Supporting Information:

An Empirical Process for the Design of High-Throughput Screening Deck Filters

Bradley C. Pearce, Michael J. Sofia, Andrew C. Good, Dieter M. Drexler, and David A. Stock

Contents:

Table 2. Statistical Analysis of the Promiscuity Ratio Index (PRI)

Table 3. Statistical Analysis of the Promiscuity Strength Index (PSI)

Table 4. Summary Table of Functional Group Query Promiscuity Linkages

Functional Group SMARTS

Table 2. Statistical Analysis of the Promiscuity Ratio Index (PRI)

Functional Group Filter	PRI	Upperbound	Lowerbound	Rule Class From HTS Benchmark	Mean	Stderr	Var	N Cmpds	Sum Actives	Sum Inactives
2halo pyrazine 5EWG	0.110	0.217	0.003	Less	0.21	0.10	0.84	78	4	1839
activated 4mem ring	0.151	0.337	-0.035	Less	0.29	0.17	0.85	28	15	1093
halo 5heterocycle bis EWG	0.192	0.628	-0.243	Less	0.37	0.37	1.37	10	2	245
hydroxamate warhead	0.237	0.258	0.215	Less	0.46	0.02	3.16	7193	2654	127678
thiol warhead	0.269	0.353	0.184	Less	0.52	0.08	2.57	378	246	7874
tris activated aryl ester	0.318	0.724	-0.089	Less	0.61	0.37	2.00	15	8	486
activated vinyl sulfonate	0.357	0.705	0.010	Less	0.69	0.32	2.52	24	14	801
acyl cyanide	0.360	0.733	-0.012	Less	0.69	0.35	2.75	23	11	762
pentafluorophenylester	0.368	1.019	-0.283	Same	0.71	0.54	2.66	9	4	244
vinyl carbonyl EWG	0.376	0.823	-0.070	Less	0.72	0.41	2.99	18	5	325
4halo pyrimidine 5EWG	0.398	0.556	0.240	Less	0.77	0.15	3.34	141	84	4406
alpha halo EWG	0.420	0.607	0.233	Less	0.81	0.18	3.80	115	58	3446
2halo pyrazine 3EWG	0.473	1.038	-0.092	Same	0.91	0.51	3.86	15	13	522
boron warhead	0.495	0.575	0.415	Less	0.95	0.08	7.99	1292	969	24942
diamino sulfide	0.626	0.830	0.423	Less	1.21	0.20	4.59	117	47	2927
dicarbonyl sulfonamide	0.669	0.951	0.387	Less	1.29	0.27	6.24	84	100	3476
acyl imidazole	0.688	0.918	0.459	Less	1.32	0.22	6.77	136	177	4926
oxaziridine	0.754	1.625	-0.116	Same	1.45	0.71	4.02	8	5	200
sulf D3 nitrogen	0.765	2.181	-0.650	Same	1.47	1.11	8.68	7	7	314
2halo pyridine 3EWG	0.825	0.938	0.711	Less	1.59	0.11	11.02	890	784	26422
2halo pyridine 5EWG	0.851	1.003	0.699	Same	1.64	0.15	8.79	396	430	12118
hyperval sulfur	0.853	1.134	0.571	Same	1.64	0.27	5.02	68	105	3551
halo olefin bis EWG	0.853	1.303	0.403	Same	1.64	0.43	7.53	41	51	1894
ortho hydroiminoquinone	0.870	1.611	0.130	Same	1.68	0.60	2.91	8	21	769
keto def heterocycle	0.887	1.007	0.768	Same	1.71	0.12	6.31	462	728	23358
trichloromethyl ketone	0.897	1.206	0.588	Same	1.73	0.30	5.93	67	89	3078
phosphorus phosphorus_bond	0.922	2.709	-0.866	Same	1.77	1.08	4.68	4	6	208
monofluoroacetate	0.964	1.861	0.068	Same	1.86	0.67	2.70	6	10	427
aryl phosphonate	1.011	1.205	0.817	Same	1.95	0.19	11.93	330	558	14929
cyanohydrin	1.021	1.134	0.908	Same	1.97	0.11	8.93	729	1360	39001
activated vinyl ester	1.033	1.211	0.855	Same	1.99	0.17	27.00	887	1230	37779
thio hydroxamate	1.056	1.177	0.936	Same	2.03	0.12	10.66	765	1384	32502
halo imino	1.070	1.195	0.945	Same	2.06	0.12	7.56	505	963	25345
sulfonyl heteroatom	1.077	1.358	0.795	Same	2.07	0.27	8.31	111	240	6128
activated acetylene	1.078	1.210	0.946	Same	2.07	0.13	21.81	1296	1065	28250
acyl pyrazole	1.082	1.210	0.954	Same	2.08	0.13	3.91	249	478	16274
triamide	1.083	1.381	0.786	Same	2.09	0.29	11.58	138	306	6814
crown ether	1.095	1.343	0.847	Same	2.11	0.24	14.87	253	544	11055
acyclic imide	1.113	1.223	1.003	Greater	2.14	0.11	7.49	647	1387	38824
acyl 123 triazole	1.116	1.391	0.842	Same	2.15	0.27	8.70	122	218	5960
4halo pyridine 3EWG	1.119	1.264	0.973	Same	2.15	0.14	7.80	384	679	14819
alpha dicarbonyl	1.131	1.179	1.083	Greater	2.18	0.05	12.41	5685	10151	276562
trifluoroacetate ester	1.132	1.520	0.743	Same	2.18	0.38	10.56	75	159	3891
perhalo dicarbonyl phenyl	1.141	1.628	0.654	Same	2.20	0.47	17.53	79	180	3687
trinitromethane derivative	1.156	3.696	-1.383	Same	2.23	1.76	15.51	5	10	235
alpha halo heteroatom tert	1.165	1.625	0.705	Same	2.24	0.44	10.51	54	110	2948
aldehyde	1.168	1.222	1.114	Greater	2.25	0.05	9.20	3274	6718	184922
2halo pyrimidine 5EWG	1.171	1.649	0.692	Same	2.25	0.46	11.83	56	88	2568
sulf D2 nitrogen	1.186	1.339	1.032	Greater	2.28	0.15	9.03	399	860	21443
2halo pyridazine 5EWG	1.199	3.175	-0.777	Same	2.31	1.20	5.72	4	11	317
triflate	1.208	1.505	0.911	Same	2.32	0.29	7.71	93	158	4570
flavanoid	1.226	1.460	0.992	Same	2.36	0.23	7.53	145	370	9328
non ring acetal	1.226	1.278	1.175	Greater	2.36	0.05	8.83	3490	8277	209369
rhodanine	1.230	1.297	1.164	Greater	2.37	0.07	12.16	2858	5544	120917
azide	1.261	1.381	1.141	Greater	2.43	0.12	8.24	596	1478	43755
NO phosphonate	1.261	1.938	0.585	Same	2.43	0.63	8.63	22	50	1329
perchloro_cp	1.300	1.761	0.840	Same	2.50	0.43	4.00	22	39	1258
disulfonyliminoquinone	1.304	2.531	0.077	Same	2.51	1.00	7.99	8	12	399
azo filter3	1.304	2.308	0.300	Same	2.51	0.82	5.34	8	28	743
hetero silyl	1.313	1.431	1.194	Greater	2.53	0.12	11.49	849	1276	33513
ortho quinone	1.329	2.029	0.628	Same	2.56	0.66	14.93	34	88	1734
meldrums acid_deriv	1.347	1.595	1.100	Greater	2.59	0.24	9.13	157	363	9332
sulfonyl anhydride	1.356	3.013	-0.301	Same	2.61	1.15	6.60	5	16	387
tertiary halide sulfate	1.363	1.557	1.170	Greater	2.62	0.19	21.80	606	1767	39903
trihalovinyl heteroatom	1.397	3.827	-1.033	Same	2.69	1.68	14.19	5	10	220
4 pyridone 3 5 EWG	1.404	1.884	0.924	Same	2.70	0.45	4.79	24	77	2089
sulf D2 oxygen D2	1.410	2.015	0.805	Same	2.72	0.56	6.19	20	66	1733
acyl activated NO	1.438	1.802	1.075	Greater	2.77	0.35	16.88	135	230	5846
azo filter2	1.450	1.852	1.047	Greater	2.79	0.39	14.16	93	212	4650
para hydroquinone	1.452	1.815	1.090	Greater	2.80	0.35	22.74	182	539	10029
oxime	1.460	1.602	1.318	Greater	2.81	0.14	65.97	3387	7857	205372
non_ring_CH2O_acetal	1.474	1.521	1.427	Greater	2.84	0.05	10.64	5005	13603	327205

hydrazine	1.514	1.606	1.422	Greater	2.91	0.09	11.39	1391	4296	97893
isonitrile	1.520	1.862	1.178	Greater	2.93	0.33	8.19	75	329	8332
sulfite sulfate ester	1.522	2.067	0.977	Same	2.93	0.52	12.48	46	149	3435
aziridine diazine	1.540	1.717	1.363	Greater	2.96	0.17	12.37	412	1096	24527
gte 3 COOH	1.543	1.705	1.382	Greater	2.97	0.16	15.21	609	1785	34769
acyl_134 triazole	1.547	1.882	1.212	Greater	2.98	0.33	11.43	108	336	7198
trifluoromethyl ketone	1.548	1.706	1.390	Greater	2.98	0.15	13.20	552	1251	29242
para_nitrophenyl ester	1.569	1.762	1.375	Greater	3.02	0.19	10.65	298	664	16172
phosphorus_sulfur_bond	1.590	2.029	1.152	Greater	3.06	0.43	18.84	104	295	5115
polyene	1.596	1.880	1.311	Greater	3.07	0.28	18.18	235	634	11863
thiocarbonate	1.598	1.915	1.281	Greater	3.08	0.31	40.45	420	903	16579
alpha_halo_heteroatom	1.618	1.931	1.306	Greater	3.12	0.30	14.84	160	459	10397
secondary_halide_sulfate	1.619	1.704	1.534	Greater	3.12	0.08	15.47	2225	7027	170984
azo amino	1.622	1.801	1.443	Greater	3.12	0.18	8.13	265	957	21546
trisub_bis_act_olefin	1.632	1.718	1.546	Greater	3.14	0.08	14.76	2088	5993	125465
nitro	1.634	1.916	1.353	Greater	3.15	0.27	8.06	108	369	9440
anhydride	1.638	1.796	1.481	Greater	3.15	0.15	16.56	693	1899	38200
non_ring_ketal	1.640	1.756	1.524	Greater	3.16	0.11	11.57	894	2620	60514
triaryl_phosphine_oxide	1.657	2.123	1.192	Greater	3.19	0.44	7.84	40	91	2284
betalactam_EWG	1.687	2.054	1.320	Greater	3.25	0.36	10.47	83	179	4544
HOBt ester	1.689	2.773	0.606	Same	3.25	0.98	16.47	17	70	1297
halo_acrylate	1.697	1.873	1.522	Greater	3.27	0.17	38.19	1295	1462	27374
alpha_halo_amine	1.726	2.142	1.309	Greater	3.32	0.40	13.31	82	253	5962
sulfonium	1.754	2.083	1.424	Greater	3.38	0.32	5.73	57	213	5237
azo_filter1	1.759	3.306	0.213	Same	3.39	1.07	5.75	5	17	368
CH2_S#O_3_ring	1.763	1.987	1.538	Greater	3.39	0.22	10.33	215	649	16933
polysulfide	1.774	3.221	0.328	Same	3.42	1.25	17.18	11	55	886
acrylate	1.781	1.969	1.593	Greater	3.43	0.18	36.85	1082	1343	25306
primary_halide_sulfate	1.799	1.864	1.734	Greater	3.46	0.06	13.88	3418	9934	216800
four_nitriles	1.800	2.350	1.251	Greater	3.47	0.53	14.13	51	179	3058
gte_4_basic_N	1.804	1.958	1.650	Greater	3.47	0.15	21.70	954	3594	77726
phosphorane	1.816	2.234	1.399	Greater	3.50	0.40	8.00	50	185	4405
para_quinone	1.817	2.224	1.409	Greater	3.50	0.40	17.71	113	269	4664
activated_S#O_3_ring	1.842	2.138	1.546	Greater	3.55	0.29	10.34	125	401	9161
thioester	1.862	1.987	1.736	Greater	3.58	0.12	19.99	1325	5083	95439
gte_7_aliphatic_OH	1.865	2.031	1.700	Greater	3.59	0.16	17.29	659	2758	62360
bis_activated_aryl_ester	1.886	2.283	1.490	Greater	3.63	0.39	24.92	167	275	5933
ortho_nitrophenyl_carbonyl	1.935	2.287	1.584	Greater	3.73	0.34	24.34	207	389	8097
gte_2_free_phos	1.962	2.110	1.815	Greater	3.78	0.14	8.52	409	1537	33659
benzidine_like	1.981	6.062	-2.101	Same	3.81	3.06	56.06	6	33	228
activated_diazo	2.005	3.638	0.372	Same	3.86	1.36	16.72	9	33	749
quat_N_acyl	2.023	2.820	1.225	Greater	3.89	0.73	10.75	20	49	1195
nitrosamine	2.033	2.344	1.721	Greater	3.91	0.30	15.49	168	304	7437
aryl_thiocarbonyl	2.034	2.131	1.937	Greater	3.92	0.10	9.21	1020	2267	46757
hydrazothiourea	2.035	4.601	-0.531	Same	3.92	1.92	22.16	6	42	659
halo_phenolic_carbonyl	2.055	3.277	0.833	Same	3.96	1.16	52.65	39	45	1052
gte_8_CF2_or_CH2	2.058	2.134	1.983	Greater	3.96	0.07	24.25	4468	15473	267646
diazo_carbonyl	2.073	2.538	1.609	Greater	3.99	0.45	12.62	63	193	4695
2halo_pyridazine_3EWG	2.083	3.446	0.719	Same	4.01	1.30	67.35	40	12	389
gte_10_carbon_sb_chain	2.084	2.164	2.004	Greater	4.01	0.08	24.81	4039	14053	244496
linear_polycyclic_aromatic_I	2.115	2.747	1.484	Greater	4.07	0.61	31.78	85	357	5839
beta_lactone	2.122	3.045	1.199	Greater	4.08	0.85	15.24	21	90	1484
alpha_halo_carbonyl	2.135	2.229	2.040	Greater	4.11	0.09	14.45	1697	5797	129803
phosphorous_nitrogen_bond	2.164	2.399	1.930	Greater	4.17	0.23	15.96	304	1292	23292
gte_2_N_quats	2.189	2.332	2.045	Greater	4.21	0.14	16.04	812	3840	72404
betalactam	2.202	2.237	2.167	Greater	4.24	0.03	12.89	11175	61954	1302755
peroxide	2.215	3.067	1.363	Greater	4.26	0.79	15.08	24	79	1544
perhalo_phenyl	2.218	3.009	1.428	Greater	4.27	0.76	38.36	66	266	4125
paraquat_like	2.220	3.377	1.063	Greater	4.27	1.05	18.77	17	83	1459
phosphite	2.239	2.968	1.511	Greater	4.31	0.70	20.78	43	167	3276
ortho_hydroquinone	2.258	2.360	2.157	Greater	4.35	0.10	8.08	822	2481	49502
maleimide_etc	2.281	2.547	2.015	Greater	4.39	0.26	30.10	443	1457	24355
azo_aryl	2.301	2.439	2.162	Greater	4.43	0.14	27.01	1464	5552	85581
bad_cations	2.391	2.872	1.910	Greater	4.60	0.46	15.28	71	362	6798
linear_polycyclic_aromatic_II	2.458	2.826	2.091	Greater	4.73	0.36	19.87	155	523	7913
quat_N_N	2.489	2.744	2.234	Greater	4.79	0.25	18.38	296	1771	32465
sulfonyl_halide	2.612	3.244	1.981	Greater	5.03	0.61	23.29	63	238	3592
gte_7_total_hal	2.705	3.728	1.682	Greater	5.21	0.99	83.35	85	405	4180
trinitro_aromatic	2.886	3.322	2.450	Greater	5.56	0.42	15.86	89	468	8091
para_hydroiminoquinone	2.906	4.477	1.336	Greater	5.60	1.41	29.82	15	75	983
carbonyl_halide	2.971	3.505	2.438	Greater	5.72	0.51	17.73	67	320	4979
carbodiimide_iso#thio#cyanate	2.994	3.294	2.695	Greater	5.76	0.29	17.77	208	1521	23032
phosphonium	3.039	3.366	2.712	Greater	5.85	0.32	17.06	168	1231	19336
gte_4_nitro	3.055	3.846	2.263	Greater	5.88	0.77	54.09	92	300	4550
gte_2_sulfonic_acid	3.256	3.593	2.919	Greater	6.27	0.33	50.30	463	2930	32238

bis_keto_olefin	3.317	4.088	2.547	Greater	6.39	0.74	27.81	51	285	4071
disulfide_acyclic	3.393	3.708	3.078	Greater	6.53	0.31	33.88	356	2084	28513
bad_boron	3.480	4.148	2.812	Greater	6.70	0.64	20.03	49	369	4719
thiopyrylium	3.584	5.077	2.091	Greater	6.90	1.12	7.50	6	49	645
gte_3_iodine	3.613	4.299	2.928	Greater	6.96	0.67	121.31	270	1554	14603
polyhalo_phenol_b	3.723	4.255	3.192	Greater	7.17	0.52	34.73	130	1111	13033
branched_polycyclic_aromatic	3.729	3.905	3.553	Greater	7.18	0.17	21.66	729	6769	78774
gte_5_phenolic_OH	3.768	4.599	2.937	Greater	7.25	0.80	42.32	66	479	4536
oxonium	3.877	4.100	3.655	Greater	7.46	0.22	18.99	401	2726	34941
halogen_heteroatom	3.905	4.289	3.521	Greater	7.52	0.38	52.33	371	2633	28959
diazonium	3.989	5.291	2.687	Greater	7.68	1.22	43.44	29	254	2890
porphyrin	4.308	6.465	2.152	Greater	8.29	1.94	56.20	15	152	1459
contains_metal	4.423	4.731	4.116	Greater	8.52	0.30	50.63	559	4511	44047
polyhalo_phenol_a	4.515	12.280	-3.251	Same	8.69	4.70	88.27	4	81	512
thio_xanthate	4.682	5.493	3.870	Greater	9.01	0.78	31.47	52	705	6384
thiosulfoxide	4.918	8.037	1.800	Greater	9.47	2.34	32.72	6	68	699
polyhalo_phenol_c	5.949	9.066	2.831	Greater	11.45	2.78	108.05	14	172	1114
quinone_methide	6.913	7.979	5.847	Greater	13.31	1.04	172.64	160	1162	8488
polyhalo_phenol_d	9.842	11.998	7.685	Greater	18.95	2.05	168.51	40	955	3824
4halo_pyrimidine_2_6EWG					0.00			1	0	24
azo_filter4					2.70			1	3	108
halo_phenolic_sulfonyl					1.40	1.40	3.91	2	4	163
phos_serine_warhead					0.00	0.00	0.00	3	0	37
phos_threonine_warhead					0.00	0.00	0.00	2	0	11
phos_tyrosine_warhead					0.00			1	0	4
sulphonyl_cyanide					0.00			1	0	25
trifluoroacetate_thioester					0.00			1	0	25

Promiscuity Ratio Index (PRI) = [Mean % Active Flagged Assays] / [[Mean % Active Non-Flagged Assays] = 1.925% HTS]

Table 3. Statistical Analysis of the Promiscuity Strength Index (PSI)

Functional Group Filter	N Actives	PSI	Stderr2	t Value	Pr > t	Rule Class From HTS Benchmark
2halo_pyrazine_5EWG	4	1.00	0.000	-1.572	0.116	Same
2halo_pyridazine_3EWG	11	1.09	0.091	-2.504	0.012	Less
diamino_sulfide	31	1.52	0.285	-3.391	0.001	Less
oxaziridine	3	1.67	0.333	-0.965	0.334	Same
vinyl_carbonyl_EWG	3	1.67	0.333	-0.965	0.334	Same
azo_filter4	1	2.00				
halo_5heterocycle_bis_EWG	1	2.00				
monofluoroacetate	4	2.00	0.408	-0.886	0.376	Same
pentafluorophenylester	2	2.00				
phosphorus_phosphorus_bond	2	2.00				
nitrosamine	133	2.12	0.147	-4.633	0.000	Less
perchloro_cp	17	2.24	0.304	-1.494	0.135	Same
activated_acetylene	420	2.34	0.117	-6.701	0.000	Less
disulfonyliminoquinone	5	2.40	0.600	-0.684	0.494	Same
tris_activated_aryl_ester	3	2.67	0.882	-0.371	0.710	Same
bis_activated_aryl_ester	99	2.69	0.260	-2.063	0.039	Less
acrylate	468	2.71	0.104	-4.287	0.000	Less
2halo_pyridine_3EWG	268	2.72	0.156	-3.208	0.001	Less
halo_acrylate	503	2.73	0.112	-4.290	0.000	Less
acyl_cyanide	4	2.75	0.479	-0.371	0.710	Same
acyl_pyrazole	164	2.76	0.149	-2.325	0.020	Less
alpha_halo_EWG	20	2.85	0.582	-0.677	0.498	Same
triflate	52	2.87	0.314	-1.054	0.292	Same
aryl_thiocarbonyl	772	2.87	0.080	-4.011	0.000	Less
ortho_nitrophenyl_carbonyl	128	2.94	0.226	-1.374	0.170	Same
hetero_silyl	403	3.01	0.108	-1.904	0.057	Same
4halo_pyrimidine_5EWG	26	3.12	0.585	-0.308	0.758	Same
halo_olefin_bis_EWG	16	3.13	0.523	-0.228	0.819	Same
trichloromethyl_ketone	28	3.14	0.352	-0.270	0.787	Same
acyl_activated_NO	69	3.16	0.259	-0.376	0.707	Same
hyperval_sulfur	29	3.24	0.402	-0.093	0.926	Same
para_nitrophenyl_ester	197	3.24	0.218	-0.230	0.818	Same
activated_vinyl_sulfonate	4	3.25	1.652	-0.028	0.977	Same
betalactam_EWG	52	3.25	0.285	-0.103	0.918	Same
2halo_pyridine_5EWG	127	3.25	0.323	-0.153	0.879	Same
quat_N_acyl	15	3.27	0.539	-0.033	0.974	Same
triaryl_phosphine_oxide	26	3.31	0.463	0.028	0.977	Same
ortho_hydroquinone	722	3.35	0.103	0.543	0.587	Same
acyl_123_triazole	59	3.36	0.335	0.170	0.865	Same
halo_phenolic_carbonyl	13	3.46	1.113	0.210	0.833	Same
2halo_pyrimidine_5EWG	24	3.50	0.654	0.350	0.726	Same
sulf_D3_nitrogen	2	3.50				
keto_def_heterocycle	197	3.53	0.200	1.163	0.245	Same
alpha_dicarbonyl	2683	3.59	0.063	5.207	0.000	Greater
diazo_carbonyl	52	3.60	0.480	0.754	0.451	Same
CH2_S#O_3_ring	169	3.63	0.231	1.497	0.134	Same
hydroxamate_warhead	632	3.67	0.169	3.227	0.001	Greater
2halo_pyridazine_5EWG	3	3.67	2.186	0.223	0.824	Same
aldehyde	1707	3.71	0.083	5.884	0.000	Greater
4halo_pyridine_3EWG	176	3.72	0.270	1.931	0.053	Same
azide	368	3.72	0.161	2.819	0.005	Greater
trifluoromethyl_ketone	318	3.74	0.131	2.737	0.006	Greater
alpha_halo_carbonyl	1430	3.79	0.089	6.393	0.000	Greater
halo_imino	233	3.81	0.244	2.720	0.007	Greater
acyclic_imide	338	3.83	0.178	3.366	0.001	Greater
NO_phosphonate	12	3.83	1.160	0.644	0.520	Same
activated_vinyl_ester	293	3.88	0.203	3.478	0.001	Greater
gte_7_aliphatic_OH	542	3.89	0.137	4.801	0.000	Greater
alpha_halo_amine	59	3.90	0.464	1.599	0.110	Same
aryl_phosphonate	131	3.93	0.326	2.512	0.012	Greater
meldrums_acid_deriv	90	3.93	0.287	2.089	0.037	Greater
primary_halide_sulfate	2330	3.94	0.069	10.640	0.000	Greater
activated_S#O_3_ring	96	3.98	0.284	2.311	0.021	Greater
2halo_pyrazine_3EWG	3	4.00	2.082	0.421	0.674	Same
activated_diazo	7	4.00	1.069	0.643	0.520	Same
halo_phenolic_sulfonyl	1	4.00				
acyl_imidazole	42	4.02	0.770	1.628	0.104	Same
dicarbonyl_sulfonamide	23	4.04	0.670	1.237	0.216	Same
cyanohydrin	310	4.05	0.222	4.608	0.000	Greater
gte_2_free_phos	350	4.06	0.235	4.946	0.000	Greater
alpha_halo_heteroatom	102	4.07	0.363	2.692	0.007	Greater
sulf_D2_nitrogen	195	4.10	0.253	3.860	0.000	Greater

nitro	85	4.11	0.387	2.575	0.010	Greater
non_ring_acetal	1890	4.13	0.084	12.414	0.000	Greater
para_quinone	62	4.13	0.450	2.262	0.024	Greater
peroxide	18	4.17	0.579	1.274	0.203	Same
rhodanine	1285	4.17	0.092	10.809	0.000	Greater
non_ring_CH2O_acetal	3082	4.18	0.062	16.834	0.000	Greater
non_ring_ketal	583	4.19	0.142	7.468	0.000	Greater
ortho_hydroiminoquinone	5	4.20	1.158	0.697	0.486	Same
aziridine_diazirine	240	4.22	0.245	4.937	0.000	Greater
gte_4_basic_N	673	4.23	0.146	8.385	0.000	Greater
azo_filter1	4	4.25	2.287	0.658	0.511	Same
sulfonium	47	4.26	0.359	2.267	0.023	Greater
sulfonyl_heteroatom	50	4.26	0.475	2.349	0.019	Greater
secondary_halide_sulfate	1535	4.28	0.096	13.287	0.000	Greater
thio_hydroxamate	296	4.32	0.278	6.071	0.000	Greater
phosphorane	40	4.33	0.449	2.242	0.025	Greater
gte_4_nitro	63	4.35	0.404	2.880	0.004	Greater
linear_polycyclic_aromatic_II	112	4.36	0.460	3.868	0.000	Greater
anhydride	390	4.37	0.190	7.296	0.000	Greater
oxime	1678	4.38	0.087	15.300	0.000	Greater
trifluoroacetate_ester	35	4.40	0.713	2.250	0.024	Greater
4_pyridone_3_5_EWG	17	4.47	0.576	1.668	0.095	Same
alpha_halo_heteroatom_tert	23	4.48	0.586	1.952	0.051	Same
boron_warhead	197	4.49	0.298	5.755	0.000	Greater
azo_filter2	45	4.49	0.399	2.755	0.006	Greater
trisub_bis_act_olefin	1242	4.50	0.096	14.546	0.000	Greater
trinitromethane_derivative	2	4.50				
flavonoid	78	4.53	0.352	3.739	0.000	Greater
thiol_warhead	47	4.55	0.579	2.967	0.003	Greater
thiocarbonate	187	4.59	0.358	6.105	0.000	Greater
sulfite_sulfate_ester	29	4.69	0.938	2.583	0.010	Greater
hydrazine	854	4.72	0.129	14.312	0.000	Greater
ortho_quinone	18	4.72	1.464	2.082	0.037	Greater
azo_amino	189	4.74	0.319	6.807	0.000	Greater
polyene	126	4.75	0.365	5.600	0.000	Greater
carbonyl_halide	58	4.90	0.490	4.193	0.000	Greater
sulf_D2_oxygen_D2	13	4.92	0.655	2.018	0.044	Greater
triamide	60	4.93	0.813	4.361	0.000	Greater
phosphite	32	4.94	0.616	3.194	0.001	Greater
acyl_134_triazole	64	4.95	0.553	4.559	0.000	Greater
sulfonyl_halide	45	4.96	0.511	3.829	0.000	Greater
phosphorous_nitrogen_bond	235	5.00	0.272	8.958	0.000	Greater
activated_4mem_ring	3	5.00	1.528	1.015	0.310	Same
four_nitriles	32	5.00	0.672	3.315	0.001	Greater
sulfonyl_anhydride	3	5.00	1.528	1.015	0.310	Same
trihalovinyl_heteroatom	2	5.00				
gte_3_COOH	334	5.02	0.236	10.834	0.000	Greater
maleimide_etc	270	5.05	0.265	9.917	0.000	Greater
paraquat_like	15	5.07	2.015	2.358	0.018	Greater
trinitro_aromatic	85	5.07	0.350	5.626	0.000	Greater
gte_10_carbon_sb_chain	2541	5.11	0.096	31.260	0.000	Greater
gte_8_CF2_or_CH2	2781	5.15	0.093	33.269	0.000	Greater
tertiary_halide_sulfate	321	5.16	0.385	11.437	0.000	Greater
phosphorus_sulfur_bond	51	5.22	0.616	4.713	0.000	Greater
azo_aryl	1003	5.27	0.210	21.391	0.000	Greater
bad_cations	64	5.28	0.587	5.460	0.000	Greater
thioester	852	5.42	0.168	21.261	0.000	Greater
gte_2_N_quats	651	5.45	0.183	18.860	0.000	Greater
disulfide_acyclic	323	5.54	0.241	13.825	0.000	Greater
azo_filter3	5	5.60	1.631	1.771	0.077	Same
isonitrile	52	5.71	0.480	5.986	0.000	Greater
crown_ether	85	5.78	0.532	7.857	0.000	Greater
betalactam	9972	5.87	0.048	85.755	0.000	Greater
beta_lactone	14	5.93	1.035	3.385	0.001	Greater
perhalo_dicarbonyl_phenyl	27	6.15	0.913	5.092	0.000	Greater
para_hydroquinone	80	6.18	0.505	8.846	0.000	Greater
linear_polycyclic_aromatic_I	53	6.30	0.735	7.517	0.000	Greater
bis_keto_olefin	43	6.40	0.594	6.982	0.000	Greater
quat_N_N	261	6.47	0.292	17.589	0.000	Greater
perhalo_phenyl	36	6.50	0.913	6.603	0.000	Greater
oxonium	385	6.51	0.225	21.673	0.000	Greater
para_hydroiminoquinone	11	6.55	1.364	3.702	0.000	Greater
HOBT_ester	9	6.78	2.448	3.588	0.000	Greater
phosphonium	159	6.92	0.396	15.680	0.000	Greater

bad_boron	46	7.02	0.715	8.678	0.000	Greater
carbodiimide_iso#thio#cyanate	196	7.19	0.390	18.704	0.000	Greater
thiopyrylium	6	7.33	1.606	3.396	0.001	Greater
halogen_heteroatom	317	7.64	0.391	26.512	0.000	Greater
polysulfide	6	7.67	2.124	3.676	0.000	Greater
gte_7_total_hal	45	7.78	1.499	10.318	0.000	Greater
contains_metal	512	8.13	0.312	37.446	0.000	Greater
gte_2_sulfonic_acid	340	8.16	0.495	30.718	0.000	Greater
polyhalo_phenol_b	114	8.56	0.594	19.291	0.000	Greater
gte_3_iodine	161	8.69	0.768	23.452	0.000	Greater
hydrazothiourea	4	9.00	3.582	3.916	0.000	Greater
gte_5_phenolic_OH	50	9.02	1.200	13.889	0.000	Greater
quinone_methide	118	9.10	1.007	21.614	0.000	Greater
diazonium	26	9.38	1.384	10.656	0.000	Greater
branched_polycyclic_aromatic	655	9.49	0.232	54.305	0.000	Greater
thiosulfoxide	6	11.00	2.769	6.477	0.000	Greater
polyhalo_phenol_c	12	11.92	2.661	10.248	0.000	Greater
porphyrin	12	12.42	2.244	10.843	0.000	Greater
thio_xanthate	45	14.78	1.088	26.425	0.000	Greater
benzidine_like	2	16.00				
polyhalo_phenol_a	3	17.33	8.172	8.343	0.000	Greater
polyhalo_phenol_d	37	23.30	2.401	41.705	0.000	Greater

Promiscuity Strength Index (PSI) = Mean of the Number of Active Assays = 3.29 ± 0.004 SE for HTS Benchmark

Table 4. Summary Table of Functional Group Query Promiscuity Linkages

Functional Group Filter	PRI	PRI Class	PSI	PSI Class	% Pass SI	Cmpds Tested SI	Linkage
4halo_pyrimidine_2_6EWG	0	NA	3.12	Same	NA	NA	NR
phos_serine_warhead	0	NA	NA	NA	NA	NA	NR
phos_threonine_warhead	0	NA	NA	NA	NA	NA	NR
phos_tyrosine_warhead	0	NA	NA	NA	NA	NA	NR
sulphonyl_cyanide	0	NA	NA	NA	NA	NA	NR
trifluoroacetate_thioester	0	NA	NA	NA	NA	NA	NR
2halo_pyrazine_5EWG	0.11	Less	1.00	Same	0	10	LOW
activated_4mem_ring	0.15	Less	5.00	Same	0	7	LOW
halo_5heterocycle_bis_EWG	0.19	Less	2.00	NA	31	13	NR
hydroxamate_warhead	0.24	Less	3.67	Greater	72	726	MED
thiol_warhead	0.27	Less	4.55	Greater	NA	NA	MED
tris_activated_aryl_ester	0.32	Less	2.67	Same	18	11	LOW
activated_vinyl_sulfonate	0.36	Less	3.25	Same	30	10	LOW
acyl_cyanide	0.36	Less	2.75	Same	10	10	LOW
pentafluorophenylester	0.37	Same	2.00	NA	13	8	NR
vinyl_carbonyl_EWG	0.38	Less	1.67	Same	0	6	LOW
4halo_pyrimidine_5EWG	0.4	Less	3.12	Same	0	10	LOW
alpha_halo_EWG	0.42	Less	2.85	Same	18	11	LOW
2halo_pyrazine_3EWG	0.47	Same	4.00	Same	67	9	MED
boron_warhead	0.5	Less	4.49	Greater	21	14	MED
diamino_sulfide	0.63	Less	1.52	Less	10	10	LOW
dicarbonyl_sulfonamide	0.67	Less	4.04	Same	0	10	LOW

acyl_imidazole	0.69	Less	4.02	Same	0	6	LOW
halo_phenolic_sulfonyl	0.73		4.00	NA	NA	NA	NR
oxaziridine	0.75	Same	1.67	Same	43	7	MED
sulf_D3_nitrogen	0.77	Same	3.50	NA	29	7	NR
2halo_pyridine_3EWG	0.82	Less	2.72	Less	56	16	LOW
2halo_pyridine_5EWG	0.85	Same	3.25	Same	75	20	MED
halo_olefin_bis_EWG	0.85	Same	3.13	Same	20	10	MED
hyperval_sulfur	0.85	Same	3.24	Same	0	2	MED
ortho_hydroiminoquinone	0.87	Same	4.20	Same	NA	NA	MED
keto_def_heterocycle	0.89	Same	3.53	Same	60	10	MED
trichloromethyl_ketone	0.9	Same	3.14	Same	NA	NA	MED
phosphorus_phosphorus_bond	0.92	Same	2.00	NA	0	3	NR
monofluoroacetate	0.96	Same	2.00	Same	100	1	MED
All HTS Data	1.00	NA	3.29	NA	73	46636	NA
aryl_phosphonate	1.01	Same	3.93	Greater	53	17	HIGH
cyanohydrin	1.02	Same	4.05	Greater	39	18	HIGH
activated_vinyl_ester	1.03	Same	3.88	Greater	11	27	HIGH
thio_hydroxamate	1.06	Same	4.32	Greater	35	51	HIGH
halo_imino	1.07	Same	3.81	Greater	38	32	HIGH
activated_acetylene	1.08	Same	2.34	Less	58	19	LOW
acyl_pyrazole	1.08	Same	2.76	Less	14	14	LOW
sulfonyl_heteroatom	1.08	Same	4.26	Greater	42	12	HIGH
triamide	1.08	Same	4.93	Greater	30	10	HIGH
crown_ether	1.09	Same	5.78	Greater	NA	NA	HIGH
acyclic_imide	1.11	Greater	3.83	Greater	41	27	HIGH
4halo_pyridine_3EWG	1.12	Same	3.72	Same	57	21	MED
acyl_123_triazole	1.12	Same	3.36	Same	0	11	MED
alpha_dicarbonyl	1.13	Greater	3.59	Greater	80	463	HIGH
trifluoroacetate_ester	1.13	Same	4.40	Greater	8	13	HIGH
perhalo_dicarbonyl_phenyl	1.14	Same	6.15	Greater	10	10	HIGH
trinitromethane_derivative	1.16	Same	4.50	NA	NA	NA	NR
2halo_pyrimidine_5EWG	1.17	Same	3.50	Same	69	13	MED
aldehyde	1.17	Greater	3.71	Greater	54	61	HIGH
alpha_halo_heteroatom_tert	1.17	Same	4.48	Same	10	10	MED
sulf_D2_nitrogen	1.19	Greater	4.10	Greater	30	20	HIGH
2halo_pyridazine_5EWG	1.2	Same	3.67	Same	NA	NA	MED
triflate	1.21	Same	2.87	Same	41	17	MED
flavanoid	1.23	Same	4.53	Greater	NA	NA	HIGH
non_ring_acetal	1.23	Greater	4.13	Greater	63	57	HIGH
rhodanine	1.23	Greater	4.17	Greater	61	878	HIGH
azide	1.26	Greater	3.72	Greater	67	6	HIGH
NO_phosphonate	1.26	Same	3.83	Same	22	9	MED
azo_filter3	1.3	Same	5.60	Same	NA	NA	MED
disulfonyliminoquinone	1.3	Same	2.40	Same	0	6	MED

perchloro_cp	1.3	Same	2.24	Same	NA	NA	MED
hetero_silyl	1.31	Greater	3.01	Same	43	30	HIGH
ortho_quinone	1.33	Same	4.72	Greater	24	38	HIGH
meldrums_acid_deriv	1.35	Greater	3.93	Greater	27	11	HIGH
sulfonyl_anhydride	1.36	Same	5.00	Same	0	5	MED
tertiary_halide_sulfate	1.36	Greater	5.16	Greater	32	25	HIGH
4_pyridone_3_5_EWG	1.4	Same	4.47	Same	20	10	MED
azo_filter4	1.4		2.00	NA	NA	NA	NR
trihalovinyl_heteroatom	1.4	Same	5.00	NA	NA	NA	NR
sulf_D2_oxygen_D2	1.41	Same	4.92	Greater	10	10	HIGH
acyl_activated_NO	1.44	Greater	3.16	Same	14	14	HIGH
azo_filter2	1.45	Greater	4.49	Greater	80	10	HIGH
para_hydroquinone	1.45	Greater	6.18	Greater	50	12	HIGH
oxime	1.46	Greater	4.38	Greater	68	37	HIGH
non_ring_CH2O_acetal	1.47	Greater	4.18	Greater	37	123	HIGH
hydrazine	1.51	Greater	4.72	Greater	44	25	HIGH
isonitrile	1.52	Greater	5.71	Greater	NA	NA	HIGH
sulfite_sulfate_ester	1.52	Same	4.69	Greater	10	10	HIGH
aziridine_diazirine	1.54	Greater	4.22	Greater	36	14	HIGH
gte_3_COOH	1.54	Greater	5.02	Greater	29	14	HIGH
acyl_134_triazole	1.55	Greater	4.95	Greater	50	12	HIGH
trifluoromethyl_ketone	1.55	Greater	3.74	Greater	76	21	HIGH
para_nitrophenyl_ester	1.57	Greater	3.24	Same	29	14	HIGH
phosphorus_sulfur_bond	1.59	Greater	5.22	Greater	22	9	HIGH
polyene	1.6	Greater	4.75	Greater	9	11	HIGH
thiocarbonate	1.6	Greater	4.59	Greater	7	29	HIGH
alpha_halo_heteroatom	1.62	Greater	4.07	Greater	5	20	HIGH
azo_amino	1.62	Greater	4.74	Greater	75	4	HIGH
secondary_halide_sulfate	1.62	Greater	4.28	Greater	15	54	HIGH
nitron	1.63	Greater	4.11	Greater	0	3	HIGH
trisub_bis_act_olefin	1.63	Greater	4.50	Greater	39	74	HIGH
anhydride	1.64	Greater	4.37	Greater	22	18	HIGH
non_ring_ketal	1.64	Greater	4.19	Greater	56	27	HIGH
triaryl_phosphine_oxide	1.66	Greater	3.31	Same	100	1	HIGH
betalactam_EWG	1.69	Greater	3.25	Same	38	13	HIGH
HOBT_ester	1.69	Same	6.78	Greater	0	10	HIGH
halo_acrylate	1.7	Greater	2.73	Less	52	25	MED
alpha_halo_amine	1.73	Greater	3.90	Same	6	17	HIGH
sulfonium	1.75	Greater	4.26	Greater	100	3	HIGH
azo_filter1	1.76	Same	4.25	Same	NA	NA	MED
CH2_S#O_3_ring	1.76	Greater	3.63	Same	50	12	HIGH
polysulfide	1.77	Same	7.67	Greater	20	5	HIGH
acrylate	1.78	Greater	2.71	Less	71	14	MED
four_nitriles	1.8	Greater	5.00	Greater	NA	NA	HIGH

gte_4_basic_N	1.8	Greater	4.23	Greater	35	20	HIGH
primary_halide_sulfate	1.8	Greater	3.94	Greater	35	49	HIGH
para_quinone	1.82	Greater	4.13	Greater	35	26	HIGH
phosphorane	1.82	Greater	4.33	Greater	0	1	HIGH
activated_S#O_3_ring	1.84	Greater	3.98	Greater	29	14	HIGH
thioester	1.86	Greater	5.42	Greater	26	35	HIGH
gte_7_aliphatic_OH	1.87	Greater	3.89	Greater	24	21	HIGH
bis_activated_aryl_ester	1.89	Greater	2.69	Less	17	12	MED
ortho_nitrophenyl_carbonyl	1.94	Greater	2.94	Same	17	12	HIGH
gte_2_free_phos	1.96	Greater	4.06	Greater	25	8	HIGH
benzidine_like	1.98	Same	16.00	NA	NA	NA	NR
activated_diazo	2.01	Same	4.00	Same	11	9	MED
quat_N_acyl	2.02	Greater	3.27	Same	10	10	HIGH
aryl_thiocarbonyl	2.03	Greater	2.87	Less	20	20	MED
hydrazothiurea	2.03	Same	9.00	Greater	NA	NA	HIGH
nitrosamine	2.03	Greater	2.12	Less	NA	NA	MED
halo_phenolic_carbonyl	2.05	Same	3.46	Same	6	18	MED
gte_8_CF2_or_CH2	2.06	Greater	5.15	Greater	62	81	HIGH
diazo_carbonyl	2.07	Greater	3.60	Same	30	10	HIGH
2halo_pyridazine_3EWG	2.08	Same	1.09	Less	30	10	LOW
gte_10_carbon_sb_chain	2.08	Greater	5.11	Greater	53	66	HIGH
beta_lactone	2.12	Greater	5.93	Greater	27	11	HIGH
linear_polycyclic_aromatic_I	2.12	Greater	6.30	Greater	0	3	HIGH
alpha_halo_carbonyl	2.13	Greater	3.79	Greater	19	26	HIGH
phosphorous_nitrogen_bond	2.16	Greater	5.00	Greater	36	11	HIGH
gte_2_N_quats	2.19	Greater	5.45	Greater	14	7	HIGH
betalactam	2.2	Greater	5.87	Greater	27	184	HIGH
peroxide	2.21	Greater	4.17	Same	0	11	HIGH
paraquat_like	2.22	Greater	5.07	Greater	0	2	HIGH
perhalo_phenyl	2.22	Greater	6.50	Greater	0	5	HIGH
phosphite	2.24	Greater	4.94	Greater	0	1	HIGH
ortho_hydroquinone	2.26	Greater	3.35	Same	83	18	HIGH
maleimide_etc	2.28	Greater	5.05	Greater	25	67	HIGH
azo_aryl	2.3	Greater	5.27	Greater	53	94	HIGH
bad_cations	2.39	Greater	5.28	Greater	0	1	HIGH
linear_polycyclic_aromatic_II	2.46	Greater	4.36	Greater	25	4	HIGH
quat_N_N	2.49	Greater	6.47	Greater	67	6	HIGH
sulfonyl_halide	2.61	Greater	4.96	Greater	9	11	HIGH
gte_7_total_hal	2.71	Greater	7.78	Greater	40	5	HIGH
trinitro_aromatic	2.89	Greater	5.07	Greater	100	1	HIGH
para_hydroiminoquinone	2.91	Greater	6.55	Greater	0	1	HIGH
carbonyl_halide	2.97	Greater	4.90	Greater	0	11	HIGH
carbodiimide_iso#thio#cyanate	2.99	Greater	7.19	Greater	0	14	HIGH
phosphonium	3.04	Greater	6.92	Greater	NA	NA	HIGH

gte_4_nitro	3.05	Greater	4.35	Greater	NA	NA	HIGH
gte_2_sulfonic_acid	3.26	Greater	8.16	Greater	35	46	HIGH
bis_keto_olefin	3.32	Greater	6.40	Greater	12	17	HIGH
disulfide_acyclic	3.39	Greater	5.54	Greater	40	15	HIGH
bad_boron	3.48	Greater	7.02	Greater	25	4	HIGH
thiopyrylium	3.58	Greater	7.33	Greater	NA	NA	HIGH
gte_3_iodine	3.61	Greater	8.69	Greater	0	5	HIGH
polyhalo_phenol_b	3.72	Greater	8.56	Greater	78	27	HIGH
branched_polycyclic_aromatic	3.73	Greater	9.49	Greater	50	22	HIGH
gte_5_phenolic_OH	3.77	Greater	9.02	Greater	17	12	HIGH
oxonium	3.88	Greater	6.51	Greater	6	18	HIGH
halogen_heteroatom	3.9	Greater	7.64	Greater	23	26	HIGH
diazonium	3.99	Greater	9.38	Greater	0	3	HIGH
porphyrin	4.31	Greater	12.42	Greater	0	1	HIGH
contains_metal	4.42	Greater	8.13	Greater	35	20	HIGH
polyhalo_phenol_a	4.51	Same	17.33	Greater	100	1	HIGH
thio_xanthate	4.68	Greater	14.78	Greater	33	3	HIGH
thiosulfoxide	4.92	Greater	11.00	Greater	0	2	HIGH
polyhalo_phenol_c	5.95	Greater	11.92	Greater	100	2	HIGH
quinone_methide	6.91	Greater	9.10	Greater	29	21	HIGH
polyhalo_phenol_d	9.84	Greater	23.30	Greater	25	4	HIGH

Table sorted on PRI. NA = not available. Linkage Ranking: HIGH if both PRI / PSI greater, or one greater and one same = 112, MED if both PRI / PSI same, or one greater & one less = 32, LOW if both PRI / PSI less, or one same and one less = 16, Not Rated (NR) if PRI or PSI not classed = 14.

Functional Group SMARTS.

```
[#7;R1]1[#6]([F,Cl,Br,I])[#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#7][#6][#6]1 2halo_pyrazine_3EWG
[#7;R1]1[#6]([F,Cl,Br,I])[#6;!$(c-N)][#7][#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#6;!$(c-N)]1 2halo_pyrazine_5EWG
[#7;R1]1[#6]([F,Cl,Br,I])[#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#6][#6][#7]1 2halo_pyridazine_3EWG
[#7;R1]1[#6]([F,Cl,Br,I])[#6][#6][#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#7]1 2halo_pyridazine_5EWG
[#7;R1]1[#6;!$(c=O)]([F,Cl,Br,I])[#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#6;!$(c-N)][#6][#6;!$(c-N)]1 2halo_pyridine_3EWG
[#7;R1]1[#6;!$(c=O)]([F,Cl,Br,I])[#6][#6;!$(c-N)][#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#6;!$(c=O);!$(c-N)]1 2halo_pyridine_5EWG
[#7;R1]1[#6]([F,Cl,Br,I])[#7][#6][#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#6]1 2halo_pyrimidine_5EWG
[#7;R1]1[#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#6]([F,Cl,Br,I])[#6][#6][#7]1 3halo_pyridazine_2EWG
[#7;R1]1[#6][#6]([F,Cl,Br,I])[#6]([$(S(=O)(=O)),$(C(F)(F)(F)),$(C#N),$N(=O)=O,$([N+](=O)[O-]),$(C=O)))[#6][#7]1 3halo_pyridazine_4EWG
```

[#7,#8,#16]1~[#6;H]~[#6]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C=O))~[#6](=O)~[#6]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C=O))~[#6;H]1 4_pyridone_3_5_EWG
 [#7;R1]1[#6;!\$(c=O);!\$(c-N)][#6]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C=O))~[#6]([F,Cl,Br,I])~[#6]!\$(c=O);!\$(c-N)1 4halo_pyridine_3EWG
 [#7]1[#6]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C=O))~[#7;R1]1[#6]([F,Cl,Br,I])~[#6]1([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C=O))~[#7;R1]1 4halo_pyrimidine_2_6EWG
 [#7]1[#6]1[#7;R1]1[#6]([F,Cl,Br,I])~[#6]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C=O))~[#6]1 4halo_pyrimidine_5EWG
 [CH2]1[O,S]C1 CH2_S#O_3_ring
 O=C(-[!N])O[\$(nnn),\$([#7]-[#7]=[#7])] HOBT_ester
 P(=O)ON NO_phosphonate
 [CH2]=[C;!\$(C-N);!\$(C-O)]C(=O) acrylate
 [#6]1~[\$(C(=O)),\$(S(=O))~[O,S,N]~[\$(C(=O)),\$(S(=O))]1 activated_4mem_ring
 C1~[O,S]~[C,N,O,S]1[a,N,O,S] activated_S#O_3_ring
 [\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O))]C#C[!\$(C-N);!\$(C-n)] activated_acetylene
 [N;!R]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O))~[N;!R]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O))] activated_diazo
 O=COC=[\$(C(S(=O)(=O))),\$(C(C(F)(F)(F))),\$(C(C#N)),\$(C(N(=O)(=O))),\$(C([N+](=O)[O-]),\$(C(C(=O))))!\$(C(N)) activated_vinyl_ester
 O(-S(=O)(=O))C=[\$(C(S(=O)(=O))),\$(C(C(F)(F)(F))),\$(C(C#N)),\$(C(N(=O)(=O))),\$(C([N+](=O)[O-]),\$(C(C(=O))))!\$(C(N)) activated_vinyl_sulfonate
 [C,c][C;!R](=O)[N;!R][C;!R](=O)[C,c] acyclic_imide
 [#7;R1]1~[#7;R1]~[#7;R1](-C(=O))~[#6]~[#6]1 acyl_123_triazole
 [#7]1~[#7]~[#6]~[#7](-C(=O)[!N])~[#6]1 acyl_134_triazole
 O=C(-[!N])O[\$([#7;+]),\$(N(C=[O,S,N])(C=[O,S,N]))] acyl_activated_NO
 C(=O)-C#N acyl_cyanide
 [C;!\$(C-N))(=O)[#7]1[#6;H1,\$([#6]([*;!R]))][#7][#6;H1,\$([#6]([*;!R]))][#6;H1,\$([#6]([*;!R]))]1 acyl_imidazole
 [C;!\$(C-N))(=O)[#7]1[#7][#6;H1,\$([#6]([*;!R]))][#6;H1,\$([#6]([*;!R]))][#6;H1,\$([#6]([*;!R]))]1 acyl_pyrazole
 [C,c][C;H1](=O) aldehyde
 C(=O)!@C(=O) alpha_dicarbonyl
 [\$(C(F)(F)(F)),\$(C#N),\$\$(N(=O)(=O)),\$([N+](=O)[O-])~[CH,CH2]~[Cl,Br,I,\$(O(S(=O)(=O)))] alpha_halo_EWG
 [F,Cl,Br,I,\$(O(S(=O)(=O)))]~[CH,CH2;!\$(CF2)]~[N,n] alpha_halo_amine
 C(=O)([CH,CH2][Cl,Br,I,\$(O(S(=O)(=O)))] alpha_halo_carbonyl
 [N,n,O,S;!\$(S(=O)(=O))~[CH,CH2;!\$(CF2)][F,Cl,Br,I,\$(O(S(=O)(=O)))] alpha_halo_heteroatom
 [N,n,O,S;!\$(S(=O)(=O))~C([Cl,Br,I,\$(O(S(=O)(=O)))](C)(C) alpha_halo_heteroatom_tert
 [\$(C(=O)),\$(C(S))~[O,S]~[\$(C(=O)),\$(C(S)),\$(C(=[N;!R])),\$(C(=N(-[C;X4])))] anhydride
 P(=O)-[O;!R]-a aryl_phosphonate
 a-[S;X2;!R]-[C;!R](=O) aryl_thiocarbonyl
 [\$(N#[N+]-[N-]),\$([N-]=[N+]=N)] azide
 [C,N]1~[C,N]~N~1 aziridine_diazirine
 [N]=[N;!R]-[N] azo_amino
 c[N;!R;!+]=[N;!R;!+]-c azo_aryl
 [N;!R]=[N;!R]-[N]=[*] azo_filter1
 [N;!\$(N-S(=O)(=O));!\$(N-C=O)]~[N;!r3;!\$(N-S(=O)(=O));!\$(N-C=O)]~[N;!\$(N-S(=O)(=O));!\$(N-C=O)] azo_filter2
 [N;!R]-[N;!R]-[N;!R] azo_filter3
 a-N=N-[N;H2] azo_filter4
 [B-,BH2,BH3,\$(B(F)(F))] bad_boron
 [C+,F+,Cl+,Br+,I+,Se+] bad_cations

[illegible]

[N+](=O)[O-],N(=O)=O].[N+](=O)[O-],N(=O)=O].[N+](=O)[O-],N(=O)=O].[N+](=O)[O-],N(=O)=O] gte_4_nitro
a[O;D1].a[O;D1].a[O;D1].a[O;D1].a[O;D1] gte_5_phenolic_OH
C[O;D1].C[O;D1].C[O;D1].C[O;D1].C[O;D1].C[O;D1].C[O;D1] gte_7_aliphatic_OH
[Cl,Br,I].[Cl,Br,I].[Cl,Br,I].[Cl,Br,I].[Cl,Br,I].[Cl,Br,I].[Cl,Br,I] gte_7_total_hal
[CH2,\$(CF2);R0][CH2,\$(CF2);R0][CH2,\$(CF2);R0][CH2,\$(CF2);R0][CH2,\$(CF2);R0][CH2,\$(CF2);R0][CH2,\$(CF2);R0] gte_8_CF2_or_CH2
[#7,#8,#16]1[#6]([\$(S(=O)(=O)),\$([F,Cl]),\$(C(F)(F)(F)),\$(C#N),\$N(=O)=O),[N+](=O)[O-]),\$(C(=O)))1[#6]([\$(S(=O)(=O)),\$([F,Cl]),\$(C(F)(F)(F)),\$(C#N),\$N(=O)=O),[N+](=O)[O-]),\$(C(=O)))1[#7]1([Cl,Br,I]) halo_5heterocycle_bis_EWG
[\$([C;H2]),\$(C&H1;\$C(F)),\$(C&H1;\$C(Cl)),\$(C&H1;\$C(Br)),\$(C&H1;\$C(I)),\$(C(F)F),\$(C(Cl)Cl),\$(C(Br)Br),\$(C(I)I),\$(C(F)Cl),\$(C(F)Br),\$(C(F)I),\$(C(Cl)Br),\$(C(Br)I)](=[C&H1;\$C(C(=O)))),\$(C(F)(C(=O))),\$(C(Cl)(C(=O))),\$(C(Br)(C(=O))),\$(C(I)(C(=O))),\$(C(C)(C(=O))),\$(C(c)(C(=O))))] halo_acrylate
C(=[#7])([Cl,Br,I,\$O(S(=O)(=O))]) halo_imino
C([Cl,Br,I,\$O(S(=O)(=O))])=C([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$N(=O)=O),[N+](=O)[O-]),\$(C(=O)))([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$N(=O)=O),[N+](=O)[O-]),\$(C(=O))] halo_olefin_bis_EWG
C(=O)Oc1c([Cl,F])[cH1,\$(c[F,Cl])]c([F,Cl])[cH1,\$(c[F,Cl])]c1([F,Cl]) halo_phenolic_carbonyl
S(=O)Oc1c([Cl,F])[cH1,\$(c[F,Cl])]c([F,Cl])[cH1,\$(c[F,Cl])]c1([F,Cl]) halo_phenolic_sulfonyl
[!C;!c;!H][F,Cl,Br,I] halogen_heteroatom
[Si]~[!#6] hetero_silyl
[N;X3;\$N-S(=O)(=O)];!\$N-C(F)(F)(F));!\$N-C#N;!\$N-C(=O));!\$N-C(S));!\$N-C(=N))]-[N;X3;\$N-S(=O)(=O)];!\$N-C(F)(F)(F));!\$N-C#N;!\$N-C(=O));!\$N-C(S));!\$N-C(=N))] hydrazine
[N;!R]=NC(=S)N hydrazothiourea
C([N;H1])([O;D1])=O hydroxamate_warhead
[\$([#16&D3]),\$([#16&D4])]=.[#6] hyperval_sulfur
[N+]#[C-] isonitrile
[\$(c([C;!R;!\$(C-[N,O,S]);!\$(C-[H]))(=O))1naaaa1,\$(c([C;!R;!\$(C-[N,O,S]);!\$(C-[H]))(=O))1naa[n,s,o]1)] keto_def_heterocycle
[\$(a12aaaaa1aa3a(aa4aaa4)a4a3)a2,\$(a12aaaaa1aa3a(aaa4a3aaaa4)a2,\$(a12aaaaa1a(aa5)a3a(aaa4a3a5aa4)a2)] linear_polycyclic_aromatic_I
[\$(a12aaaa4a1a3a(aaaa3aa4)aa2,\$(a12aaaaa1a3a(aaa4a3aaaa4)aa2,\$(a1(aaaaa4)a4a3a2aaaa3)a2aaaa1)] linear_polycyclic_aromatic_II
[\$([C;H1]),\$(C(-[F,Cl,Br,I]))]1=[C;H1]),\$(C(-[F,Cl,Br,I]))]C(=O)[N,O,S]C(=O)1 maleimide_etc
O=C1OC(C)(C)OC(C1)=O meldrums_acid_deriv
[C;H2](F)C(=O)[O,N,S] monofluoroacetate
[C;!R]=[N+][O;D1] nitron
N-[N;X2](=O) nitrosamine
[O,N,S;!\$(S~O)]!@[CH2]!@[O,S,N;!\$(S~O)] non_ring_CH2O_acetal
[O,N,S;!\$(S~O)]!@[C;H1;X4]!@[O,N,S;!\$(S~O)] non_ring_acetal
[O,N,S;!\$(S~O)]!@[C;H0;X4](!@[O,N,S;!\$(S~O)])(C) non_ring_ketal
c1c([N;D1])c([N;D1])c[cH1][cH1]1 ortho_hydroiminoquinone
a1c([O,S;D1])c([O,S;D1])a[cH1][cH1]1 ortho_hydroquinone
[#6]1(-O-[C;!R])(=[O,N;!R]))[#6]([\$(N(=O)=O)),\$([N+](=O)[O-]))[#6][#6][#6]1 ortho_nitrophenyl_carbonyl
[CH1,\$(C(-[Cl,Br,I]))]1=CC(=[O,N,S;!R])C(=[O,N,S])C=[CH1,\$(C(-[Cl,Br,I]))]1 ortho_quinone
C1~[O,S]~N1 oxaziridine
[\$(C=N[O;D1]);!\$(C=[N+]))[#6][#6] oxime
[o+,O+] oxonium
a1[cH1]c([N;D1])[cH1]ac([N;D1])1 para_hydroiminoquinone
a1[cH1]c([O,S;D1])[cH1]ac([O,S;D1])1 para_hydroquinone
[#6]1(-O-[C;!R])(=[O,N;!R]))[#6][#6][#6]([\$(N(=O)=O)),\$([N+](=O)[O-]))[#6][#6]1 para_nitrophenyl_ester

[CH1,\$(C(-[Cl,Br,I]))]1=[CH1,\$(C(-[Cl,Br,I]))]C(=[O,N,S])[CH1,\$(C(-[Cl,Br,I]))]=[CH1,\$(C(-[Cl,Br,I]))]C1(=[O,N,S]) para_quinone
[#6]1[#6][#6]([#6]2[#6][#6][#7;+][#6][#6]2)[#6][#6][#7;+]1 paraquat_like
C(=O)Oc1c(F)c(F)c(F)c(F)c1(F) pentafluorophenylester
C1(Cl)(Cl)C(Cl)C(Cl)=C(Cl)C1(Cl) perchloro_cp
c1(C=O)c([Br,Cl,I])c([Br,Cl,I])c([Br,Cl,I])c([Br,Cl,I])c1(C=O) perhalo_dicarbonyl_phenyl
c1c([Br,Cl,I])c([Br,Cl,I])c([Br,Cl,I])c([Br,Cl,I])c1([Br,Cl,I]) perhalo_phenyl
[#8]~[#8] peroxide
O=[C,S]Oc1aaa([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$ (N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$ (C(=O)N)))]aa([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$ (N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$ (C(=O)N)))]1 phenolate_bis_EWG
NC(COP(O)(O)=O)C(O)=O phos_serine_warhead
NC(C(C)OP(O)(O)=O)C(O)=O phos_threonine_warhead
NC(Cc1ccc(OP(O)(O)=O)cc1)C(O)=O phos_tyrosine_warhead
[c,C]-[P;v3] phosphite
[#15;+~!O] phosphonium
C=P phosphorane
[#15]~[N,n] phosphorous_nitrogen_bond
P~P phosphorus_phosphorus_bond
P~S phosphorus_sulfur_bond
C=[C;!R][C;!R]=[C;!R][C;!R]=[C;!R] polyene
c1c([O;D1])c(-[Cl,Br,I])c(-[Cl,Br,I])cc1.c1c([O;D1])c(-[Cl,Br,I])c(-[Cl,Br,I])cc1 polyhalo_phenol_a
c1c([O;D1])c(-[Cl,Br,I])cc(-[Cl,Br,I])c1.c1c([O;D1])c(-[Cl,Br,I])cc(-[Cl,Br,I])c1 polyhalo_phenol_b
c1c([O;D1])ccc(-[Cl,Br,I])c(-[Cl,Br,I])1.c1c([O;D1])ccc(-[Cl,Br,I])c(-[Cl,Br,I])1 polyhalo_phenol_c
c(-[Cl,Br,I])1c([O;D1])c(-[Cl,Br,I])ccc1.c(-[Cl,Br,I])1c([O;D1])c(-[Cl,Br,I])ccc1 polyhalo_phenol_d
c1c([O;D1])ccc(-[Cl,Br,I])c(-[Cl,Br,I])1.c1c([O;D1])ccc(-[Cl,Br,I])c(-[Cl,Br,I])1 polyhalo_phenol_e
[S;D2]-[S;D2]-[S;D2] polysulfide
[#6;r16,r17,r18]~[#6]1~[#6]~[#6]~[#6](~[#6])~[#7]1 porphyrin
[CH2][Cl,Br,I,\$(O(S(=O)(=O)[\$(N);!\$(O&D1)])]] primary_halide_sulfate
[N,n;R;+!]@ [N,n] quat_N_N
[N,n;+!]@C(=O) quat_N_acyl
[#6;!\$(#6)(-[N,O,S]))]1=[#6;!\$(#6)(-[N,O,S]))][#6](=[#6])[#6;!\$(#6)(-[N,O,S]))]=[#6;!\$(#6)(-[N,O,S]))][#6]1(=[O,N,S]) quinone_methide
C(=C)1SC(=S)NC(=O)1 rhodanine
[CH;!\$(C=C)][Cl,Br,I,\$(O(S(=O)(=O)[\$(N);!\$(O&D1)])]] secondary_halide_sulfate
[S;D2](-[N];!\$(N(=C));!\$(N(-S(=O)(=O));!\$(N(-C(=O)))) sulf_D2_nitrogen
[S;D2][O;D2] sulf_D2_oxygen_D2
[S;D3](-N)(-[c,C])(-[c,C]) sulf_D3_nitrogen
[C,c]OS(=O)O[C,c] sulfite_sulfate_ester
[S+;X3,\$(S-C);!\$(S-[O;D1])] sulfonium
[(C(=O)),\$(S(=O)(=O))][O,S](S(=O)(=O)) sulfonyl_anhydride
S(=O)(=O)[F,Cl,Br,I] sulfonyl_halide
[!#6;!#1;!#11;!#19]O(S(=O)(=O)(-[C,c])) sulfonyl_heteroatom
S(=O)(=O)C#N sulphonyl_cyanide
[C;X4](-[Cl,Br,I,\$(O(S(=O)(=O)[\$(N);!\$(O&D1)])]))(-[c,C])(-[c,C])(-[c,C]) tertiary_halide_sulfate
[S;D2]([\$(N(=C)),\$(N(-S(=O)(=O)),\$(N(-C(=O)))) thio_hydroxamate
[S;!R]-[C;!R]([S;!R])(-[S;!R]) thio_xanthate
SC(=O)[O,S] thiocarbonate
[S;!R;H0]C(=[S,O;!R])([O;!S;!N]) thioester
NC(C[S;D1])C(O)=O thiol_warhead
c1[S,s;+]cccc1 thiopyrylium
[C,c][S;X3](-O)-S thiosulfoxide
[(N(-C(=O)))(-C(=O))(-C(=O)),\$(n([#6](=O))([#6](=O))([#6](=O)))] triamide
P(=O)(a)(a)(a) triaryl_phosphine_oxide
[(C(=O));!(C-N);!(C-O);!(C-S)]C(Cl)(Cl)(Cl) trichloromethyl_ketone
OS(=O)(=O)(C(F)(F)(F)) triflate

C(F)(F)(F)C(=O)O trifluoroacetate_ester
 C(F)(F)(F)C(=O)S trifluoroacetate_thioester
 [\$(C(=O));!\$(C-N);!\$(C-O);!\$(C-S)]C(F)(F)(F) trifluoromethyl_ketone
 C(-[Cl,Br,I])(-[Cl,Br,I])=C(-[Cl,Br,I])(-[N,O,S]) trihalovinyl_heteroatom
 [\$(a1aaa([\$(N(=O)(=O)),\$([N+](=O)[O-]))a([\$(N(=O)(=O)),\$([N+](=O)[O-]))a1([\$(N(=O)(=O)),\$([N+](=O)[O-]))a([\$(N(=O)(=O)),\$([N+](=O)[O-]))aa1([\$(N(=O)(=O)),\$([N+](=O)[O-]))a1([\$(N(=O)(=O)),\$([N+](=O)[O-]))aa([\$(N(=O)(=O)),\$([N+](=O)[O-]))aa1([\$(N(=O)(=O)),\$([N+](=O)[O-])))] trinitro_aromatic
 C([\$([N+](=O)[O-]),\$(N(=O)=O)))([\$([N+](=O)[O-]),\$(N(=O)=O)))([\$([N+](=O)[O-]),\$(N(=O)=O)])
 trinitromethane_derivative
 [\$(O=[C,S]Oc1a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))aa1),\$(O=[C,S]Oc1a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))aaa([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))1),\$(O=[C,S]Oc1a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))aa([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))a1),\$(O=[C,S]Oc1a([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))aa([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))aa([\$(S(=O)(=O)),F,\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)O),\$(C(=O)N))1)] tris_activated_aryl_ester
 [[CH;!R];!\$(C-N)]=C([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O))))([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O))])
 trisub_bis_act_olefin
 [C;!R]([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O)))([\$(S(=O)(=O)),\$(C(F)(F)(F)),\$(C#N),\$(N(=O)(=O)),\$([N+](=O)[O-]),\$(C(=O))])=[C;!R]([C;!R](O))(!\$([#8]);!\$([#7])) vinyl_carbonyl_EWG