	NYSDOH	ECD	64	51	13	240	61
	25	Polyimide	Polyimide	30	0.25	0.25	S.Miller	Alltech	ECD	54	28	26	321	51
*	26	CNBP #2	XX%J	30	0.32	0.25	M.Hastings	J&W	MS	53	24	29	279	76
*	27	007-23	78% H	48	0.25	0.1	G.Frame	GE	MS	58	30	28	236	60

* Indicates system listed in Congener Elution Order

No. of # indicates number of coeluting PCB isomers or congeners coeluting with +2Cl homologs, found in Aroclors
No. of < or > indicates number of coeluting homologs in Aroclors differing by 1 Cl, potentially resolvable by MS detection
No. of Coelu. is sum of above 2 categories, the number of coeluting congeners in Aroclors not resolvable with ECD

"TZ#" is value similar to Separation No. (Trennzahl), calculated by dividing the difference in retention times of PCBs 1 and 209 (the 1st and last to elute on the linear temp. ramp) by the sum of the W@1/2H values of PCBs 52 and 180 in the system. The number may be thought of as the number of PCBs which could be baseline resolved between these extremes if they were sequentially spaced along the retention axis.

209IS is the retention time in minutes of the PCB #209 internal standard, the last peak to elute, indicative of analysis time
☐ = System included in minimum No. of Calibrating Mixes Calculation

Key to Polydimethylsiloxane-based Stationary Phase Structures

A	Me-Si-Me	G	CyP-Si-P
B	P-Si-P	H	CyP-Si-CyP
C	P-Si-Me	I	
D	C18-Si-Me	J	CyBA-Si-Me
E	C8-Si-Me	K	O-Si-P-Si-O
F	Proprietary	L	O-Si-C-Si-O

P = phenyl
Me = methyl
C8 = n-octyl
C18 = n-octadecyl
Proprietary
CyP = 3-cyano, n-propyl
CyBA = p-cyano, p'-allyloxy biphenyl
C = m-carborane

GC Column Injection, Column Pressure and Temperature Parameters

				Carrier Gas Data			Column Temperature Program Values						Injector Port		
Sys#	Column	Col. Len. (m)	Det.	Head Press. psig	Flow cm/ sec	Flow Temp. C	Init. Temp. C	Init. Hold min	1st Rate C/min	1st Break C	2nd Rate C/min	Final Temp C	Inj Temp C	Inj Mode 1 ul	Det. Temp C
1	DB1	30	ECD	35.2	47.8	210	90	2	15	165	2.5	255	270	Sless	300
2	DB1	30	MS	14.8	39.6	150	75	2	15	150	2.5	260	270	Sless	280
3	RTX-1	60	MS-IT	30.0	25.1	218	75	2	15	150	1.5	285	250	Sless	250
4	SPB-Octyl	30	ECD	24.0	35.9	223	90	2	15	165	3	280	270	Sless	300
5	SPB-Octyl	30	ECD	24.0	37.5	193	75	2	15	150	3	270	300	Sless	300
6	SPB-Octyl	60	ECD	35.0	55.2	210	75	2	15	150	1.2	270	250	Sless	295
7	SPB-Octyl	30	MS	10.3	37.5	215	75	2	15	150	2.5	280	270	Sless	290
8	CP-Sil5-C18	100	ECD	50.1	22.3	209	75	2	15	150	0.75	268	275	Sless	300
9	CP-Sil5-C18	100	ECD	36.7	28.2	200	75	2	15	150	0.75	250	250	SPLIT	300
10	DB-5MS	30	MS	17.0	33.2	150	100	1			2.5	285	250	OnCol	320
11	RTX-5	60	MS	26.5	21.2	300	75	2	15	150	1.2	300	250	Sless	310
12	CP-Sil 13	50	ECD	32.9	30.5	208	75	2	15	150	1.5	266		Sless	300
13	SPB-20	30	MS	9.1	33.6	215	75	2	15	150	2.5	280	270	Sless	290
14	HP-35	30	MS	9.4	33.7	280	80	1	25	180	3	280	260	Sless	300
15	RTX-35	60	MS	28.0	24.1	300	75	2	15	150	1.2	300	250	Sless	310
16	DB-17	30	MS	17.0	33.1	195	100	1			3	290	250	OnCol	300
17	HP-1301	60	MS	39.0	30	300	80	1	25	180	3	300	270	Sless	300
18	AT-1701	30	MS	1.0	18	250	90	2	15	165	3	330	300	Sless	300
19	007-ODP	50	ECD	11.0	10.6	200	75	2	15	150	1.5	250	230	Sless	300
20	DB-XLB	30	MS		33.3	150	100	1			2.5	293	250	OnCol	340
21	DB-35MS	30	MS		33.3	150	80	1			2.5	285	250	OnCol	320
22	HT-8	50	ECD	40.0	29.8	320	80	2	30	170	3	320	300	SPLIT	330
23	"CBAS"	25	ECD	23.0	42.1	211	75	5	4	155	2	250	270	SPLIT	300
24	Apiezon L	30	ECD	30.0	45.3	205	100	2	10	160	2	250	250	Sless	300
25	Polyimide	30	ECD	17.0	24.4	263	150	2	15	225	2	300	300	Sless	325
26	CNBP #2	30	MS		33.5	150	80	1			2.5	270	250	OnCol	290
27	007-23	48	MS	11.0	20.2	190	75	2	15	150	1.5	230	270	Sless	280

Notes:

1. Retention time of PC8 209 in System 19 indicates linear flow greatly exceeded Van Deempter optimum resolution was degraded, but Aroclor quantities of resolved peaks were in good agreement with averages. Reported pressure parameters not consistent with elution times.
2. Helium was carrier gas for all systems, except for hydrogen in System 6
3. Systems 2, 14 and 17 used electronic pressure control in constant flow mode at start of slow temperature ramp.
4. System 23 temperature program included 10 minute hold at 211 C

Distribution of PCB Congeners into 9 Mixes for Calibration on 12 GC Columns

PCB Congeners in Aroclors

Mix #	IUP AC#	Structure Cl Pos.	Mix #	IUP AC#	Structure Cl Pos.	Mix #	IUP AC#	Structure Cl Pos.	Mix #	IUP AC#	Structure Cl Pos.	Mix #	IUP AC#	Structure Cl Pos.
1	1	2	2	5	23	3	15	4-Apr	4	13	4-Mar	5	12	34
1	2	3	2	7	24	3	20	23-3	4	14	35	5	33	34-2
1	**3**	4	2	10	26	3	27	26-3	4	35	34-3	5	49	24-25
1	**4**	2-2	2	**17**	24-2	3	29	245	4	51	24-26	5	59	236-3
1	**6**	2-3	2	**24**	236	3	34	25-2	4	53	25-26	5	63	235-4
1	**8**	2-4	2	**26**	25-3	3	40	23-23	4	54	26-26	5	64	236-4
1	**9**	25	2	**31**	25-4	3	42	23-24	4	73	26-35	5	77	34-34
1	**16**	23-2	2	**32**	26-4	3	47	24-24	4	75	246-4	5	85	234-24
1	**18**	25-2	2	**37**	34-4	3	69	246-3	4	81	345-4	5	91	236-24
1	**19**	26-2	2	**41**	234-2	3	92	235-25	4	90	235-24	5	97	245-23
1	**22**	23-4	2	**45**	236-2	3	93	2356-2	4	100	246-24	5	104	246-26
1	**25**	24-3	2	**46**	23-26	3	101	245-25	4	117	2356-4	5	114	2345-4
1	**28**	24-4	2	**48**	245-2	3	105	234-34	4	122	345-23	5	123	345-24
1	**44**	23-25	2	**60**	234-4	3	118	245-34	4	124	345-25	5	129	2345-23
1	**52**	25-25	2	**70**	25-34	3	119	246-34	4	130	234-235	5	137	2345-24
1	**56**	23-34	2	**83**	235-23	3	128	234-234	4	154	245-246	5	156	2345-34
1	**66**	24-34	2	**84**	236-23	3	134	2356-23	4	163	2356-34	5	167	245-345
1	**67**	245-3	2	**95**	236-25	3	136	236-236	4	165	2356-35	5	176	2346-236
1	**71**	26-34	2	*103*	246-25	3	144	2346-25	4	175	2346-235	5	186	23456-25
1	**74**	245-4	2	**109**	235-34	3	151	2356-25	4	200	23456-236	5	189	2345-345
1	**82**	234-23	2	**115**	2346-4	3	157	234-345	4	201	2346-2356	20		
1	**87**	234-25	2	**131**	2346-23	3	158	2346-34	4	202	2356-2356			
1	**99**	245-24	2	**132**	234-236	3	190	23456-34	22					
1	**110**	236-34	2	**136**	235-236	3	191	2346-345						
1	**138**	234-245	2	**141**	2345-25	3	207	23456-2346						
1	**146**	235-245	2	**149**	236-245	3	208	23456-2356						
1	*147*	2356-24	2	**164**	236-345	3	209	23456-23456						
1	**153**	245-245	2	**170**	2345-234	27								
1	**173**	23456-23	2	**171**	2346-234									
1	**174**	2345-236	2	**172**	2345-235									
1	**177**	2356-234	2	**178**	2356-235									
1	**179**	2356-236	2	**183**	2346-245									
1	**180**	2345-245	2	**193**	2356-345									
1	**187**	2356-245	2	**196**	2345-2346									
1	**194**	2345-2345	2	**197**	2346-2346									
1	**195**	23456-234	2	**205**	23456-345									
1	**199**	2345-2356	36											
1	**203**	23458-245												
1	**206**	23458-2345												
39														

PCB Congeners not in Aroclors (Except BOLD)

Mix #	IUP AC#	Structure Cl Pos.	Mix #	IUP AC#	Structure Cl Pos.	Mix #	IUP AC#	Structure Cl Pos.	Mix #	IUP AC#	Structure Cl Pos.
6	11	3-Mar	7	36	35-3	8	30	246	9	23	235
6	21	234	7	72	25-35	8	43	235-2	9	39	35-4
6	38	345	7	78	345-3	8	55	234-3	9	62	2346
6	50	246-2	7	79	34-35	8	58	23-35	9	68	24-35
6	57	235-3	7	89	234-26	8	76	345-2	9	80	35-35
6	61	2345	7	96	236-26	8	108	2346-3	9	88	2346-2
6	65	2356	7	98	246-23	8	112	2356-3	9	94	235-26
6	86	2345-2	7	106	2345-3	8	120	245-35	9	111	235-35
6	102	245-26	7	107	234-35	8	159	2345-35	9	116	23456
6	113	236-35	7	152	2356-26	8	186	23456-26	9	121	246-35
6	126	345-34	7	166	23456-4	8	192	23456-35	9	125	345-26
6	127	345-35	7	182	2345-246	8	198	23456-235	9	140	234-246
6	133	235-235	7	184	2346-246	12			9	142	23456-2
6	139	2346-24	7	204	23456-246				9	143	2345-26
6	145	2346-26	14						9	148	235-246
6	161	2346-35							9	150	236-246
6	169	345-345							9	155	246-246
6	181	23456-24							9	160	23456-3
18									9	162	235-345
									9	168	246-345
									9	168	246-345
									9	188	2356-246
									21		

BOLD = Congener in any of Aroclors 1242, 1254 or 1260 @ < 1.0 Wt%
BOLD = Congener in any of Aroclors 1242, 1256 or 1260 @ > 1.0 Wt%
Italic = Congener in any of 3 Aroclors @ > 0.05 Wt%

Congener distributions from Average Values in GE 18 GC-MS/ECD System survey

BOLD congeners relegated to Mixes 6, 7, and 8 marginally above 0.05 Wt%
except #43 @ 0.24 Wt% in Aroclor 1242
Some "non-Aroclor" congeners assigned to mixes 1 – 5 to reduce coelution and # of mixes needed

MIXCOMP1.XLS

MIXSEP1.xls Sys= 1				MIXSEP1.xls Sys= 2				MIXSEP1.xls Sys= 3				MIXSEP1.xls Sys= 4				MIXSEP1.xls Sys= 5				MIXSEP1.xls Sys= 6				MIXSEP1.xls Sys= 7				MIXSEP1.xls Sys= 8			
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MIXCOMP1.XLS

MIXSEP1.xls Sys= 1				MIXSEP1.xls Sys= 2				MIXSEP1.xls Sys= 3				MIXSEP1.xls Sys= 4				MIXSEP1.xls Sys= 5				MIXSEP1.xls Sys= 6				MIXSEP1.xls Sys= 7				MIXSEP1.xls Sys= 8			
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4	7	175	62	4	7	175	62	4	7	175	83	4	7	175	46	4	7	175	47	4	7	175	44	4	7	175	38	4	7	175	30
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5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###

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6	4	65	72	6	4	65	76	6	4	65	111	6	3	38	96	6	3	38	105	6	3	38	109	6	3	38	88	6	3	38	125
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6	5	102	66	6	5	102	67	6	5	102	95	6	4	61	77	6	4	61	83	6	4	61	82	6	4	61	66	6	4	61	110
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7	6	166	15	7	6	166	13	7	6	166	17	7	6	166	4	7	6	166	6	7	6	166	10	7	6	166	9	7	6	166	5
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7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###
8	3	30	250	8	3	30	301	8	3	30	445	8	3	30	329	8	3	30	368	8	3	30	379	8	3	30	295	8	3	30	401
8	4	43	108	8	4	43	115	8	4	43	166	8	4	43	161	8	4	43	172	8	4	43	174	8	4	43	138	8	4	43	189
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9	3	23	113	9	3	23	130	9	3	23	193	9	3	23	180	9	3	23	198	9	3	23	198	9	3	23	156	9	3	23	223
9	3	39	41	9	3	39	49	9	3	39	66	9	3	39	21	9	3	39	21	9	3	39	25	9	3	39	20	9	3	39	12
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9	6	155	39	9	6	155	43	9	6	155	59	9	6	155	21	9	6	155	21	9	6	155	12	9	6	155	9	9	4	80	30
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9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###

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1	1	2	11	1	1	2	17	1	1	2	17	1	1	2	18	1	1	2	17	1	1	2	11	1	1	2	31	1	1	2	24
1	1	3	21	1	1	3	69	1	1	3	95	1	1	3	103	1	1	3	97	1	1	3	65	1	1	3	160	1	1	3	158
1	2	4	121	1	2	4	97	1	2	4	107	1	2	4	85	1	2	4	67	1	2	4	37	1	2	4	65	1	2	4	38
1	2	9	34	1	2	9	32	1	2	9	45	1	2	9	49	1	2	9	44	1	2	9	30	1	2	9	72	1	2	9	59
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MIXCOMP1.XLS

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MIXCOMP1.XLS

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6	2	11	169	6	2	11	140	6	2	11	223	6	2	11	212	6	2	11	177	6	2	11	139	6	2	11	245	6	2	11	190
6	4	50	54	6	4	50	26	6	4	50	36	6	4	50	43	6	4	50	39	6	4	50	36	6	4	50	61	6	4	50	45
6	3	21	134	6	3	21	78	6	3	21	114	6	3	21	98	6	3	21	76	6	3	21	67	6	3	21	84	6	3	21	51
6	4	65	27	6	3	38	5	6	3	38	16	6	3	38	14	6	3	38	13	6	3	38	14	6	3	38	21	6	3	38	22
6	3	38	119	6	4	65	74	6	4	65	101	6	4	65	97	6	4	65	77	6	4	65	66	6	4	65	87	6	4	65	58
6	4	57	26	6	4	57	24	6	4	57	46	6	4	57	44	6	4	57	40	6	4	57	40	6	4	57	60	6	4	57	53
6	5	102	11	6	4	61	10	6	4	61	13	6	4	61	19	6	4	61	16	6	4	61	14	6	4	61	30	6	4	61	24
6	4	61	107	6	5	102	56	6	5	102	85	6	5	102	73	6	5	102	56	6	5	102	55	6	5	102	53	6	5	102	31
6	5	113	33	6	5	113	33	6	5	113	52	6	5	113	56	6	5	113	53	6	5	113	52	6	5	113	86	6	5	113	72
6	6	145	13	6	5	86	8	6	5	86	10	6	5	86	12	6	5	86	10	6	5	86	12	6	5	86	19	6	5	86	20
6	5	86	126	6	6	145	59	6	6	145	89	6	6	145	80	6	6	145	64	6	6	145	61	6	6	145	67	6	6	145	37
6	6	139	50	6	6	139	22	6	6	139	29	6	6	139	22	6	6	139	13	6	6	139	11	6	6	139	5	6	6	133	7
6	6	133	24	6	6	133	10	6	6	133	20	6	6	133	14	6	6	133	12	6	6	133	14	6	6	133	11	6	6	139	1
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6	5	127	66	6	5	127	48	6	5	127	73	6	5	127	84	6	5	127	76	6	5	127	80	6	5	127	111	6	5	127	93
6	5	126	32	6	5	126	42	6	5	126	69	6	5	126	62	6	5	126	53	6	5	126	50	6	5	126	71	6	5	126	63
6	7	181	159	6	7	181	70	6	7	181	93	6	7	181	88	6	7	181	73	6	7	181	76	6	7	181	79	6	7	181	52
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7	3	36	70	7	3	36	91	7	3	36	142	7	3	36	135	7	3	36	110	7	3	36	95	7	3	36	142	7	3	36	105
7	5	96	60	7	4	72	10	7	4	72	26	7	4	72	53	7	4	72	58	7	4	72	70	7	4	72	123	7	4	72	120
7	4	72	62	7	5	96	47	7	5	96	74	7	5	96	55	7	5	96	38	7	5	96	28	7	5	96	35	7	5	96	12
7	5	98	70	7	5	98	51	7	5	98	75	7	5	98	83	7	5	98	66	7	5	98	64	7	5	98	60	7	5	98	32
7	5	89	52	7	5	89	18	7	5	89	16	7	5	89	1	7	4	79	8	7	4	79	11	7	4	79	36	7	4	79	33
7	6	152	64	7	4	79	15	7	4	79	30	7	4	79	27	7	5	89	16	7	5	89	16	7	4	78	7	7	4	78	19
7	4	79	22	7	6	152	2	7	4	78	7	7	4	78	14	7	4	78	16	7	4	78	16	7	5	89	33	7	5	89	23
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7	5	106	53	7	5	106	34	7	5	106	53	7	5	106	46	7	5	106	37	7	5	106	29	7	5	106	49	7	5	106	39
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7	6	166	3	7	6	166	4	7	6	166	5	7	7	182	5	7	7	182	9	7	7	182	18	7	7	182	22	7	7	182	19
7	7	182	83	7	7	182	60	7	7	182	87	7	6	166	78	7	6	166	63	7	6	166	53	7	6	166	68	7	6	166	55
7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###	7	8	204	###
8	3	30	436	8	3	30	276	8	3	30	421	8	3	30	421	8	3	30	344	8	3	30	290	8	3	30	481	8	3	30	346
8	4	43	208	8	4	43	104	8	4	43	155	8	4	43	149	8	4	43	120	8	4	43	111	8	4	43	147	8	4	43	104
8	4	58	34	8	4	58	21	8	4	58	33	8	4	58	33	8	4	58	29	8	4	58	28	8	4	58	46	8	4	58	37
8	4	76	31	8	4	76	23	8	4	76	31	8	4	76	37	8	4	76	33	8	4	76	38	8	4	76	44	8	4	76	37
8	4	55	89	8	4	55	51	8	4	55	83	8	4	55	66	8	4	55	52	8	4	55	51	8	4	55	56	8	4	55	36
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8	5	109	84	8	5	109	31	8	5	109	37	8	5	109	28	8	5	109	17	8	5	109	9	8	5	109	5	8	5	120	7
8	5	120	165	8	5	120	138	8	5	120	220	8	5	120	226	8	5	120	198	8	5	120	210	8	5	120	275	8	5	109	197
8	7	186	108	8	7	186	25	8	7	186	29	8	7	186	20	8	7	186	10	8	7	186	10	8	6	159	10	8	6	159	26
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8	7	192	63	8	7	192	54	8	7	192	78	8	7	192	78	8	7	192	68	8	7	192	65	8	7	192	95	8	7	192	78
8	8	198	###	8	8	198	###	8	8	198	###	8	8	198	###	8	8	198	###	8	8	198	###	8	8	198	###	8	8	198	###
9	3	23	245	9	3	23	131	9	3	23	187	9	3	23	184	9	3	23	150	9	3	23	132	9	3	23	191	9	3	23	135
9	3	39	5	9	3	39	23	9	3	39	51	9	3	39	47	9	3	39	40	9	3	39	40	9	3	39	69	9	3	39	60
9	4	62	115	9	4	62	53	9	4	62	71	9	4	62	65	9	4	62	49	9	4	62	35	9	4	62	42	9	4	62	22
9	4	68	15	9	4	68	36	9	4	68	66	9	4	68	71	9	4	68	56	9	4	68	54	9	4	68	60	9	4	68	32
9	5	94	48	9	5	94	24	9	5	94	22	9	5	94	2	9	4	80	8	9	4	80	7	9	4	80	23	9	4	80	26
9	5	88	40	9	5	121	1	9	4	80	11	9	4	80	12	9	5	94	4	9	5	121	5	9	5	121	22	9	5	121	32
9	5	121	17	9	5	88	1	9	5	121	2	9	5	121	21	9	5	121	28	9	5	94	31	9	5	94	36	9	5	94	22
9	6	155	20	9	4	80	21	9	5	88	31	9	5	88	16	9	5	88	7	9	6	155	3	9	6	155	8	9	6	155	12
9	4	80	22	9	6	155	40	9	6	155	61	9	6	155	72	9	6	155	65	9	5	88	68	9	5	88	69	9	5	88	32
9	6	150	55	9	6	150	18	9	6	150	30	9	6	150	18	9	6	150	7	9	6	150	2	9	5	111	18	9	5	111	32
9	5	125	11	9	5	125	4	9	5	125	3	9	5	111	11	9	5	111	14	9	5	111	14	9	6	150	10	9	6	148	2
9	5	116	15	9	5	116	5	9	5	111	6	9	5	125	3	9	6	148	2	9	6	148	4	9	6	148	18	9	6	150	19
9	6	148	23	9	5	111	3	9	5	116	8	9	5	116	1	9	5	125	3	9	5	125	13	9	5	125	6	9	5	125	0
9	5	111	68	9	6	148	60	9	6	148	87	9	6	148	97	9	5	116	80	9	5	116	70	9	5	116	101	9	5	116	79
9	6	143	0	9	6	140	8	9	6	140	14	9	6	140	14	9	6	140	14	9	6	140	15	9	6	140	16	9	6	140	10
9	6	140	19	9	6	143	10	9	6	143	14	9	6	143	11	9	6	143	5	9	6	143	1	9	7	188	6	9	7	188	4
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9	7	188	58	9	7	188	16	9	7	188	23	9	6	142	17	9	6	142	8	9	6	168	2	9	6	168	9	9	6	143	11
9	6	168	56	9	6	168	40	9	6	168	59	9	6	168	62	9	6	168	56	9	6	142	69	9	6	142	71	9	6	142	47
9	6	160	81	9	6	160	36	9	6	160	44	9	6	160	43	9	6	160	33	9	6	160	24	9	6	160	33	9	6	160	19
9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###	9	6	162	###

MIXCOMP1.XLS

MIXSEP1.xls			Sys= 17	MIXSEP1.xls			Sys= 18	MIXSEP1.xls			Sys= 20	MIXSEP1.xls			Sys= 21	MIXSEP1.xls			Sys= 22	MIXSEP1.xls			Sys= 23	MIXSEP1.xls			Sys= 24	MIXSEP1.xls			Sys= 27
			Sep				Sep				Sep				Sep				Sep				Sep				Sep				Sep
Mi #	Cl #	IUP AC#	W Unit	Mi #	Cl #	IUP AC#	W Unit	Mi #	Cl #	IUP AC#	W Unit	Mi #	Cl #	IUP AC#	W Unit	Mi #	Cl #	IUP AC#	W Unit	Mi #	Cl #	IUP AC#	W Unit	Mi #	Cl #	IUP AC#	W Unit	Mi #	Cl #	IUP AC#	W Unit
1	1	1	105	1	1	1	94	1	1	1	262	1	1	1	237	1	1	1	139	1	1	1	132	1	1	1	131	1	1	1	122
1	1	2	13	1	1	2	12	1	1	2	43	1	1	2	42	1	1	2	12	1	1	2	6	1	2	4	8	1	1	2	22
1	1	3	57	1	1	3	50	1	1	3	50	1	1	3	119	1	1	3	44	1	2	4	17	1	1	2	10	1	1	3	9
1	2	4	58	1	2	4	41	1	2	4	147	1	2	4	102	1	2	4	71	1	1	3	36	1	1	3	101	1	2	4	5
1	2	9	38	1	2	9	38	1	2	9	40	1	2	9	58	1	2	9	47	1	2	9	29	1	2	9	15	1	2	9	59
1	2	6	16	1	2	6	14	1	2	6	40	1	2	6	38	1	2	6	14	1	2	6	19	1	2	6	12	1	2	6	21
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1	3	19	55	1	3	19	41	1	3	19	101	1	3	19	70	1	3	19	64	1	3	19	46	1	2	8	84	1	3	19	12
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1	5	110	28	1	5	110	25	1	5	110	23	1	5	87	59	1	5	110	15	1	5	110	2	1	5	110	3	1	5	87	32
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1	7	179	33	1	7	179	36	1	7	179	44	1	7	179	40	1	6	153	42	1	6	153	40	1	6	153	23	1	5	82	29
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2	2	7	58	2	2	7	59	2	2	7	64	2	2	7	106	2	2	7	57	2	2	7	40	2	2	7	15	2	2	7	104
2	2	5	119	2	2	5	95	2	2	5	184	2	2	5	180	2	2	5	111	2	2	5	65	2	2	5	123	2	2	5	52
2	3	17	25	2	3	17	14	2	3	17	35	2	3	17	44	2	3	17	15	2	3	17	18	2	3	17	10	2	3	17	36
2	3	24	24	2	3	32	7	2	3	24	32	2	3	24	36	2	3	24	27	2	3	24	17	2	3	24	28	2	3	24	31
2	3	32	46	2	3	24	64	2	3	32	77	2	3	32	54	2	3	32	53	2	3	32	53	2	3	32	84	2	3	32	33
2	3	26	21	2	3	26	19	2	3	26	37	2	3	26	40	2	3	26	17	2	3	26	20	2	3	26	6	2	3	26	24
2	3	31	70	2	3	31	59	2	3	31	46	2	3	31	92	2	3	31	38	2	3	31	14	2	4	45	7	2	3	31	52
2	4	45	25	2	4	45	25	2	4	45	19	2	4	45	30	2	4	45	24	2	4	45	16	2	4	46	11	2	4	48	18
2	4	46	19	2	4	46	2	2	4	46	40	2	4	46	4	2	4	46	29	2	4	46	21	2	3	31	84	2	4	45	4
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2	4	41	4	2	3	37	2	2	3	37	1	2	3	37	6	2	4	41	4	2	4	41	38	2	5	103	2	2	4	41	38
2	5	103	60	2	4	41	52	2	5	103	66	2	4	41	73	2	3	37	38	2	5	95	27	2	3	37	12	2	5	95	20
2	4	70	9	2	4	70	4	2	5	95	12	2	4	70	9	2	5	95	16	2	3	37	8	2	5	95	27	2	4	70	14
2	5	95	43	2	5	95	41	2	4	70	41	2	5	95	68	2	4	70	29	2	4	70	8	2	5	84	23	2	3	37	48
2	4	60	11	2	4	60	9	2	5	84	14	2	4	60	6	2	5	84	13	2	5	84	36	2	4	70	34	2	5	83	1
2	5	84	36	2	5	84	23	2	4	60	33	2	5	84	25	2	4	60	24	2	5	83	3	2	4	60	20	2	5	115	0
2	5	83	19	2	5	83	8	2	5	83	42	2	5	83	35	2	5	83	19	2	4	60	21	2	5	83	50	2	5	84	2
2	5	115	59	2	5	115	49	2	5	115	39	2	5	115	48	2	5	115	28	2	5	115	11	2	5	115	8	2	4	60	28
2	6	135	13	2	6	135	13	2	6	135	18	2	6	135	23	2	6	135	14	2	6	135	13	2	6	135	22	2	6	135	19
2	5	107	2	2	6	149	3	2	6	149	20	2	6	149	4	2	6	149	17	2	6	149	28	2	6	149	15	2	6	149	44
2	6	149	33	2	5	107	23	2	5	109	14	2	5	109	41	2	5	107	10	2	6	131	18	2	6	131	12	2	6	131	0
2	6	131	29	2	6	131	29	2	6	131	30	2	6	131	41	2	6	131	17	2	5	107	3	2	6	132	12	2	5	109	28
2	6	132	16	2	6	132	8	2	6	132	24	2	6	141	1	2	6	132	22	2	6	132	24	2	5	109	44	2	7	178	18
2	6	141	31	2	6	141	24	2	6	141	26	2	6	132	32	2	6	141	18	2	6	141	8	2	6	141	13	2	6	141	4
2	6	164	8	2	7	178	4	2	6	164	15	2	6	164	0	2	7	178	3	2	7	178	14	2	6	164	12	2	7	183	4
2	7	178	24	2	6	164	15	2	6	178	28	2	7	178	35	2	6	164	20	2	6	164	5	2	7	178	32	2	6	132	4
2	7	183	56	2	7	183	49	2	7	183	59	2	7	183	83	2	7	183	39	2	7	183	23	2	7	183	22	2	8	197	28
2	7	171	14	2	8	197	1	2	7	171	15	2	7	171	6	2	7	171	1	2	8	197	28	2	7	171	18	2	6	164	53
2	8	197	8	2	7	171	17	2	8	197	8	2	7	172	0	2	8	197	21	2	7	171	44	2	8	197	22	2	7	171	25
2	7	172	17	2	7	172	15	2	7	172	18	2	8	197	17	2	7	172	13	2	7	172	28	2	7	172	11	2	7	172	26
2	7	193	46	2	7	193	39	2	7	193	50	2	7	193	75	2	7	193	34	2	7	193	28	2	7	193	20	2	7	193	10

MIXCOMP1.XLS

MIXSEP1.xls Sys= 17				MIXSEP1.xls Sys= 18				MIXSEP1.xls Sys= 20				MIXSEP1.xls Sys= 21				MIXSEP1.xls Sys= 22				MIXSEP1.xls Sys= 23				MIXSEP1.xls Sys= 24				MIXSEP1.xls Sys= 27			
Mi #	Cl #	IUP AC#	Sep W Unit	Mi #	Cl #	IUP AC#	Sep W Unit	Mi #	Cl #	IUP AC#	Sep W Unit	Mi #	Cl #	IUP AC#	Sep W Unit	Mi #	Cl #	IUP AC#	Sep W Unit	Mi #	Cl #	IUP AC#	Sep W Unit	Mi #	Cl #	IUP AC#	Sep W Unit	Mi #	Cl #	IUP AC#	Sep W Unit
2	7	170	16	2	7	170	3	2	7	170	14	2	7	170	3	2	7	170	3	2	8	196	22	2	7	170	17	2	8	196	51
2	8	196	95	2	8	196	81	2	8	196	105	2	8	196	108	2	8	196	80	2	7	170	111	2	8	196	89	2	7	170	87
2	8	205	###	2	8	205	###	2	8	205	###	2	8	205	###	2	8	205	###	2	8	205	###	2	8	205	###	2	8	205	###
3	2	15	13	3	2	15	3	3	3	27	38	3	3	27	6	3	3	27	7	3	3	27	42	3	3	27	55	3	3	34	5
3	3	27	39	3	3	27	26	3	2	15	36	3	2	15	36	3	2	15	43	3	3	34	12	3	2	15	44	3	3	29	10
3	3	34	8	3	3	34	1	3	3	34	18	3	3	34	22	3	3	34	6	3	3	29	15	3	3	34	21	3	3	27	79
3	3	29	82	3	3	29	87	3	3	29	82	3	3	29	119	3	3	29	71	3	2	15	48	3	3	29	26	3	4	69	5
3	3	20	44	3	3	20	21	3	3	20	73	3	3	20	39	3	3	20	32	3	3	20	9	3	3	20	79	3	2	15	39
3	4	69	26	3	4	69	22	3	4	69	32	3	4	69	47	3	4	69	22	3	4	69	24	3	4	69	24	3	4	47	21
3	4	47	52	3	4	47	53	3	4	47	40	3	4	47	72	3	4	47	38	3	4	47	38	3	4	47	6	3	3	20	80
3	4	42	51	3	4	42	50	3	4	42	42	3	4	42	65	3	4	42	38	3	4	42	37	3	4	42	7	3	4	42	37
3	4	40	41	3	4	40	16	3	4	40	59	3	4	40	36	3	4	40	22	3	4	40	7	3	4	40	66	3	5	93	37
3	5	93	40	3	5	93	37	3	5	93	57	3	5	93	39	3	5	93	41	3	5	93	43	3	5	93	80	3	5	92	11
3	5	92	13	3	5	92	9	3	5	92	16	3	5	92	17	3	5	92	13	3	5	92	12	3	5	92	5	3	5	101	10
3	5	101	25	3	5	101	18	3	5	101	31	3	5	101	31	3	5	101	24	3	5	101	21	3	6	136	12	3	4	40	1
3	5	119	56	3	5	119	49	3	5	119	39	3	5	119	85	3	5	119	14	3	5	119	3	3	5	101	28	3	5	119	70
3	6	136	28	3	6	136	17	3	6	136	39	3	6	136	9	3	6	136	31	3	6	136	37	3	5	119	35	3	6	138	6
3	6	151	9	3	6	151	6	3	6	151	12	3	6	151	13	3	6	151	10	3	6	151	6	3	6	151	15	3	6	144	0
3	6	144	26	3	6	144	29	3	6	144	38	3	6	144	38	3	6	144	29	3	6	144	34	3	6	144	7	3	6	151	76
3	5	118	16	3	5	118	9	3	6	134	7	3	5	118	18	3	6	134	11	3	6	134	34	3	6	134	50	3	6	134	13
3	6	134	44	3	6	134	44	3	5	118	54	3	6	134	65	3	5	118	43	3	5	118	46	3	5	118	23	3	5	118	75
3	5	105	44	3	5	105	26	3	5	105	47	3	5	105	35	3	5	105	25	3	5	105	7	3	5	105	43	3	6	158	15
3	6	158	53	3	6	158	49	3	6	158	46	3	6	158	78	3	6	158	35	3	6	158	47	3	6	158	13	3	5	105	70
3	6	128	53	3	6	128	38	3	6	128	64	3	6	128	51	3	6	128	48	3	6	128	77	3	6	128	72	3	9	208	1
3	6	157	25	3	6	157	15	3	6	157	23	3	6	157	9	3	6	157	11	3	7	191	12	3	6	157	23	3	6	128	12
3	7	191	42	3	7	191	34	3	7	191	47	3	7	191	63	3	7	191	31	3	6	157	5	3	7	191	26	3	9	207	3
3	7	190	50	3	7	190	23	3	7	190	45	3	7	190	48	3	7	190	12	3	9	208	15	3	7	190	17	3	7	191	28
3	9	208	12	3	9	208	11	3	9	208	15	3	9	208	19	3	9	208	11	3	9	207	26	3	9	208	15	3	6	157	39
3	9	207	119	3	9	207	92	3	9	207	127	3	9	207	138	3	9	207	84	3	7	190	84	3	9	207	107	3	7	190	35
3	10	209	###	3	10	209	###	3	10	209	###	3	10	209	###	3	10	209	###	3	10	209	###	3	10	209	###	3	10	209	###
4	2	14	86	4	2	14	87	4	2	14	123	4	2	14	161	4	2	14	81	4	2	14	62	4	2	14	22	4	2	14	164
4	2	13	98	4	2	13	79	4	2	13	72	4	2	13	153	4	2	13	50	4	4	54	19	4	4	54	28	4	2	13	22
4	4	54	60	4	4	54	47	4	4	54	87	4	4	54	58	4	4	54	60	4	2	13	31	4	2	13	68	4	4	54	16
4	4	53	10	4	4	53	5	4	4	53	19	4	4	53	16	4	4	53	14	4	4	53	7	4	4	53	32	4	4	51	6
4	4	51	50	4	4	51	38	4	4	51	58	4	4	51	30	4	4	51	51	4	4	51	41	4	4	51	72	4	4	53	1
4	4	73	11	4	4	73	2	4	4	73	48	4	4	73	43	4	4	73	16	4	4	73	23	4	4	73	54	4	4	73	6
4	4	75	46	4	4	75	58	4	4	75	44	4	4	75	57	4	4	75	47	4	4	75	46	4	4	75	31	4	4	75	46
4	3	35	50	4	3	35	18	4	3	35	53	4	3	35	52	4	3	35	22	4	5	100	49	4	3	35	46	4	5	100	145
4	5	100	106	4	5	100	94	4	5	100	114	4	5	100	125	4	5	100	86	4	3	35	44	4	5	100	87	4	5	90	9
4	5	90	61	4	5	90	50	4	5	90	74	4	5	90	79	4	5	90	43	4	5	90	32	4	5	90	47	4	3	35	4
4	5	117	16	4	5	117	4	4	5	117	5	4	6	154	10	4	5	117	11	4	6	154	23	4	5	117	28	4	6	154	83
4	6	154	0	4	6	154	20	4	6	154	17	4	5	117	17	4	6	154	16	4	5	117	62	4	6	154	4	4	5	117	63
4	4	81	52	4	4	81	35	4	4	81	46	4	4	81	43	4	4	81	34	4	5	124	6	4	4	81	39	4	6	165	13
4	5	124	42	4	5	124	26	4	5	124	39	4	5	124	29	4	5	124	24	4	4	81	6	4	5	124	18	4	5	124	26
4	6	165	7	4	6	165	16	4	5	122	1	4	6	165	35	4	6	165	15	4	6	165	24	4	5	122	14	4	4	81	16
4	5	122	57	4	5	122	41	4	6	165	64	4	5	122	64	4	5	122	31	4	5	122	16	4	6	165	28	4	7	175	2
4	6	130	10	4	6	130	7	4	6	130	15	4	6	130	10	4	6	130	8	4	7	175	3	4	6	130	15	4	8	202	13
4	6	163	19	4	6	163	5	4	6	163	14	4	6	163	7	4	6	163	6	4	6	130	10	4	6	163	15	4	8	201	7
4	7	175	58	4	7	175	32	4	7	175	60	4	7	175	71	4	7	175	29	4	8	202	5	4	7	175	22	4	5	122	19
4	8	202	14	4	8	202	18	4	8	202	16	4	8	202	20	4	8	202	12	4	6	163	7	4	8	202	19	4	6	130	18
4	8	201	46	4	8	201	41	4	8	201	46	4	8	201	59	4	8	201	32	4	8	201	43	4	8	201	16	4	6	163	33
4	8	200	###	4	8	200	###	4	8	200	###	4	8	200	###	4	8	200	###	4	8	200	###	4	8	200	###	4	8	200	###
5	2	12	166	5	2	12	138	5	2	12	197	5	2	12	229	5	2	12	142	5	2	12	78	5	2	12	130	5	2	12	62
5	3	33	68	5	3	33	48	5	3	33	97	5	3	33	88	5	3	33	43	5	3	33	6	5	3	33	66	5	5	104	24
5	4	49	26	5	4	49	15	5	4	49	11	5	4	49	34	5	4	49	7	5	5	104	21	5	5	104	6	5	3	33	6
5	5	104	28	5	5	104	36	5	5	104	38	5	5	104	34	5	5	104	36	5	4	49	44	5	4	49	20	5	4	49	94
5	4	59	23	6	4	59	19	5	4	59	41	5	4	59	45	5	4	59	17	5	4	59	20	5	4	59	34	5	4	59	26
5	4	64	42	5	4	64	29	5	4	64	62	5	4	64	42	5	4	64	45	5	4	64	44	5	4	64	70	5	4	64	8
5	4	63	46	5	4	63	39	5	4	63	27	5	4	63	56	5	4	63	18	5	5	91	7	5	5	91	15	5	4	63	31
5	5	91	93	5	5	91	76	5	5	91	94	5	5	91	95	5	5	91	83	5	4	63	74	5	4	63	80	5	5	91	101
6	5	97	21	5	5	97	18	5	5	97	32	5	5	97	35	5	5	97	17	5	5	97	21	5	5	97	22	5	5	97	21
5	5	85	28	5	5	85	35	5	5	85	41	5	5	85	32	5	5	85	31	5	5	85	57	5	5	85	47	5	5	85	43
5	4	77	34	5	4	77	12	5	4	77	34	5	4	77	28	5	4	77	23	5	7	176	6	5	4	77	35	5	5	123	7
5	5	123	28	5	5	123	22	5	5	123	33	5	5	123	45	5	5	123	19	5	5	123	19	5	5	123	16	5	7	176	42
5	5	114	59	5	5	114	37	5	5	114	42	5	5	114	54	5	5	114	15	5	4	77	5	5	7	176	4	5	5	114	10
5	7	176	1	5	7	176	6	5	7	176	7	5	6	137	5	5	7	176	20	5	5	114	11	5	5	114	36	5	6	137	31
5	6	137	37	5	6	137	34	5	6	137	27	5	7	176	39	5	6	137	25	5	6	137	27	5	6	137	4	5	4	77	24
5	6	129	37	5	6	129	23	5	6	129	51	5	6	129	36	5	6	129	21	5	6	129	14	5	6	129	40	5	6	185	15
5	6	167	3	5	7	185	5	5	7	185	14	5	6	167	0	5	7	185	17	5	7	185	58	5	7	185	38	5	6	129	28
5	7	185	41	6	6	167	37	5	6	167	45	5	7	185	63	5	6	167	31	5	6	167	54	5	6	167	20	5	6	167	66
5	6	156	130	5	6	156	100	5	6	156	136	5	6	156	139	5	6	156	93	5	6	156	129	5	6	156	107	5	6	156	106
5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###	5	7	189	###

MIXCOMP1.XLS

MIXSEP1.xls Sys= 17

Mi #	Cl #	IUP AC#	Sep W Unit
6	2	11	139
6	4	50	38
6	3	21	88
6	4	65	0
6	3	38	84
6	4	57	34
6	4	61	13
6	5	102	70
6	5	113	44
6	5	86	4
6	6	145	73
6	6	139	29
6	6	133	16
6	6	161	29
6	5	127	71
6	5	126	41
6	7	181	103
6	6	169	###
7	3	36	101
7	4	72	30
7	5	96	50
7	5	98	71
7	5	89	17
7	4	79	17
7	6	152	7
7	4	78	82
7	5	108	11
7	5	106	27
7	7	184	97
7	7	182	3
7	6	166	67
7	8	204	###
8	3	30	309
8	4	43	126
8	4	58	28
8	4	76	30
8	4	55	60
8	5	112	4
8	5	109	29
8	5	120	186
8	7	186	33
8	6	159	82
8	7	192	65
8	8	198	###
9	3	23	150
9	3	39	29
9	4	62	55
9	4	68	57
9	5	94	17
9	5	121	3
9	4	80	8
9	5	88	6
9	6	155	62
9	6	150	33
9	5	111	4
9	6	148	1
9	5	116	0
9	5	125	80
9	6	140	17
9	6	143	2
9	7	188	10
9	6	142	19
9	6	168	60
9	6	160	41
9	6	162	###

MIXSEP1.xls Sys= 18

Mi #	Cl #	IUP AC#	Sep W Unit
6	2	11	99
6	4	50	39
6	3	21	61
6	4	65	11
6	3	38	66
6	4	57	23
6	4	61	12
6	5	102	61
6	5	113	29
6	6	145	2
6	5	86	56
6	6	139	26
6	6	133	10
6	6	161	35
6	5	127	61
6	5	126	14
6	7	181	98
6	6	169	###
7	3	36	79
7	4	72	28
7	5	96	33
7	5	98	67
7	5	89	17
7	6	152	0
7	4	79	21
7	4	78	58
7	5	108	8
7	5	106	3
7	7	184	83
7	7	182	10
7	6	166	37
7	8	204	###
8	3	30	274
8	4	43	109
8	4	58	20
8	4	76	30
8	4	55	39
8	5	112	3
8	5	109	24
8	5	120	142
8	7	186	33
8	6	159	60
8	7	192	47
8	8	198	###
9	3	23	140
9	3	39	7
9	4	62	54
9	4	68	48
9	5	94	5
9	5	121	5
9	6	155	9
9	4	80	0
9	5	88	53
9	6	150	26
9	6	148	2
9	5	116	3
9	5	111	7
9	5	125	59
9	6	140	4
9	7	188	11
9	6	143	5
9	6	142	17
9	6	168	49
9	6	160	37
9	6	162	###

MIXSEP1.xls Sys= 20

Mi #	Cl #	IUP AC#	Sep W Unit
6	2	11	163
6	4	50	52
6	3	21	110
6	4	65	4
6	3	38	100
6	4	57	22
6	5	102	7
6	4	61	85
6	5	113	36
6	5	86	4
6	6	145	97
6	6	139	29
6	6	133	21
6	6	161	48
6	5	127	67
6	5	126	27
6	7	181	126
6	6	169	###
7	3	36	104
7	5	96	6
7	4	72	66
7	5	98	66
7	5	89	38
7	6	152	19
7	4	79	19
7	4	78	84
7	5	107	10
7	5	106	20
7	7	184	97
7	7	182	18
7	6	166	58
7	8	204	###
8	3	30	363
8	4	43	155
8	4	58	22
8	4	76	43
8	4	55	66
8	5	112	5
8	5	108	48
8	5	120	157
8	7	186	63
8	6	159	75
8	7	192	62
8	8	198	###
9	3	23	206
9	3	39	6
9	4	62	81
9	4	68	24
9	5	94	41
9	5	88	8
9	6	155	12
9	6	155	15
9	4	80	45
9	6	150	23
9	5	125	20
9	6	148	2
9	5	116	15
9	5	111	66
9	6	143	4
9	6	140	17
9	7	188	0
9	6	143	33
9	6	142	63
9	6	168	54
9	6	160	162
9	6	162	###

MIXSEP1.xls Sys= 21

Mi #	Cl #	IUP AC#	Sep W Unit
6	2	11	194
6	4	50	61
6	3	21	97
6	3	38	5
6	4	65	99
6	3	38	43
6	4	57	9
6	5	102	73
6	4	61	112
6	5	113	63
6	5	86	13
6	6	145	82
6	5	86	15
6	6	139	14
6	6	133	42
6	6	161	96
6	5	127	44
6	5	126	112
6	7	181	125
6	6	169	###
7	3	36	67
7	4	72	42
7	5	98	93
7	5	89	9
7	4	79	23
7	6	152	4
7	4	78	98
7	5	107	11
7	5	106	27
7	7	184	100
7	7	182	30
7	6	166	58
7	8	204	###
8	3	30	419
8	4	43	154
8	4	58	32
8	4	76	52
8	4	55	53
8	5	112	6
8	5	108	27
8	5	120	222
8	7	186	28
8	6	159	82
8	7	192	80
8	8	198	###
9	3	23	208
9	3	39	27
9	4	62	63
9	4	68	64
9	5	94	5
9	5	121	13
9	4	80	25
9	6	155	2
9	5	88	85
9	6	150	20
9	5	111	1
9	6	148	3
9	5	125	14
9	5	116	96
9	5	111	66
9	6	140	8
9	6	143	4
9	7	188	16
9	6	142	7
9	6	168	79
9	6	160	46
9	6	162	###

MIXSEP1.xls Sys= 22

Mi #	Cl #	IUP AC#	Sep W Unit
6	2	11	103
6	4	50	47
6	3	21	61
6	4	65	21
6	3	38	59
6	5	102	8
6	4	57	18
6	4	61	54
6	5	113	20
6	6	145	14
6	5	86	52
6	6	139	25
6	6	133	17
6	6	161	27
6	5	127	52
6	7	181	91
6	6	169	###
7	3	36	70
7	5	96	6
7	4	72	50
7	5	98	51
7	5	89	16
7	6	152	18
7	7	184	9
7	4	79	20
7	4	78	57
7	5	108	6
7	7	184	3
7	7	182	11
7	6	166	30
7	8	204	20
8	3	30	275
8	4	43	115
8	4	58	23
8	4	76	21
8	4	55	35
8	5	112	7
8	5	109	30
8	5	120	102
8	7	186	53
8	6	159	53
8	7	192	34
8	8	198	###
9	3	23	135
9	3	39	12
9	4	62	56
9	5	94	27
9	5	88	2
9	5	121	0
9	6	155	10
9	4	80	29
9	6	150	38
9	6	148	7
9	5	125	2
9	5	116	5
9	5	111	48
9	6	140	1
9	7	188	5
9	6	143	12
9	6	142	26
9	6	168	42
9	6	160	35
9	6	162	###

MIXSEP1.xls Sys= 23

Mi #	Cl #	IUP AC#	Sep W Unit
6	2	11	24
6	4	50	70
6	3	21	40
6	4	65	55
6	3	38	14
6	5	102	12
6	4	57	20
6	4	61	33
6	6	145	9
6	5	113	24
6	5	86	46
6	6	139	34
6	6	133	17
6	6	161	83
6	5	127	4
6	7	181	73
6	5	126	152
6	6	169	###
7	3	36	7
7	5	96	28
7	4	72	22
7	5	98	49
7	5	89	1
7	6	152	87
7	7	184	9
7	4	79	14
7	4	78	25
7	5	108	7
7	5	106	34
7	7	182	26
7	8	204	20
8	3	30	216
8	4	43	120
8	4	58	16
8	4	76	35
8	4	55	21
8	5	112	2
8	5	109	41
8	5	120	51
8	7	186	114
8	6	159	58
8	7	192	28
8	8	198	###
9	3	23	116
9	4	62	42
9	3	39	11
9	5	94	2
9	6	155	6
9	4	68	21
9	5	88	7
9	5	121	19
9	6	150	42
9	6	148	1
9	4	80	15
9	5	125	13
9	5	116	18
9	5	111	0
9	6	140	1
9	6	140	19
9	6	143	29
9	6	168	58
9	6	160	57
9	6	162	###

MIXSEP1.xls Sys= 24

Mi #	Cl #	IUP AC#	Sep W Unit
6	2	11	93
6	4	50	41
6	3	21	89
6	4	65	33
6	3	38	61
6	5	102	11
6	4	57	19
6	4	61	55
6	6	145	1
6	5	113	21
6	5	86	89
6	6	139	37
6	6	133	19
6	6	161	48
6	5	127	31
6	5	126	9
6	7	181	112
6	6	169	###
7	5	96	22
7	3	36	79
7	4	72	11
7	5	98	26
7	5	89	31
7	6	152	86
7	4	79	8
7	4	78	56
7	5	107	8
7	5	106	13
7	7	184	79
7	7	182	4
7	6	166	43
7	8	204	###
8	3	30	259
8	4	43	149
8	4	58	17
8	4	76	19
8	4	55	55
8	5	112	9
8	5	108	73
8	5	120	53
8	7	186	108
8	6	159	46
8	7	192	30
8	8	198	###
9	3	23	154
9	4	62	18
9	3	39	38
9	5	94	31
9	4	68	7
9	5	121	9
9	3	39	33
9	5	94	30
9	5	88	7
9	6	150	19
9	6	148	23
9	4	80	29
9	5	125	21
9	5	116	11
9	6	148	32
9	5	111	0
9	6	143	17
9	6	140	3
9	6	142	15
9	7	188	48
9	6	168	28
9	6	160	62
9	6	162	###

MIXSEP1.xls Sys= 27

Mi #	Cl #	IUP AC#	Sep W Unit
6	4	50	21
6	2	11	90
6	3	21	18
6	4	65	85
6	3	38	15
6	4	57	12
6	5	102	6
6	4	61	68
6	6	145	2
6	5	113	47
6	5	86	28
6	6	139	45
6	6	133	3
6	6	161	136
6	7	181	7
6	5	127	101
6	5	126	120
6	6	169	###
7	3	36	18
7	4	72	57
7	5	96	6
7	5	98	65
7	6	152	38
7	7	184	12
7	5	89	71
7	4	79	30
7	5	107	0
7	4	78	17
7	5	106	12
7	7	182	10
7	6	166	82
7	8	204	###
8	3	30	415
8	4	43	76
8	4	58	21
8	4	76	68
8	5	108	2
8	4	55	4
8	5	112	9
8	5	120	112
8	7	186	108
8	6	159	52
8	7	192	27
8	8	198	###
9	3	23	150
9	4	62	12
9	6	155	37
9	4	68	13
9	5	121	9
9	3	39	33
9	5	94	30
9	5	88	7
9	6	150	19
9	6	148	23
9	4	80	29
9	5	125	40
9	6	140	26
9	6	143	10
9	6	168	4
9	6	142	106
9	6	160	47
9	6	162	###