



**Analysis of AEIC CS5-94 AWTT HVTT Results  
for XLPE & TRXLPE Data after Unification and  
Randomization of Database for the  
ICEA/UPCSTAC  
Liaison Group - Power Cable Section**

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**June 3, 2002  
Providence, Rhode Island**

## STRATEGY FOR ANALYSIS OF UPCSTAC **RANDOMIZED** XLPE & TRXLPE AWTT HVTT RESULTS

1. **Combine XLPE and TRXLPE Databases.**
2. **Delete Material ID's and Randomize Database.**
3. **AWTT HVTT Database to Include Conventional Conductor Shield Results, Only.**
4. **Database to Include AEIC CS5-94 Test Results, Only.**
5. **Perform Weibull/Distribution Analysis of Data Sets in Maximum Groupings/Plots of 10 Data Sets.**
6. **Generate Reduced Bias Adjustment/Maximum Likelihood Estimator (RBA/mle) Contours (with Likelihood Ratio Confidence Bounds) With Best-Fit Distribution via Monte Carlo Simulation.**
7. **Determine Overlap of RBA/mle Contours for Corresponding Data Sets, and Combine Overlapping Contours into Distinct "Parent" Populations.**
8. **Define "Parent" Population as That Merged/Combined Population Which Contains the Majority of the Data.**
9. **Perform Outlier Tests on Parent Populations for Individual Outlier Data Values.**
10. **Insert Any Premature AWTT Failures as HVTT Suspension Data @ 100 V/mil Value.**

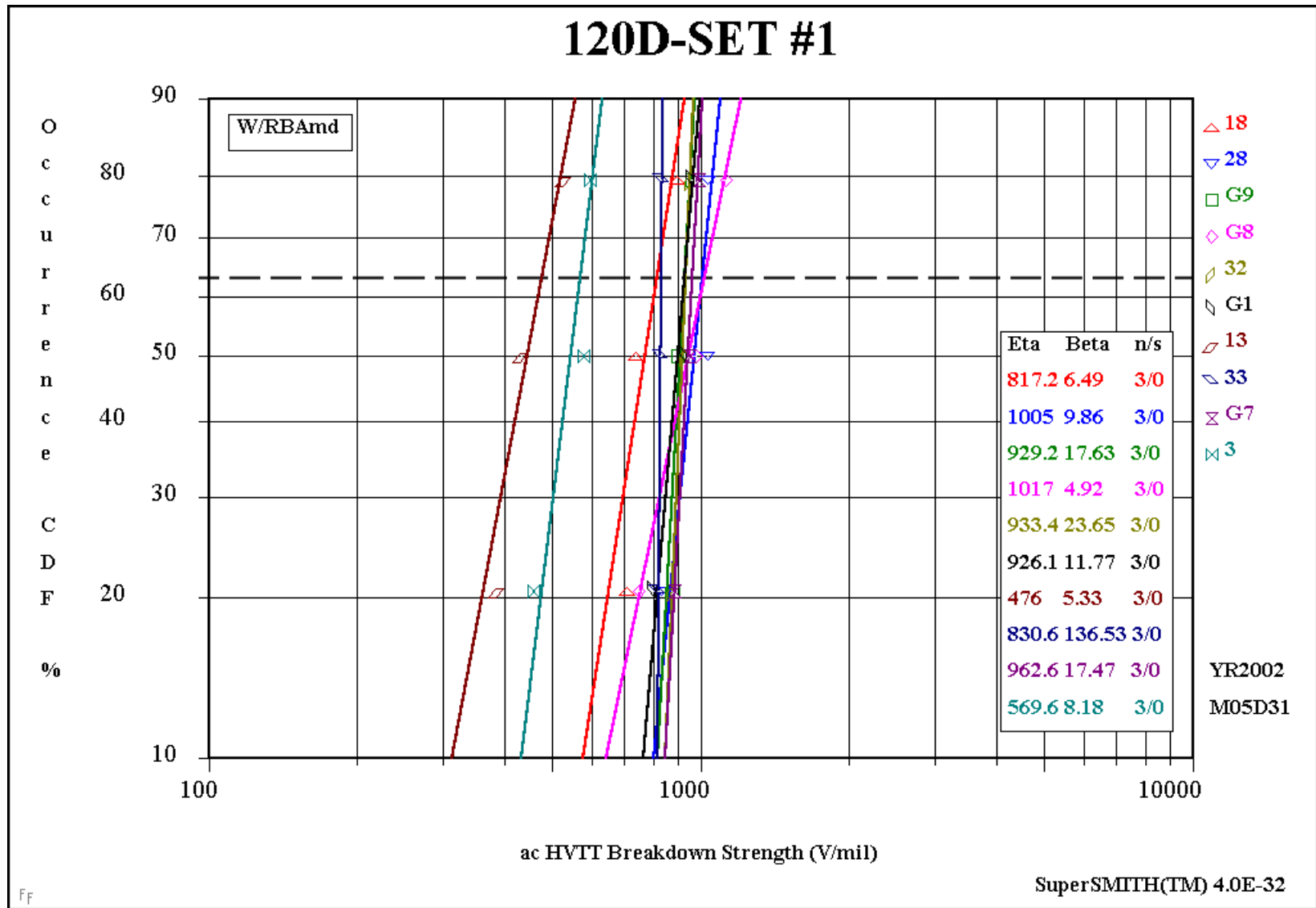
## STRATEGY FOR ANALYSIS OF UPCSTAC XLPE & TRXLPE AWTT HVTT RESULTS (Continued)

- 11. Perform Weibull/Distribution Analysis of Parent Populations.**
  - A. Select Predominant “Best-Fit” Distribution for XLPE and TRXLPE Parent Population Comparisons**
- 12. Generate RBA/mle Contours of XLPE and TRXLPE(s) Parent Populations.**
  - A. Determine Presence or Absence of Overlap of 120, 180 and 360-Day Parent Populations.**
- 13. Tabulate Parent Populations’ Composition**
  - A. XLPE**
  - B. TRXLPE**
- 14. Calculate Minimum HVTT Values for XLPE and TRXLPE(s) Parent Populations.**
  - A. Use 90% Reliability (B10) HVTT Value @ 90% Confidence Levels, NOT 50% confidence value (not the value taken off best-fit linear regression line)**
- 15. Tabulate Minimum Pass/Fail AWTT HVTT Values for XLPE and TRXLPE(s).**

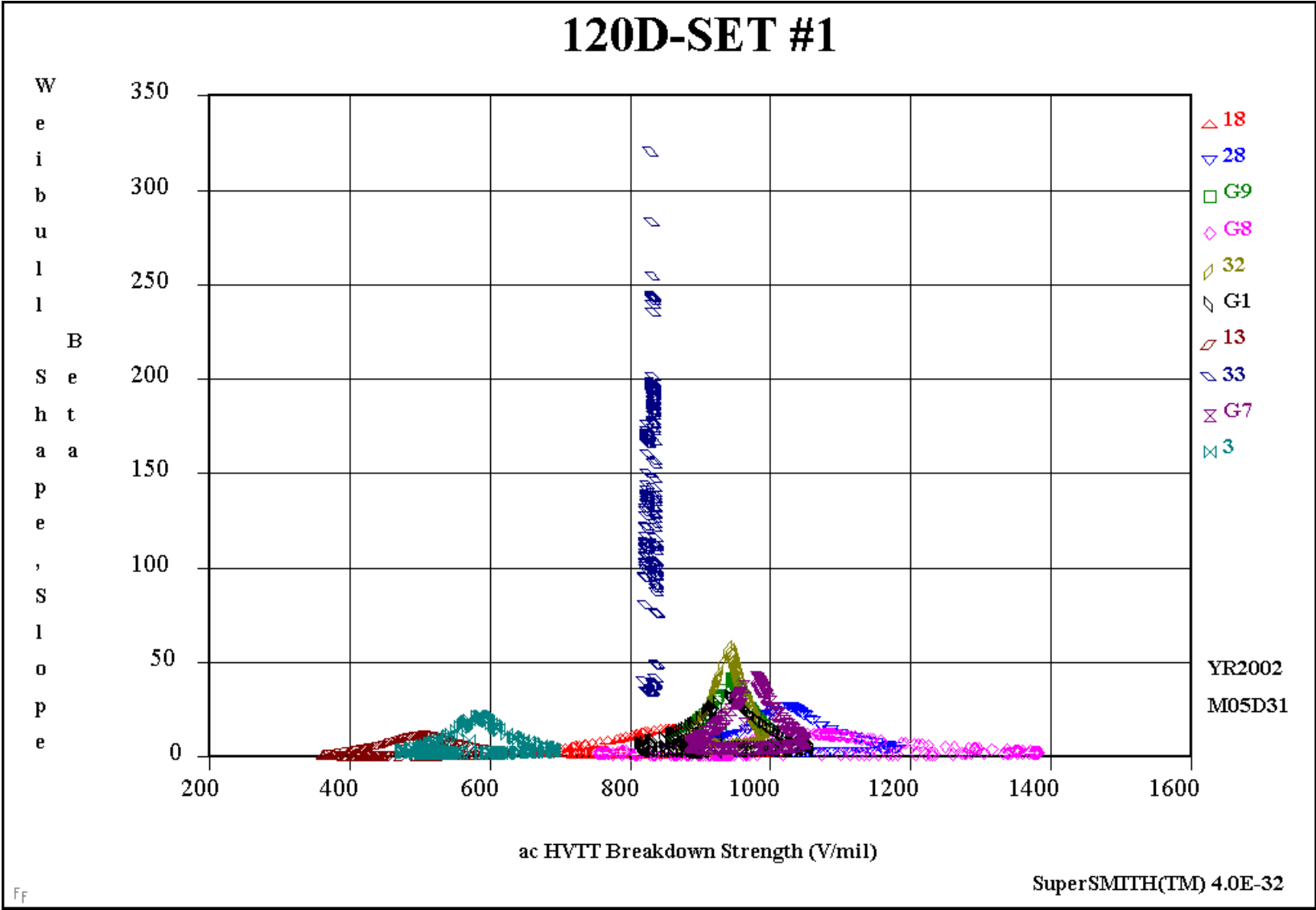
# UPCSTAC DATABASE - RANDOMIZED (w/o Material Identity)

ID	BEFORE LOAD-CYCLE			AFTER LOAD-CYCLE			120D AWTT			180D AWTT			360D AWTT		
	1	2	3	7	8	9	13	14	15	16	17	18	19	20	21
13	811	1102	587	1265	1255	1053	432	386	529	319	675	564	559	451	485
35	1093	1167	1110	909	1003	1078	440	479	551	546	675	564	559	451	485
29	934	716	879	1420	1312	1343	827	480	693	808	349	554	739	653	585
16	1220	820	1060	1220	820	780	540	500	540	500	380	340	420	260	340
18-1	870	861	960	903	1116	1003	631	508	680	508	631	621	574	516	463
14	1460	1460	1227	997	856	780	573	543	534	481	543	537	549	395	327
15	1310	1358	1404	1334	1186	1297	500	571	545	490	449	439	369	Failed	Failed
38	940	940	980	1260	1180	660	660	580	460	540	540	580	420	460	500
23	1212	1234	1187	618	852	1056	1031	618	704	830	846	780	738	642	549
17-1	1342	1167	875	1260	836	930	664	726	736	628	711	537	638	598	618
20	978	924	896	1341	1333	1312	607	731	607	635	581	597	773	670	701
18	711	717	749	879	1062	1124T	707	736	893	648	655	669	583	645	648
30	1026	1038	1075	1466	1225	767	674	738	603	563	646	628	514	486	519
25	997	806	974	1044	1082	1048	-666	742	1056	836	797	747	762	604	525
12	1099	1005	1220	1380	1229	1177	689	773	650	650D	574	610	611T	532	608
33	825	833	856	1087	1112	1059	820	833	831	820	757	664	642	662	597
28	723	614	1050	819	976	1180	1032	834	1030	428	928	582	681	796	640
27	1420	1420	1420	1338	1420	1420	557	854	828	743	810	683	476	642	642
32	784	763	811	1052	927	1031	927	875	953	914	772	1088	896	1033	1009
21	924	896	940	1317	1234	1240	668	963	989	705	791	920	675	588	479
22	1141	1232	1220	1372	1058	1173	1113	969	1098	942	841	749	543	875	865
34	894	937	951	1293	1307	1323	1026	970	836	672	974	827	642	638	668
37	988	908	980	1155	1322	1310	723	987	1031	910	855	879	797	857	558
39	940	900	940	1620	1340	1580	940	1020	900	940	1100	940	1100	1020	860
31	1200	1145	1187	799	758	1159	540	1091	608	521	463	508	418	468	514
19	963	973	965	1300	1344	1339	847	1106	966	937	927	1097	625	777	645
36	1021	997	937	1300	1331	1225	759	1141	831	719	866	831	616	277	552
24	1020	1420	1401	919	1224	1170	1102	1198	988	1069	1075	1025	870	838	506
26	1396	1167	1014	1420	1215	1373	1154	1199	1173	1187	1134	909	656	638	627
G4	1025	986	1008	1449	1434	1460T	1078W	1110W	1078W	1013W	946W	987W	899D	970D	880D
8	1500T	1540T	1500T	1213	1106	1260T	500W	438D	540W	564W	440D	488D	Failed	361D	463D
11	1521	1073	1461	788	1028	1594	406W	455W	603W	519W	442W	508W	361W	365W	325W
3	833	935	1003	603	811	688	577D	458D	596D	529W	516W	529W	396D	Failed	Failed
7	1220T	1435	1300T	1709	1048	1260	497D	471D	577W	525W	376W	438W	Failed	418W	Failed
1	1487	1220T	1236	919	1067	805	523W	592W	505W	555D	399D	428D	514D	528D	492D
4	1340T	1700T	977	1530	1410	1660T	549D	595W	586W	567W	413W	458W	480W	359D	Failed
G15	1254	1167	1317	1300T	1340T	1147	635W	599W	549D	616W	540D	425D	515W	482W	442W
G12	899	880	924	1536	1666	1380T	746W	610W	772W	645W	395W	648W	645W	603W	608W
6	1357	1461	981	1420T	1340T	1420T	594D	613W	430D	503W	474W	369W	393W	352W	425W
G11	1109	1032	980	1328	1275	1256	715W	627W	756W	619W	766D	704W	650W	556W	577D
9	1388	1043	942	963	1420T	1420T	577W	635W	716W	331W	378W	365W	356W	369W	389W
G10	1271	1191	1236	1404	1148	884	802D	681W	712W	435W	492W	596W	638W	497W	458W
17	827 T	1129	1190	823	1023 T	1029 T	528 W	699 W	-710	494 W	525 W	548 W	476 W	537 W	508 W
2	1320	1317	1247	1380T	1420T	1380T	602W	704W	674D	531W	450W	526D	452D	481D	Failed
G5	997	1050	1032	885	1054	1300T	638W	716W	500W	767D	624W	780D	549D	628W	586W
G6	926	880	910	1620T	1008	1028	780W	716W	556W	704W	708W	798W	620W	577W	598W
5	1620T	1460T	1780T	1300T	1220T	1220T	537W	719W	580W	573W	537W	361W	525W	624W	457W
10	1046	1313	1230	1466	1450	1412	522W	723W	611W	516W	682W	468W	531W	411D	461W
G8	775	803	891	1307	1094	1334	1126D	749D	981D	806W	758W	825W	889W	624D	567W
G14	910	890	926	997	916	870	870D	762W	844W	596D	856W	910W	613W	577W	635W
G1	811	827	865	1134	1580F	1035	960D	801W	927W	847D	932W	856D	754W	788D	793D
G2	900	945	895	1435	1365	1460	1003W	808W	1056W	1115W	1192W	1008W	865W	875D	788W
16	1052	1052	1070	1108	1147	1090	648 W	922 W	905 W	847 W	822 W	822 W	836 W	880 W	850 W
G3	885	865	870	885	890	838	944W	944W	955W	960W	893W	987W	772D	797D	788D
G9	758	767	758	1192	1225	1261	895D	960W	880D	884D	953D	788W	851D	921D	847D
G13	997	997	1027	1078	1536	1494	746D	987D	1237W	825W	896D	991D	683W	531W	732W
G7	831	890	885	1259	679	809	951W	991W	885W	979W	763W	875W	1099D	534D	1075D

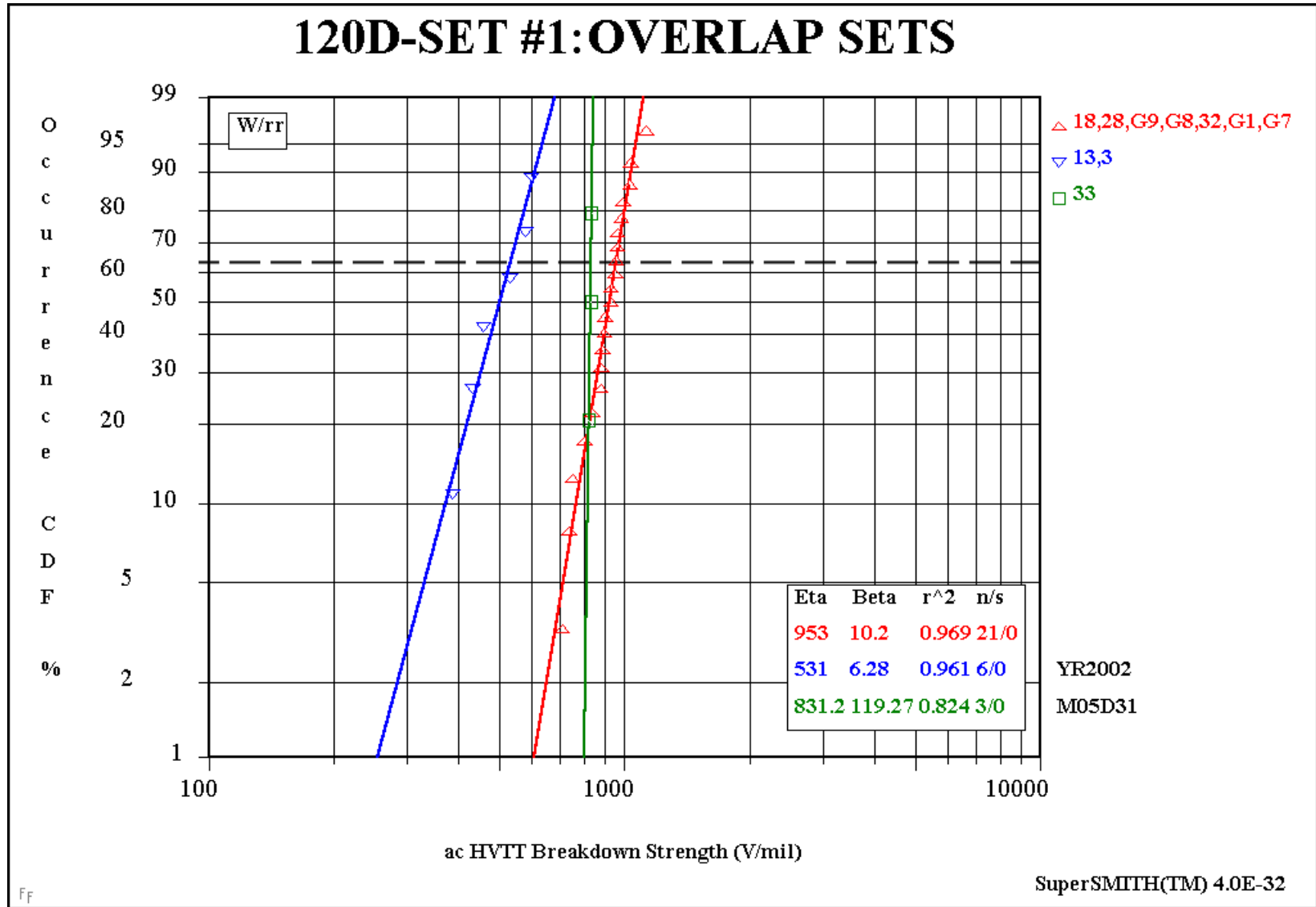
# 120D AWTT HVTT 1st 10 Data Sets



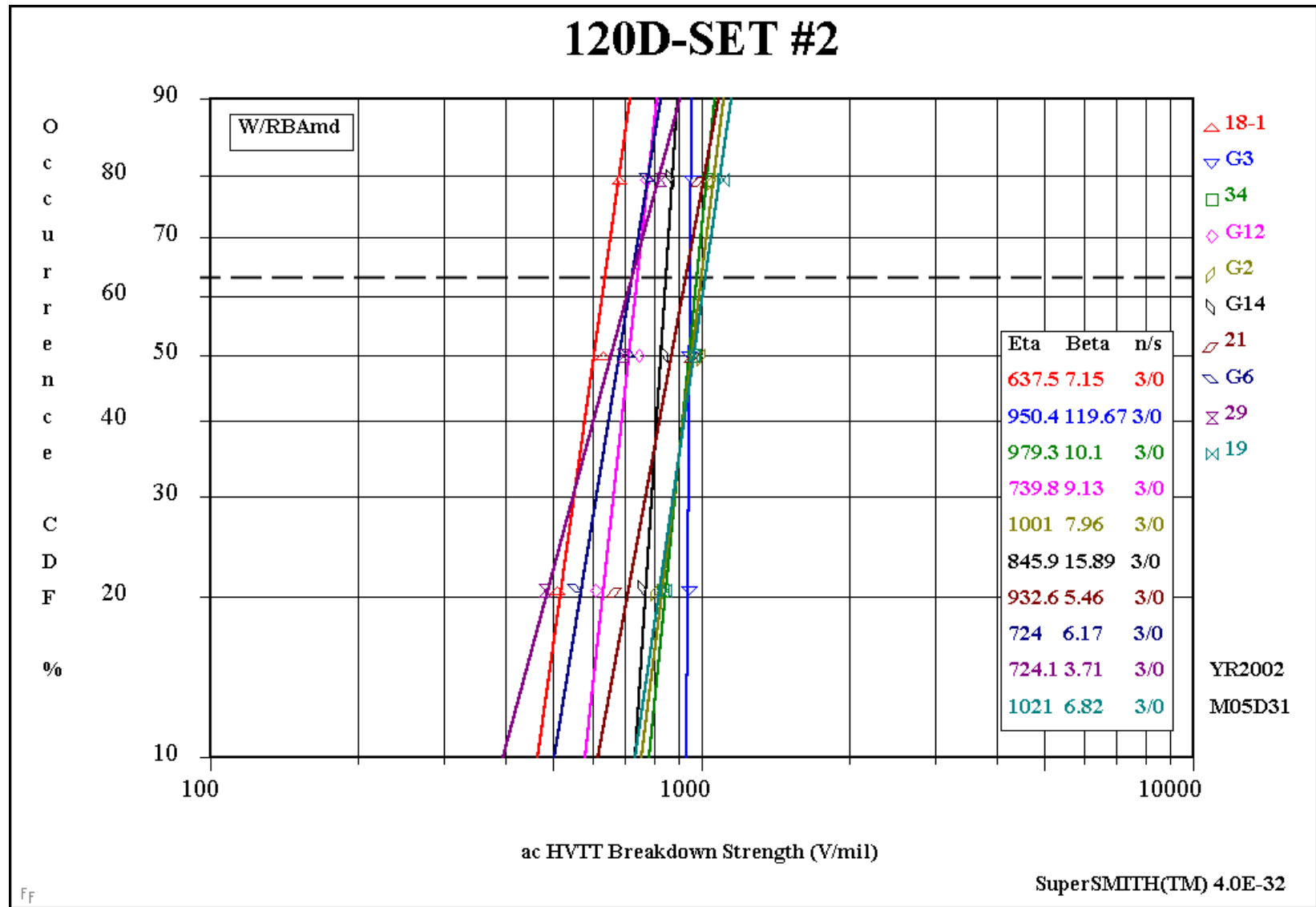
120D AWTT HVTT 1st 10 Data Sets - mmle/RBA Contours



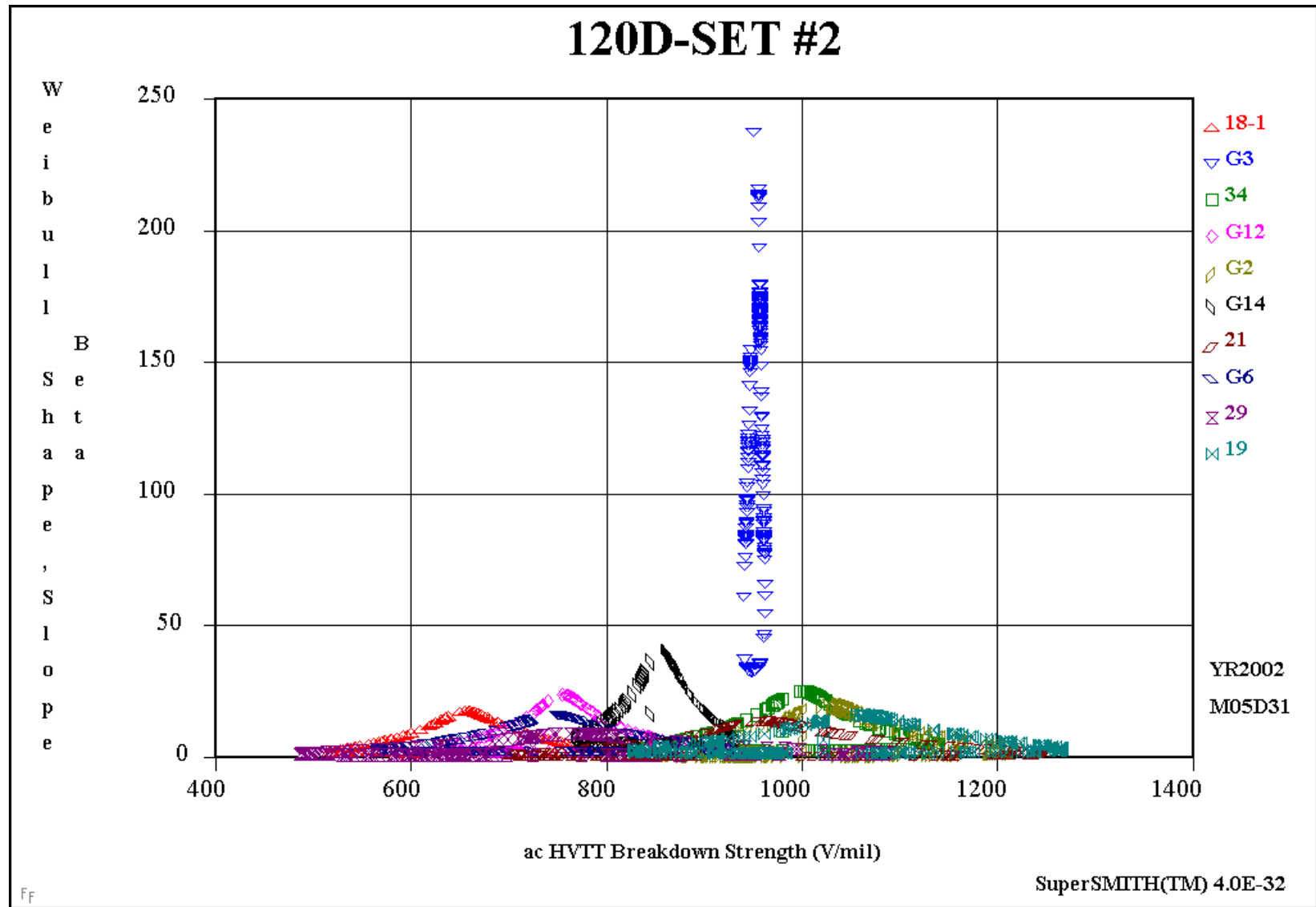
# 120D AWTT HVTT 1st 10 Data Sets - Merged via mmle/RBA Contours Overlap



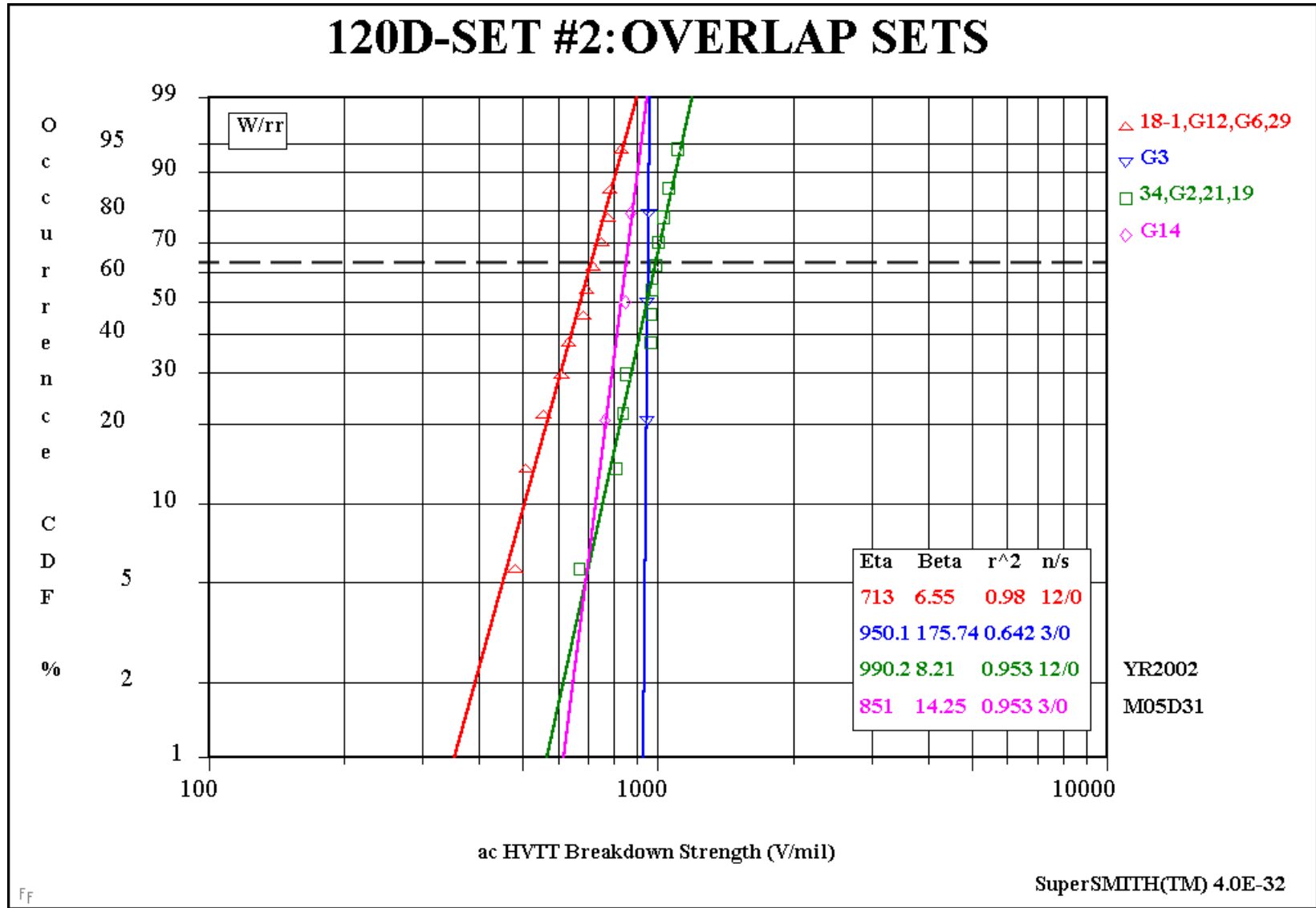
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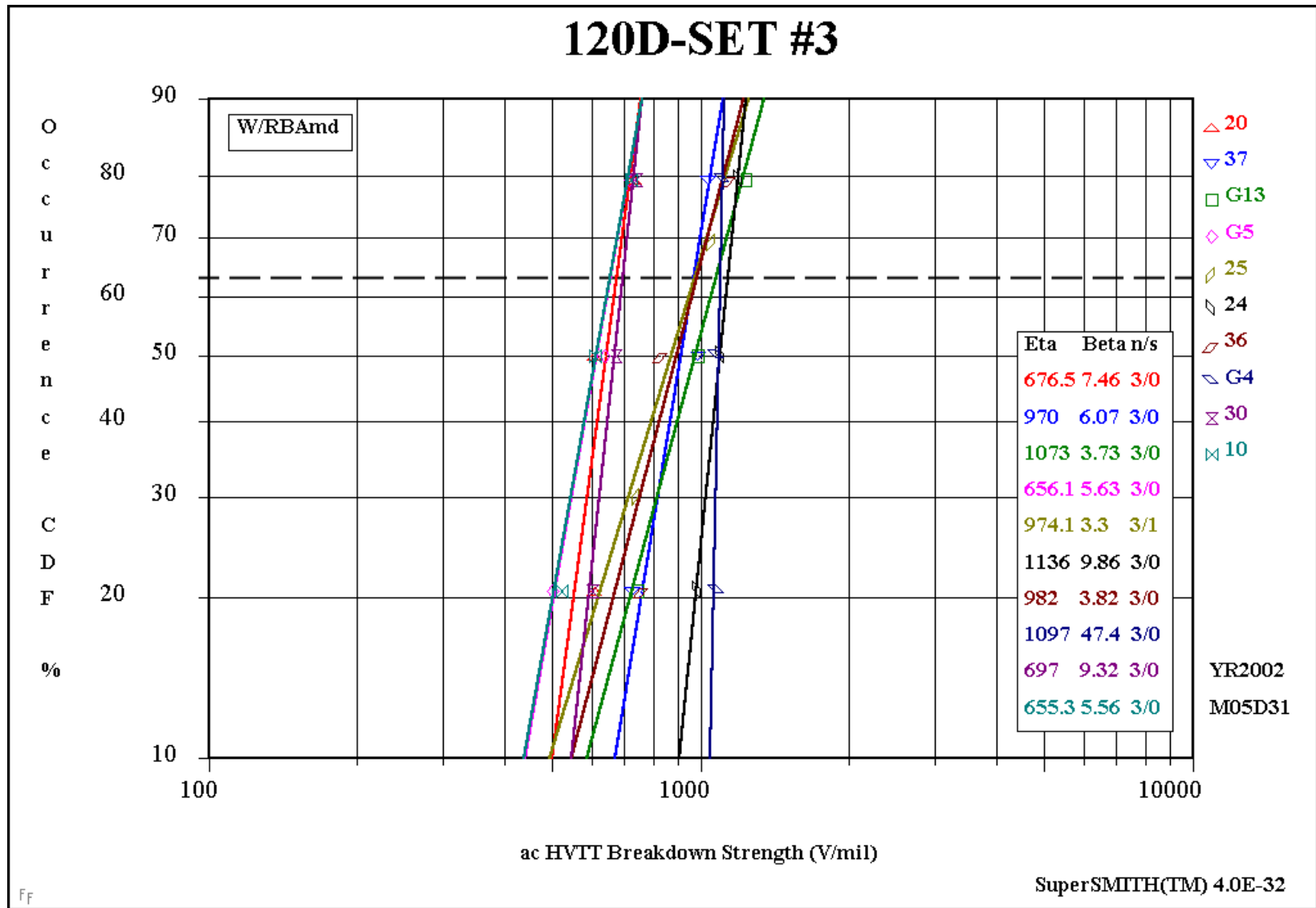
# 120D AWTT HVTT 2nd 10 Data Sets - mmle/RBA Contours



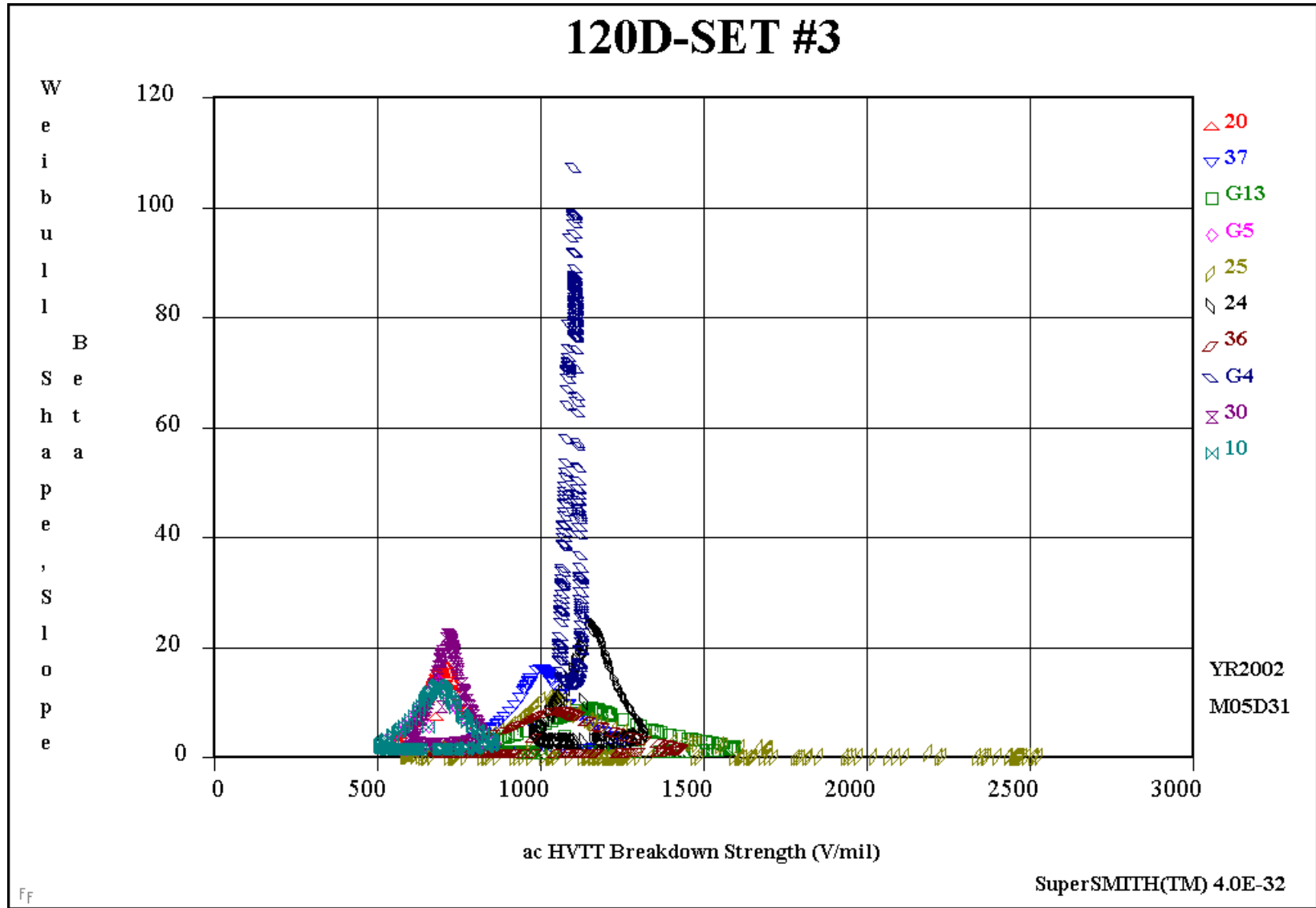
# 120D AWTT HVTT 2nd 10 Data Sets - Merged via mmle/RBA Contours Overlap



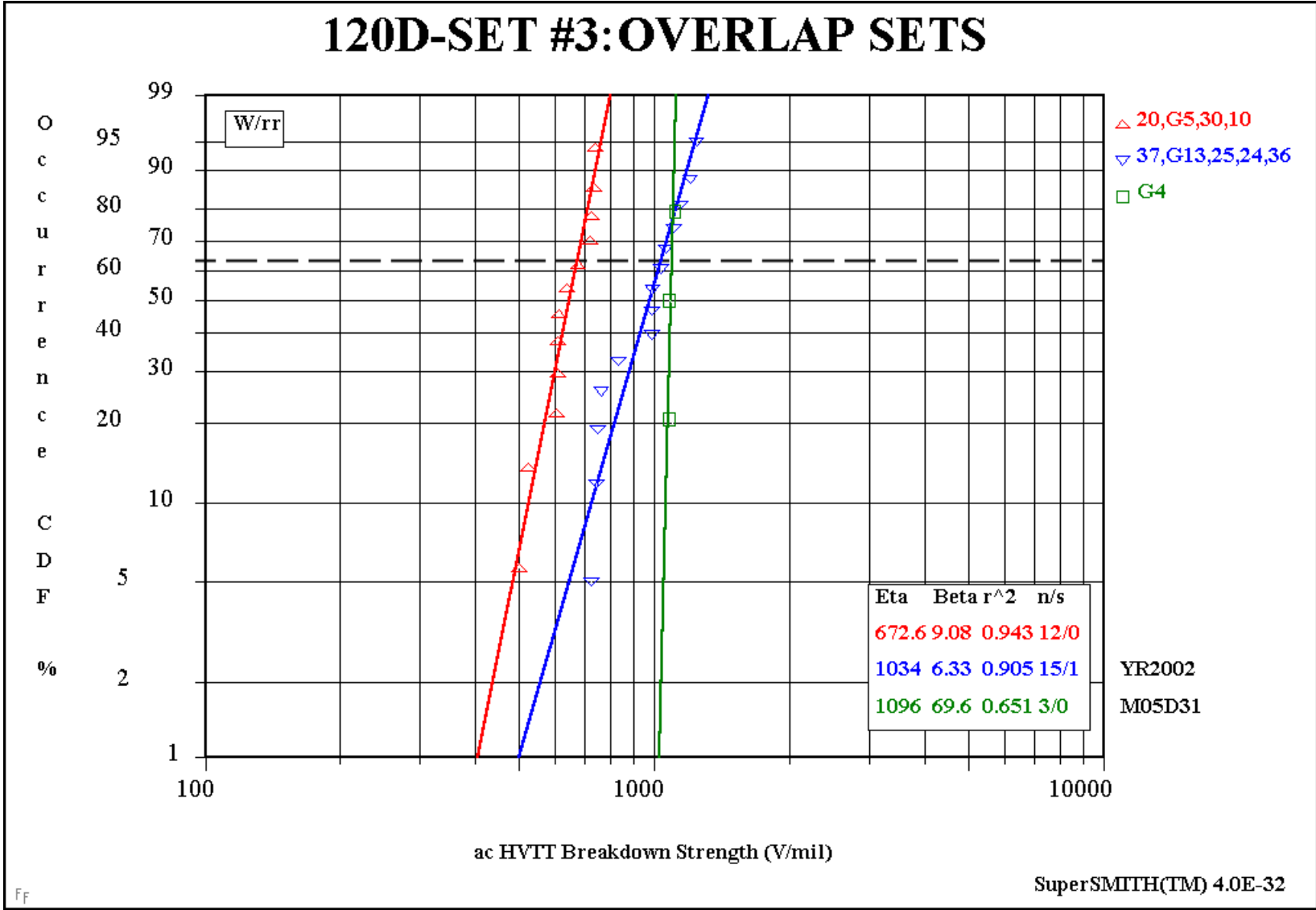
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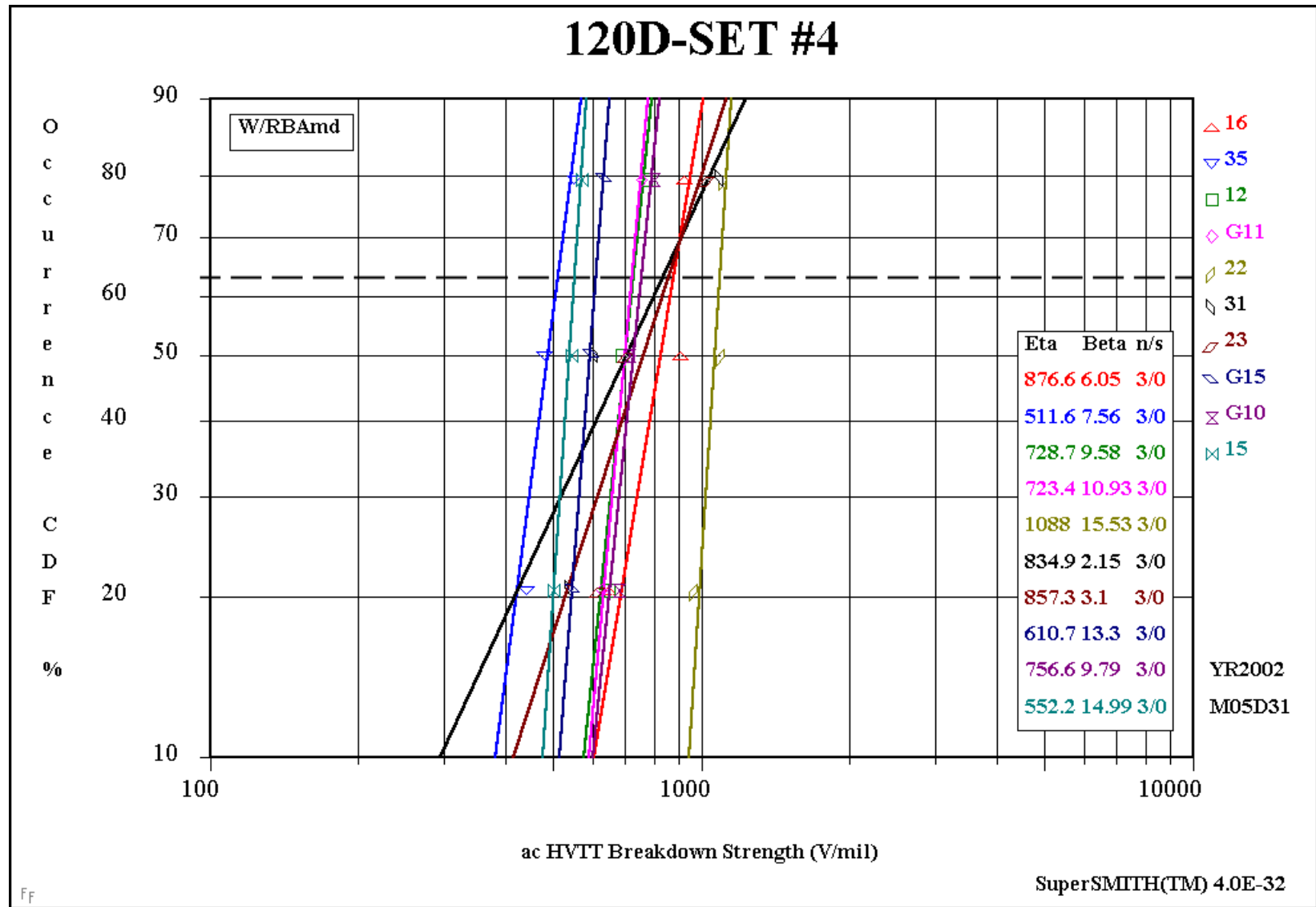
# 120D AWTT HVTT 3rd 10 Data Sets - mmle/RBA Contours Overlap



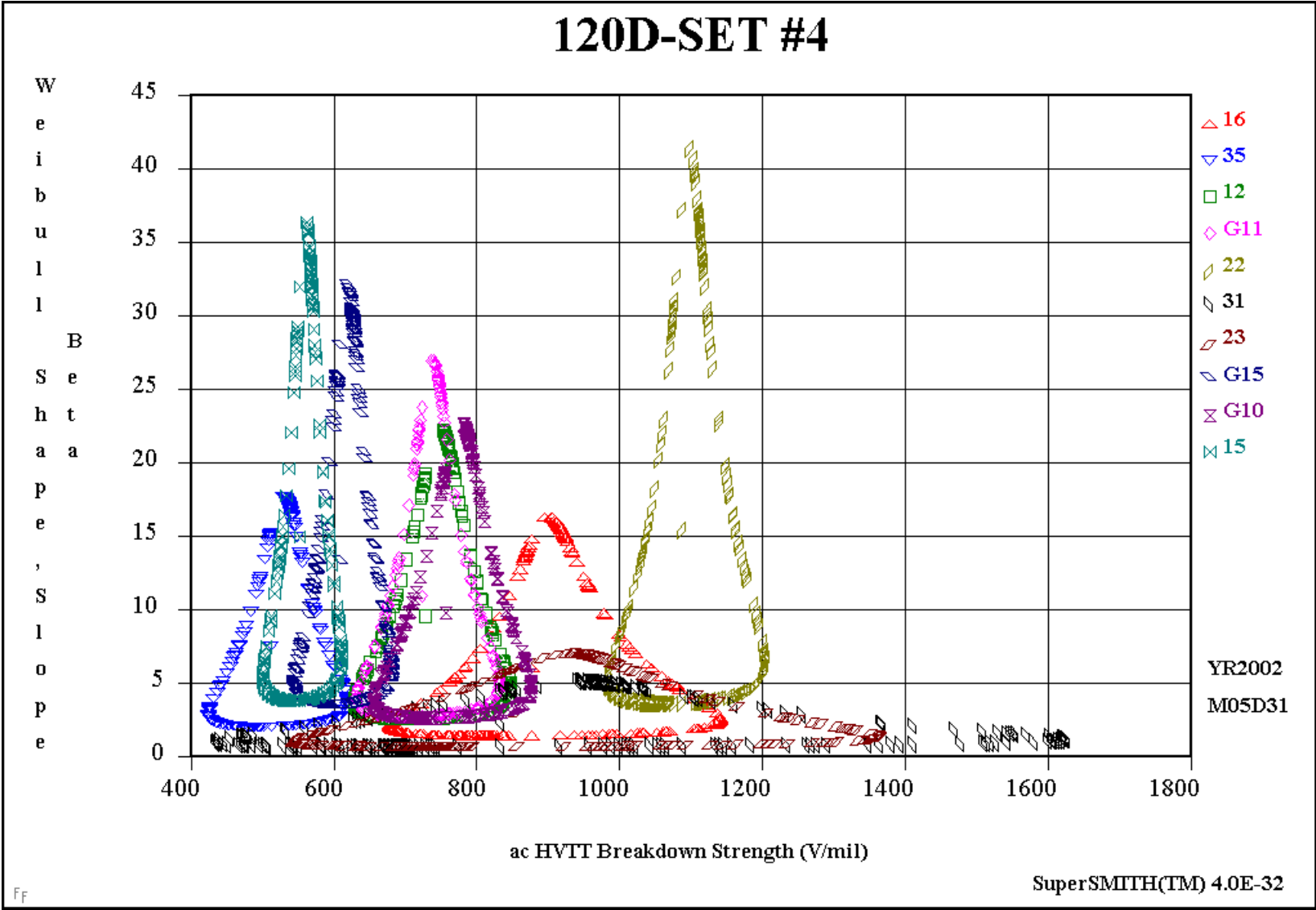
120D AWTT HVTT 3rd 10 Data Sets - Merged via mmle/RBA Contours Overlap



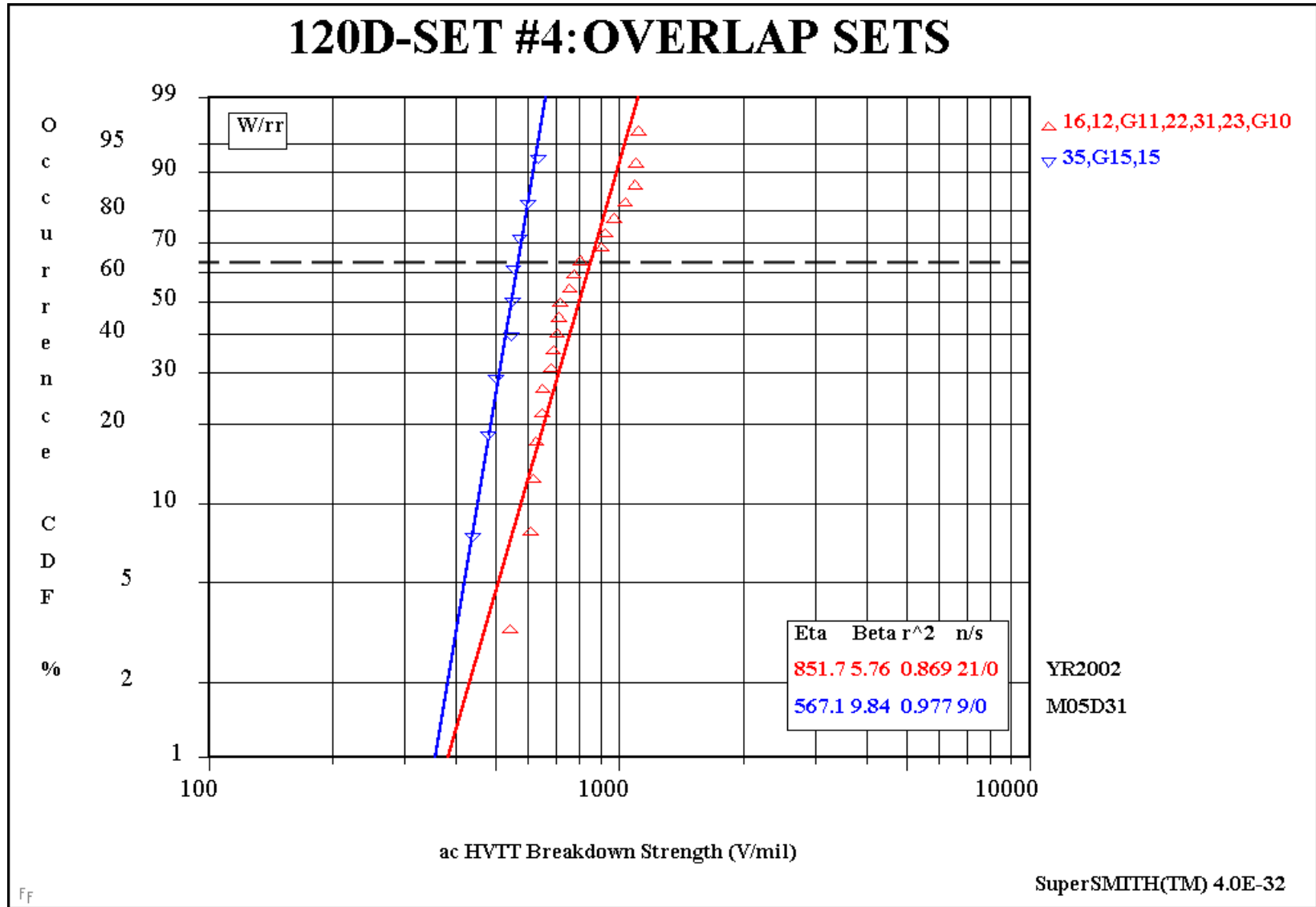
# 120D AWTT HVTT 4th 10 Data Sets



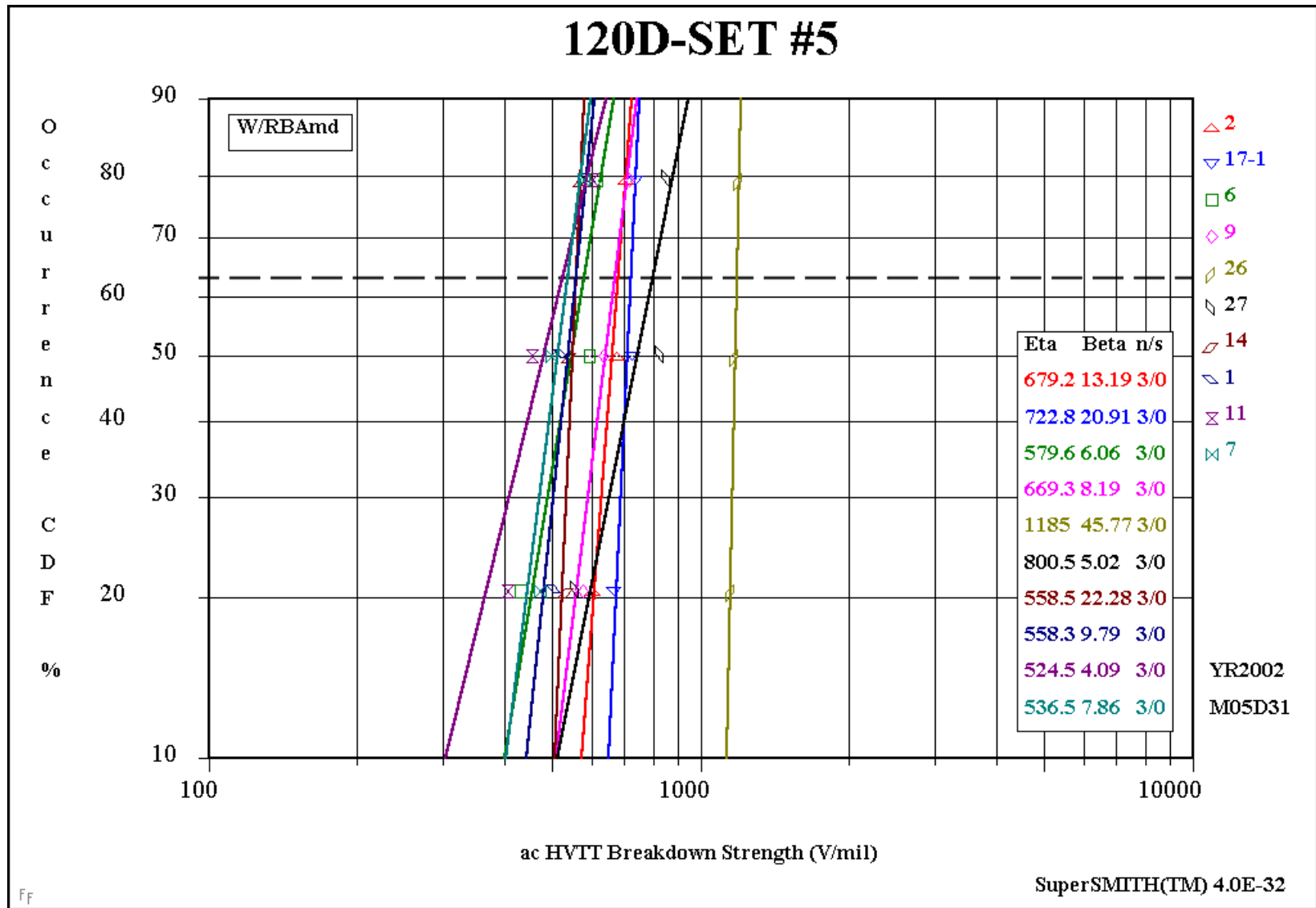
120D AWTT HVTT 4th 10 Data Sets - mmle/RBA Contours Overlap



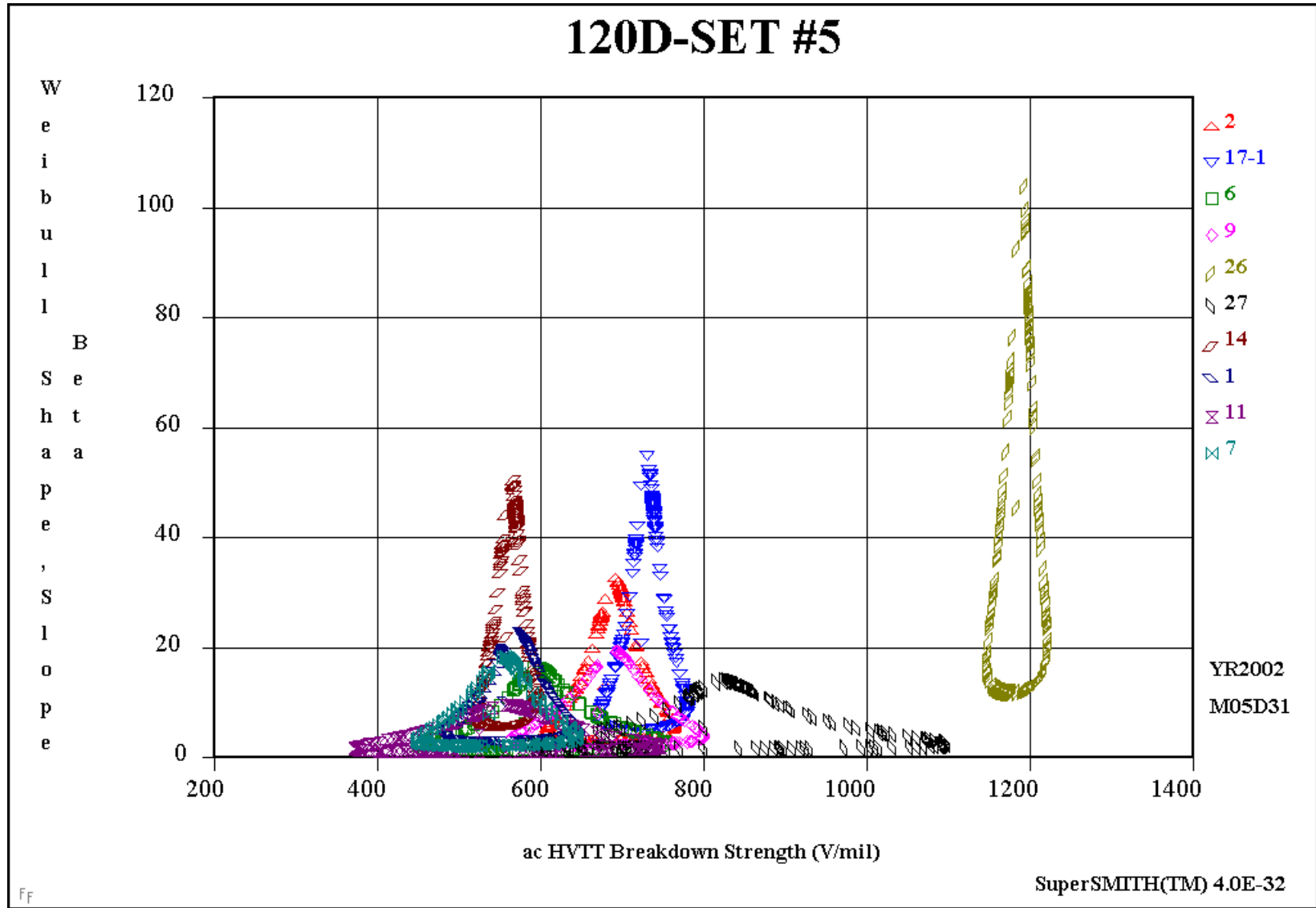
# 120D AWTT HVTT 4th 10 Data Sets - Merged via mmle/RBA Contours Overlap



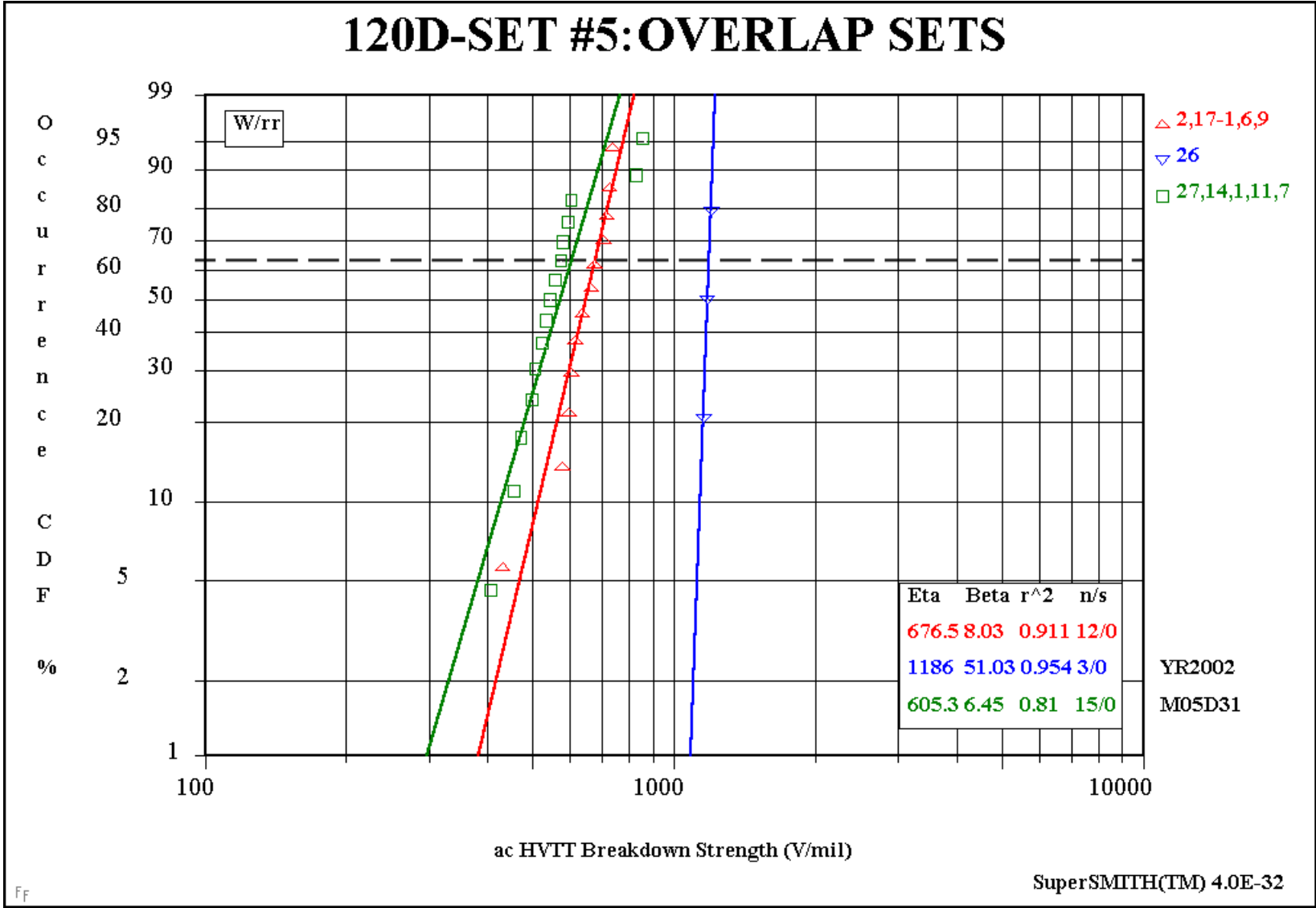
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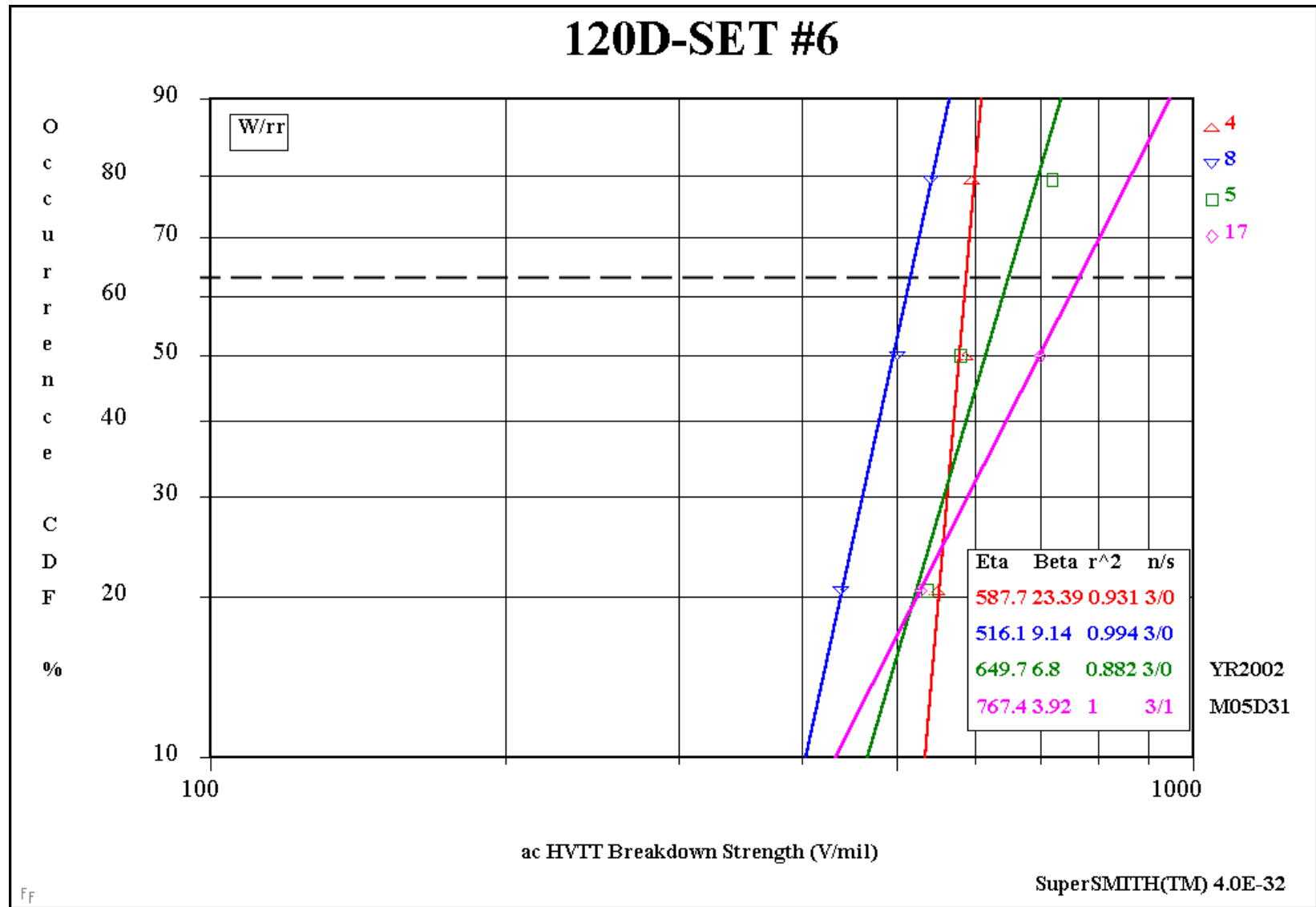
# 120D AWTT HVTT 5th 10 Data Sets - mmle/RBA Contours Overlap



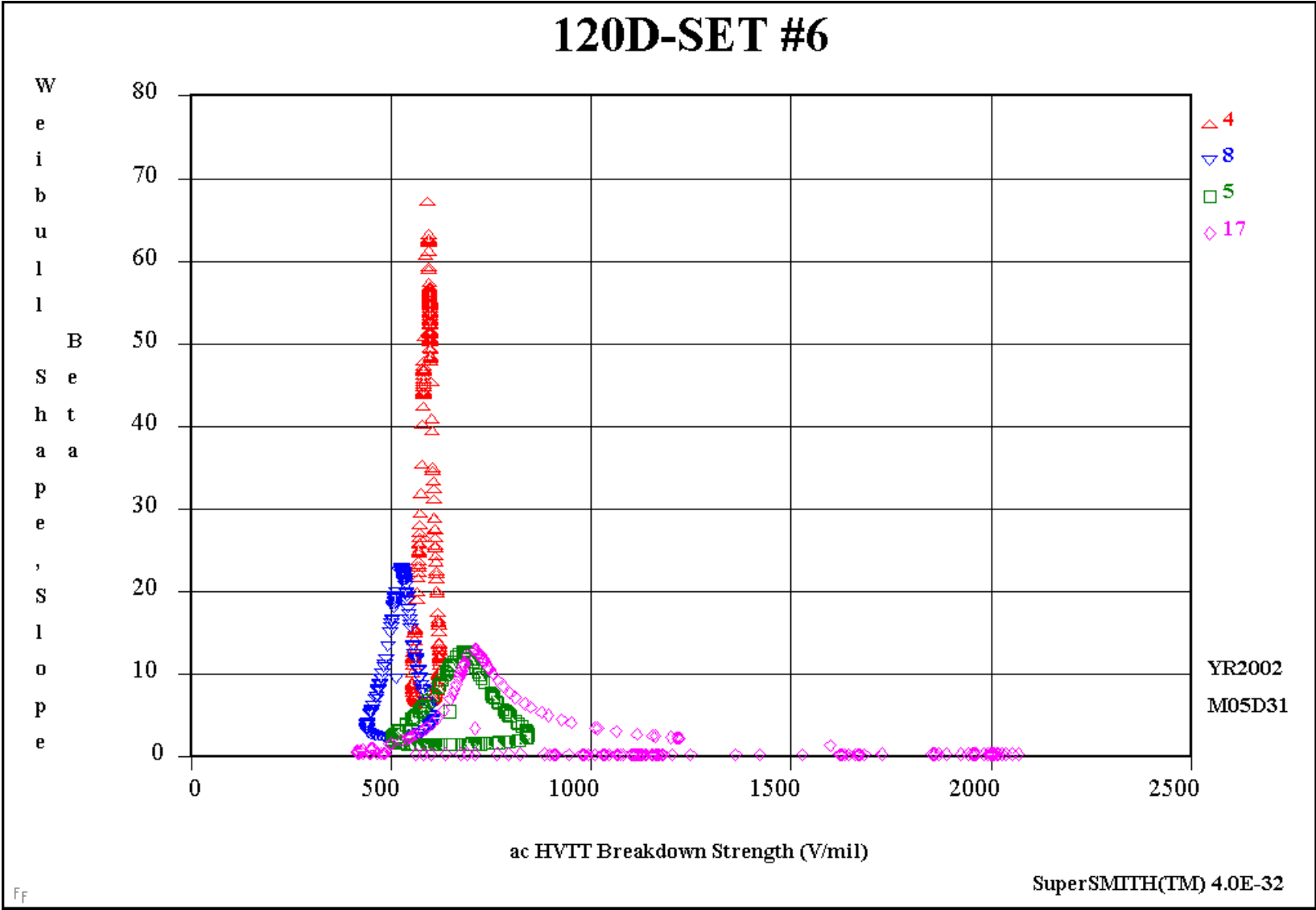
# 120D AWTT HVTT 5th 10 Data Sets - Merged via mmle/RBA Contours Overlap



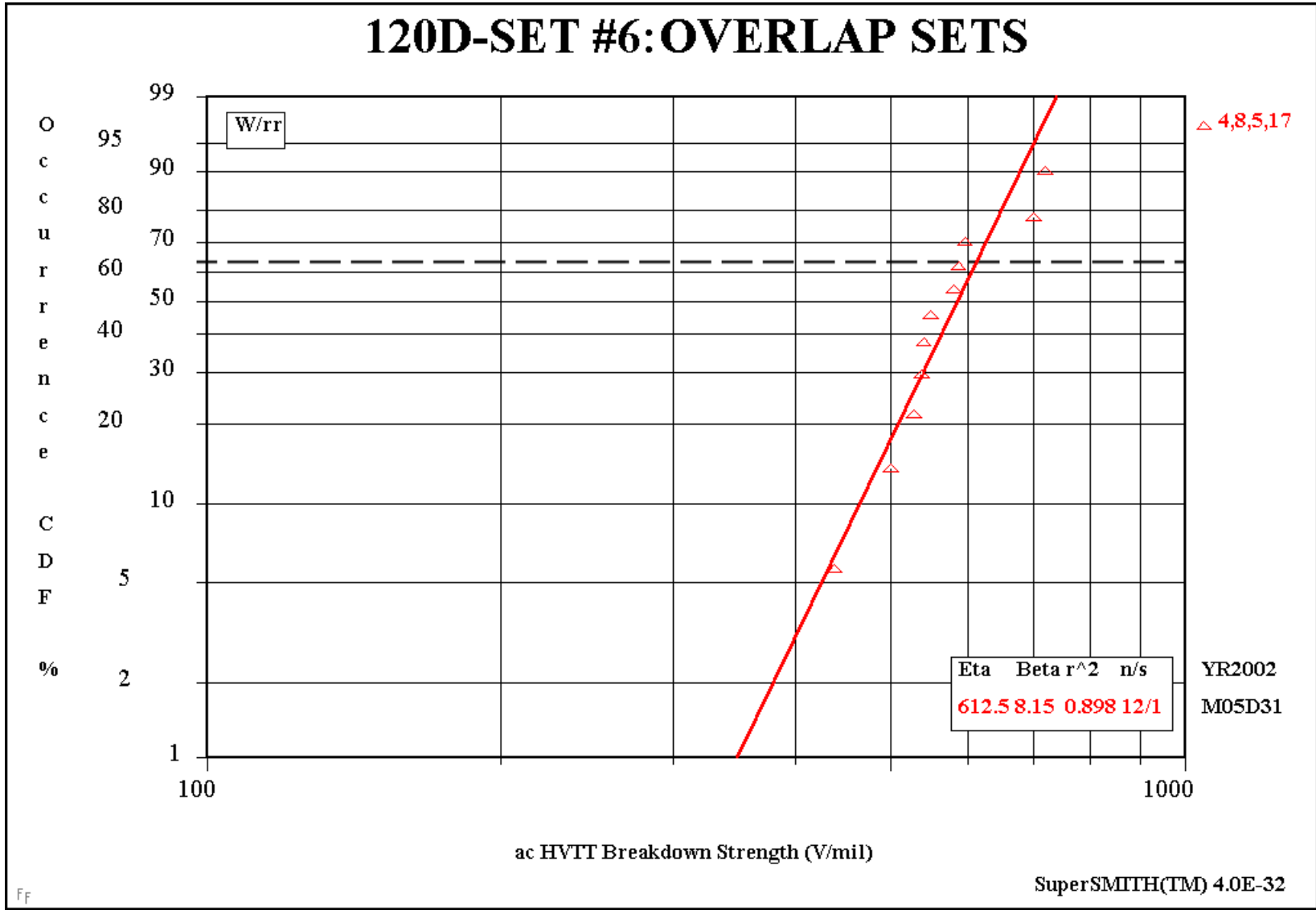
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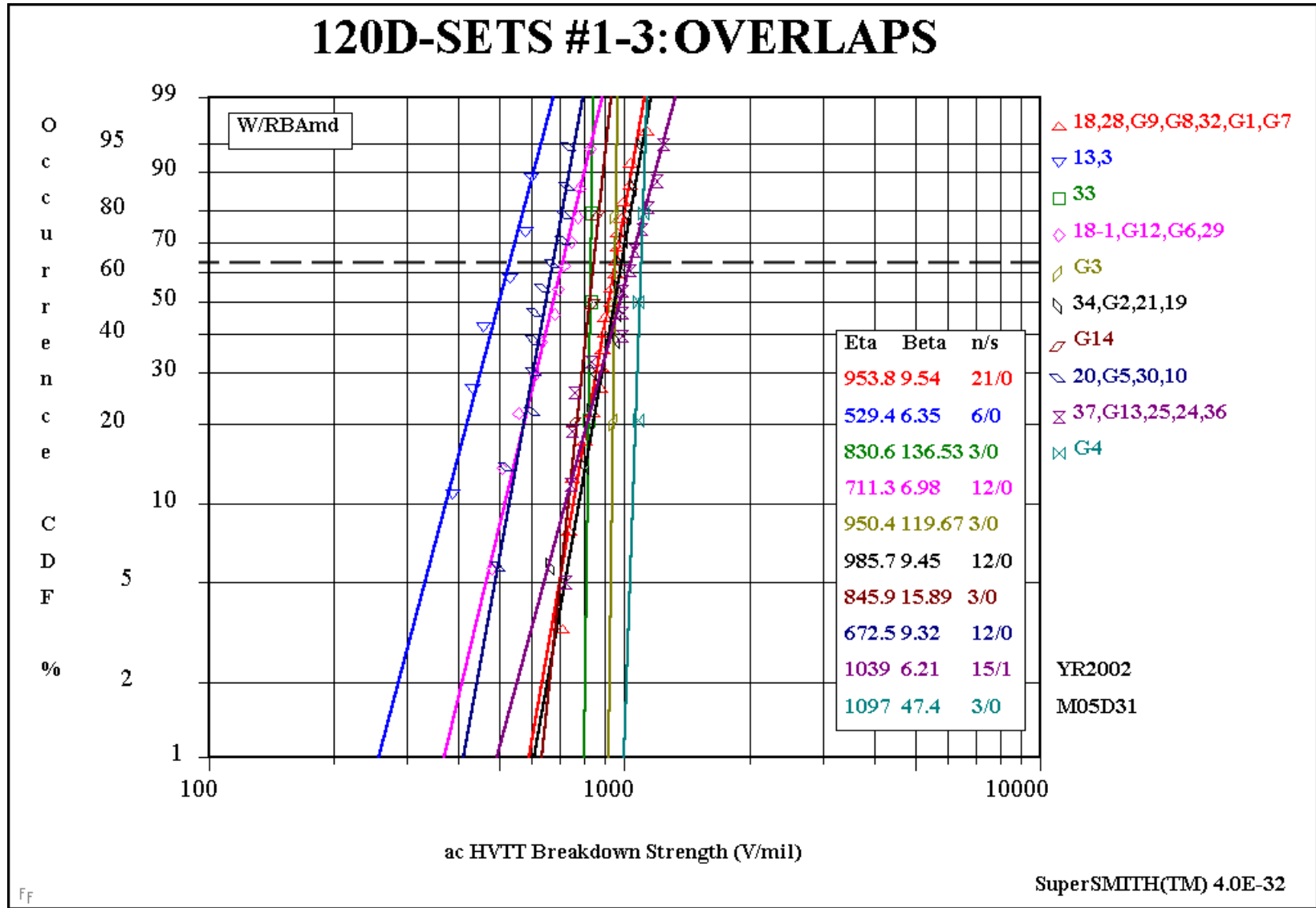
120D AWTT HVTT 6th 10 Data Sets - mmle/RBA Contours Overlap



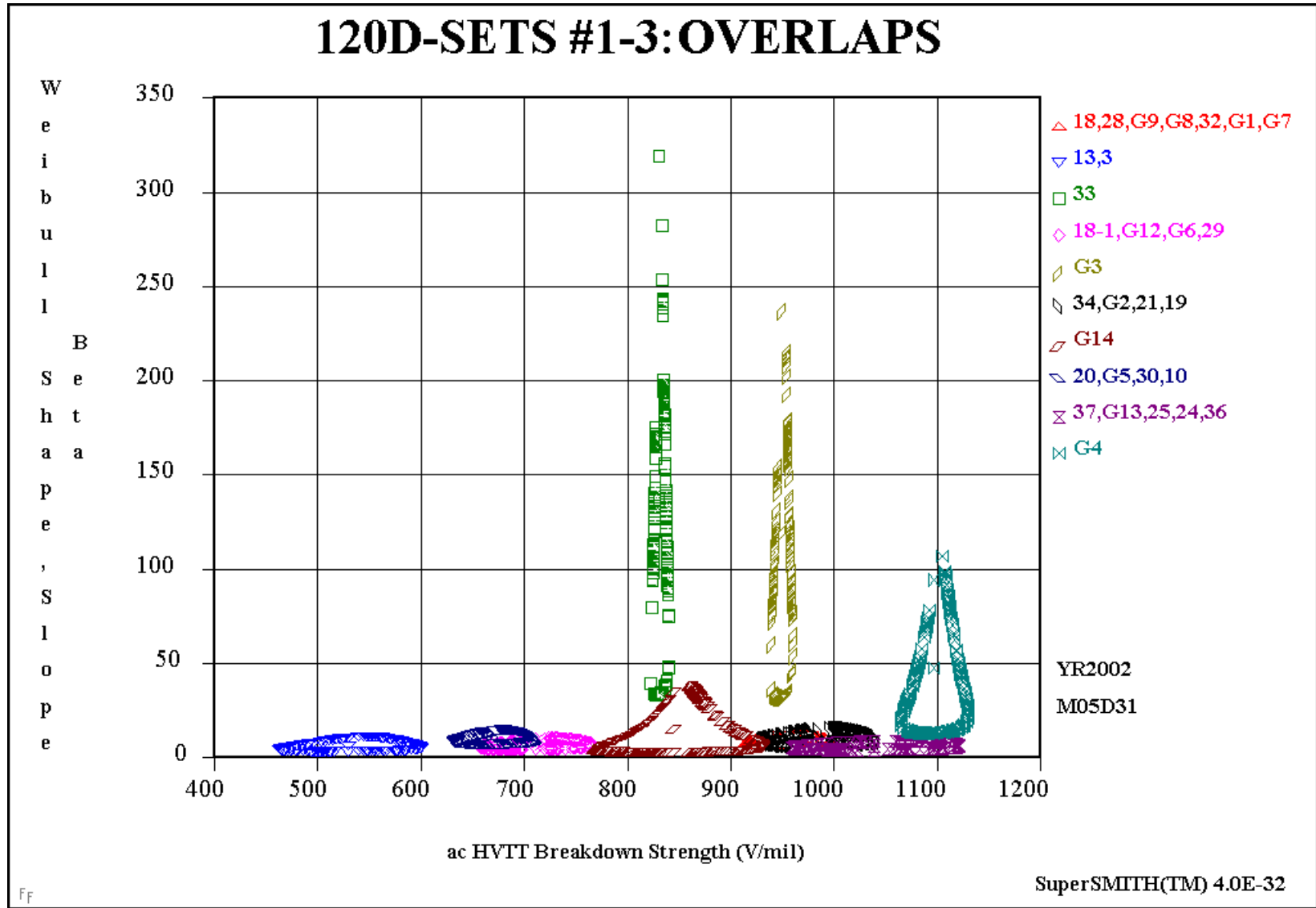
120D AWTT HVTT 6th 10 Data Sets - Merged via mmle/RBA Contours Overlap



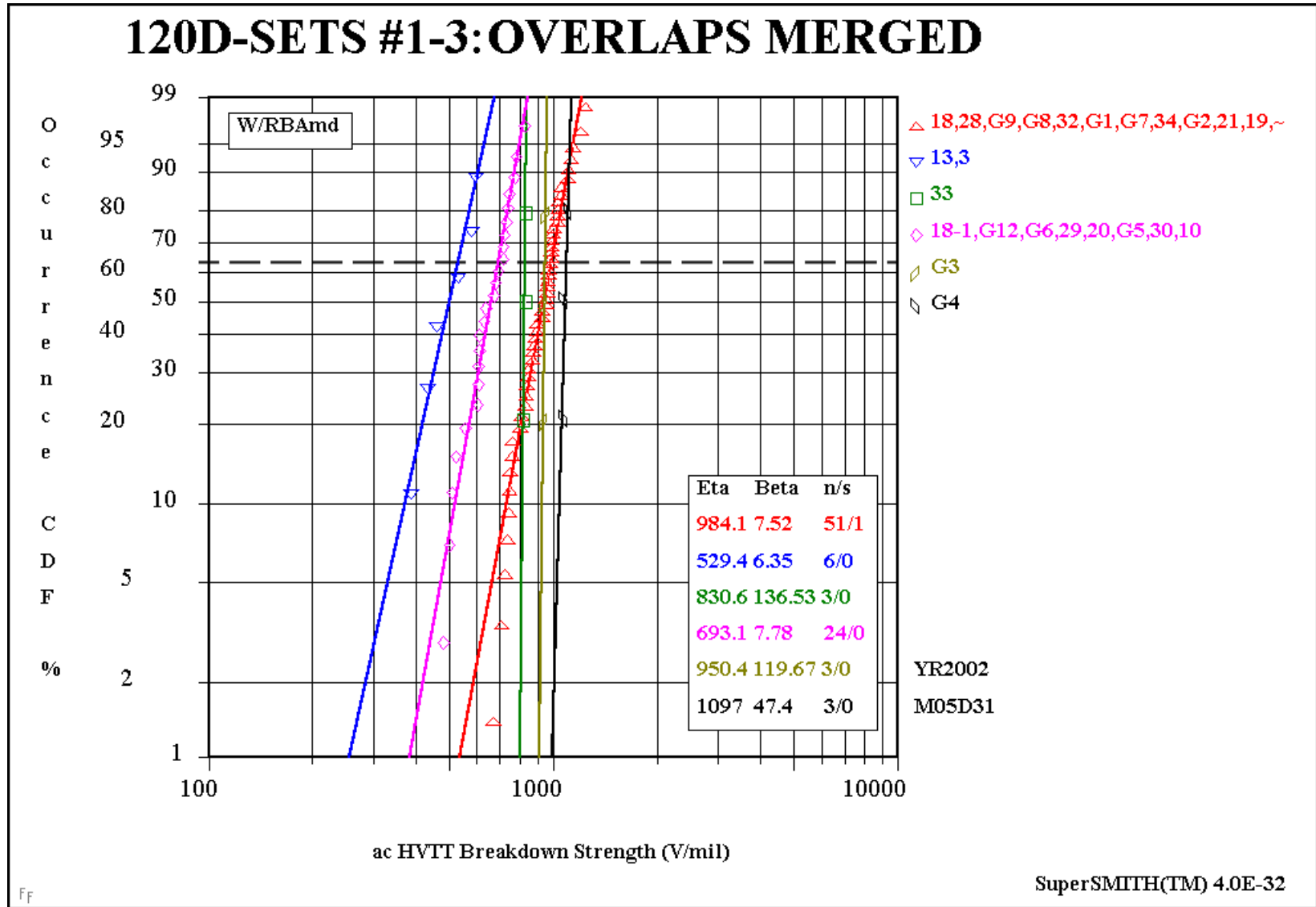
# 120D AWTT HVTT Data Sets: 1-3 Overlaps



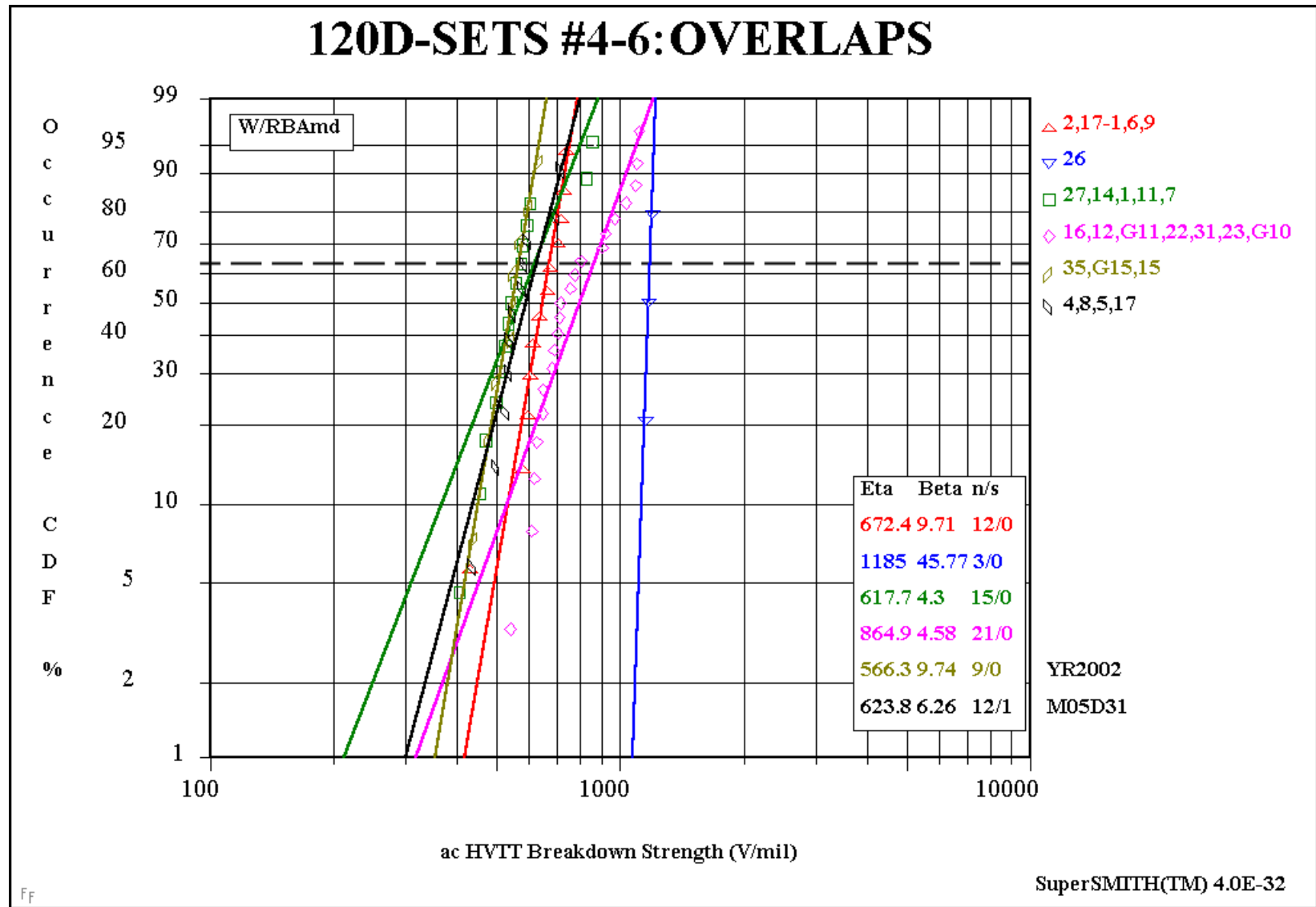
# 120D AWTT HVTT Data Sets: 1-3 Overlaps - mmle/RBA Contours



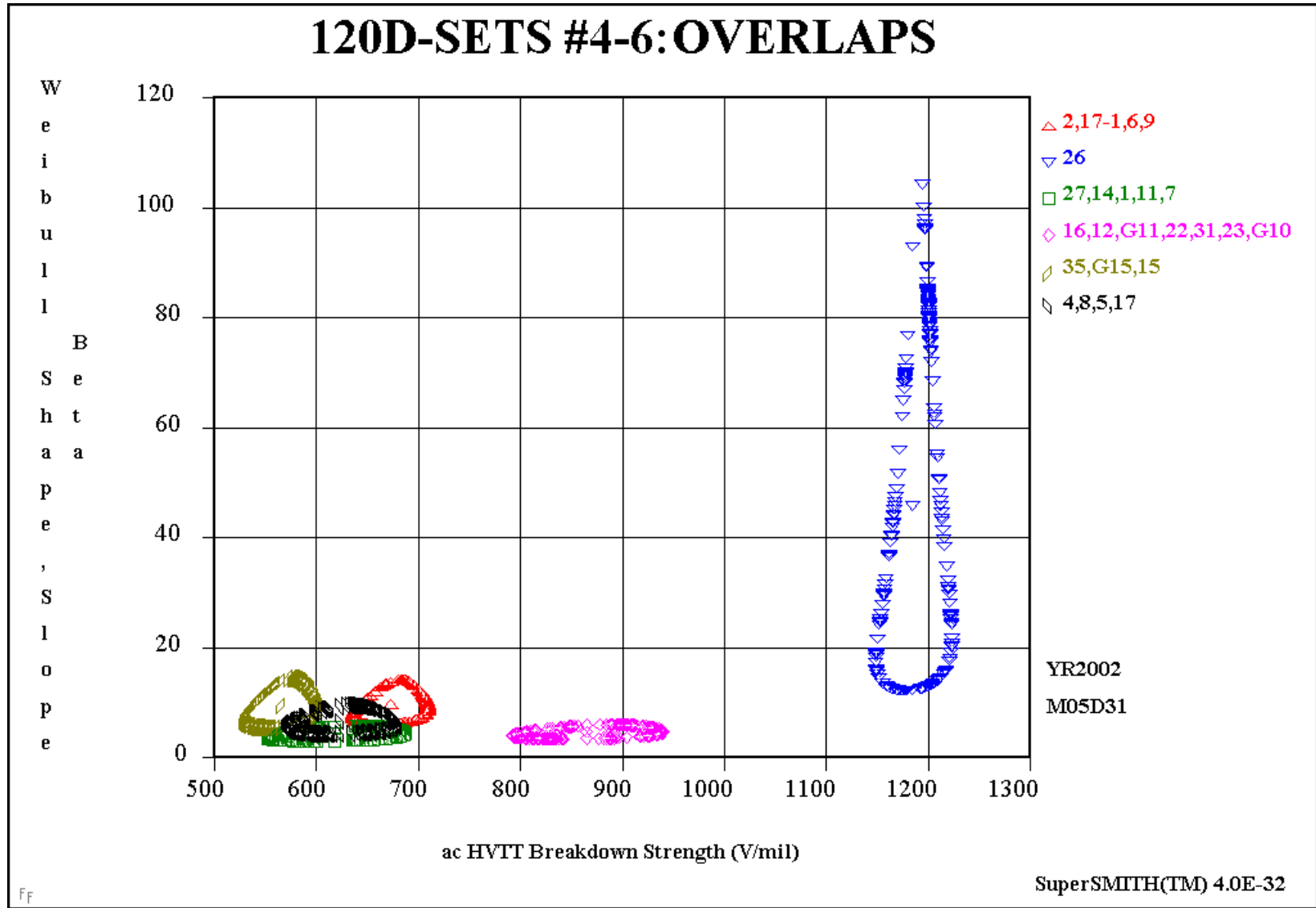
# 120D AWTT HVTT Merged Data Sets - 1-3: - Combined via Contours Overlap



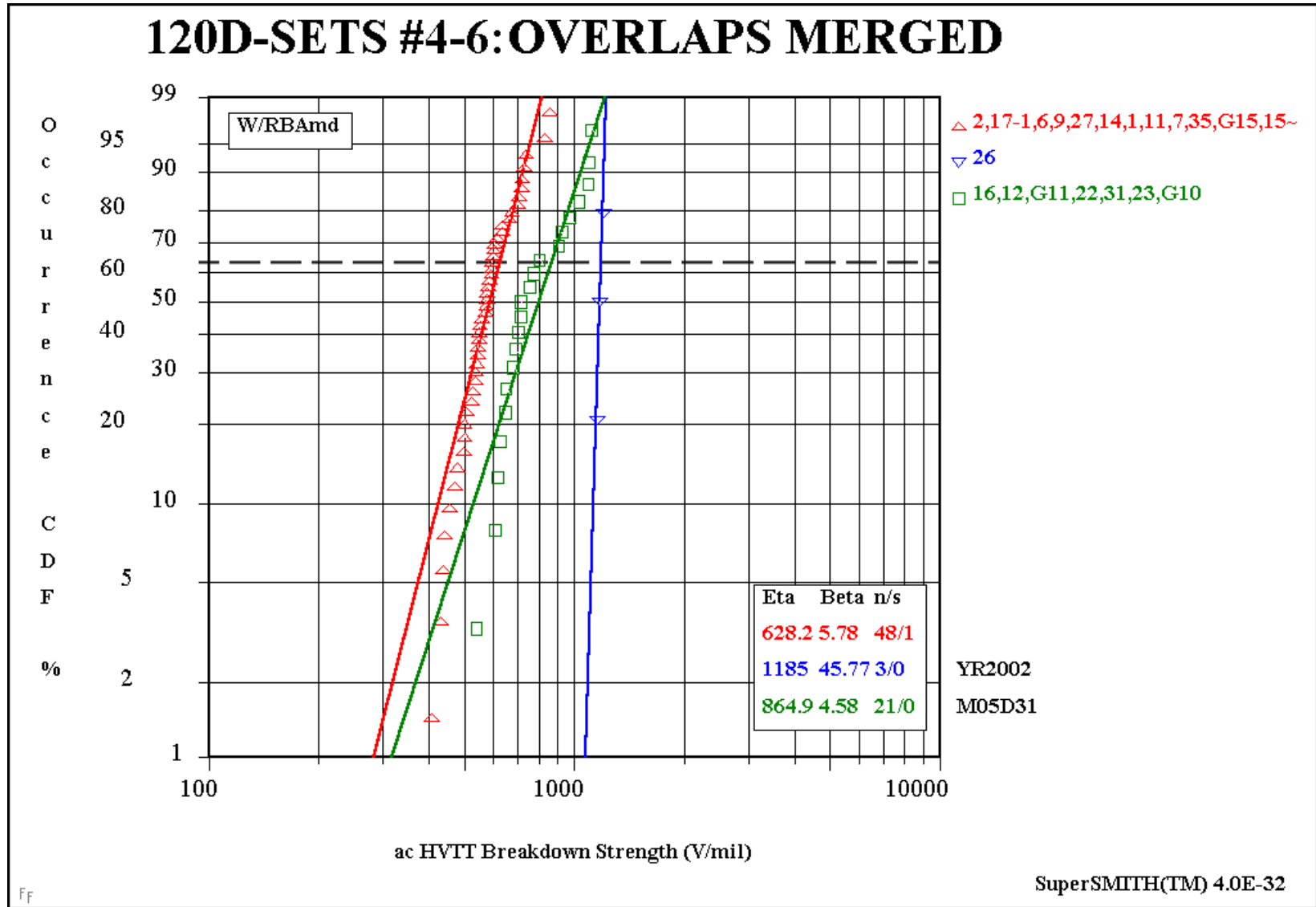
# 120D AWTT HVTT Data Sets: 4- 6 Overlaps



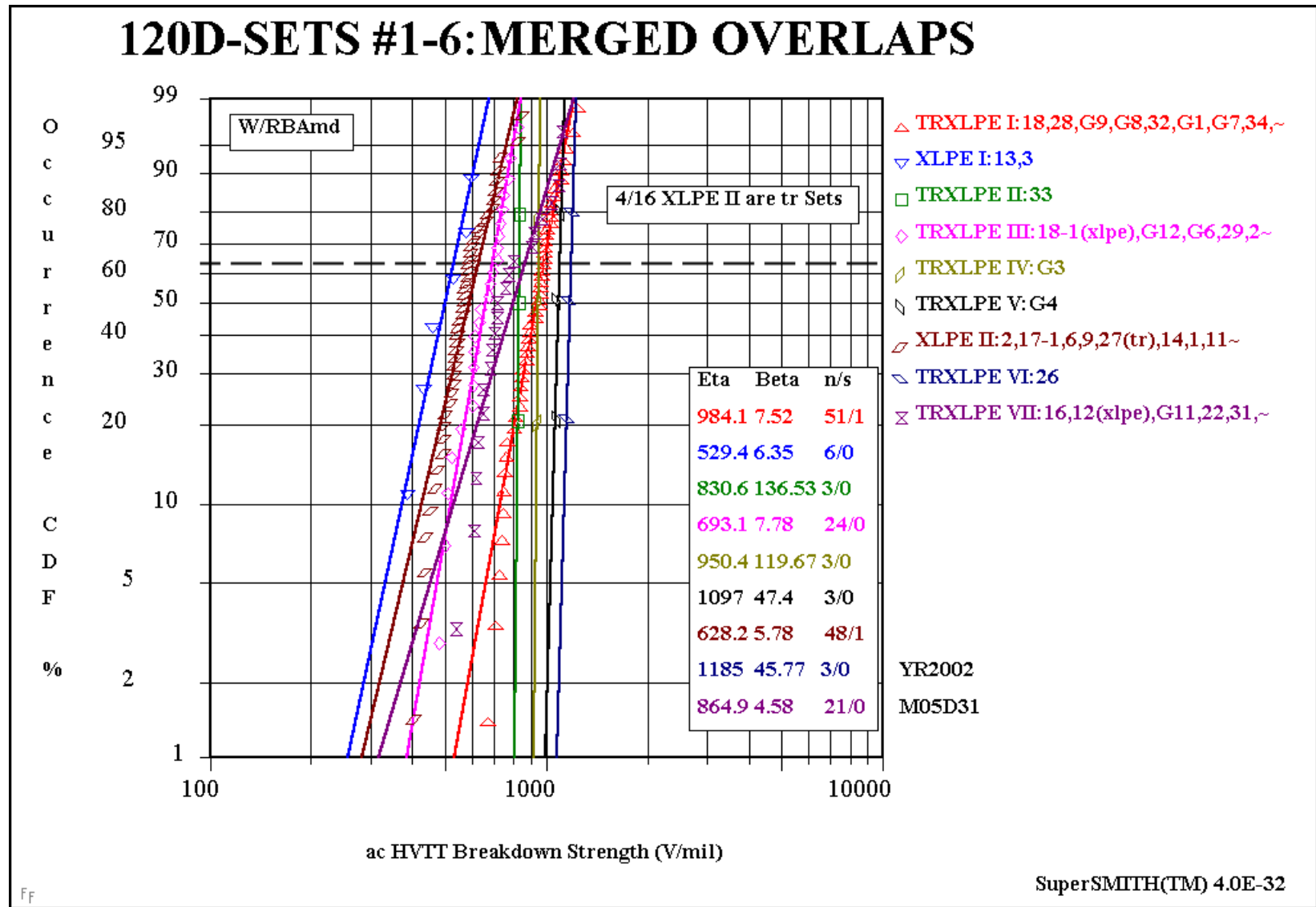
# 120D AWTT HVTT Data Sets: 4- 6 Overlaps - mmle/RBA Contours



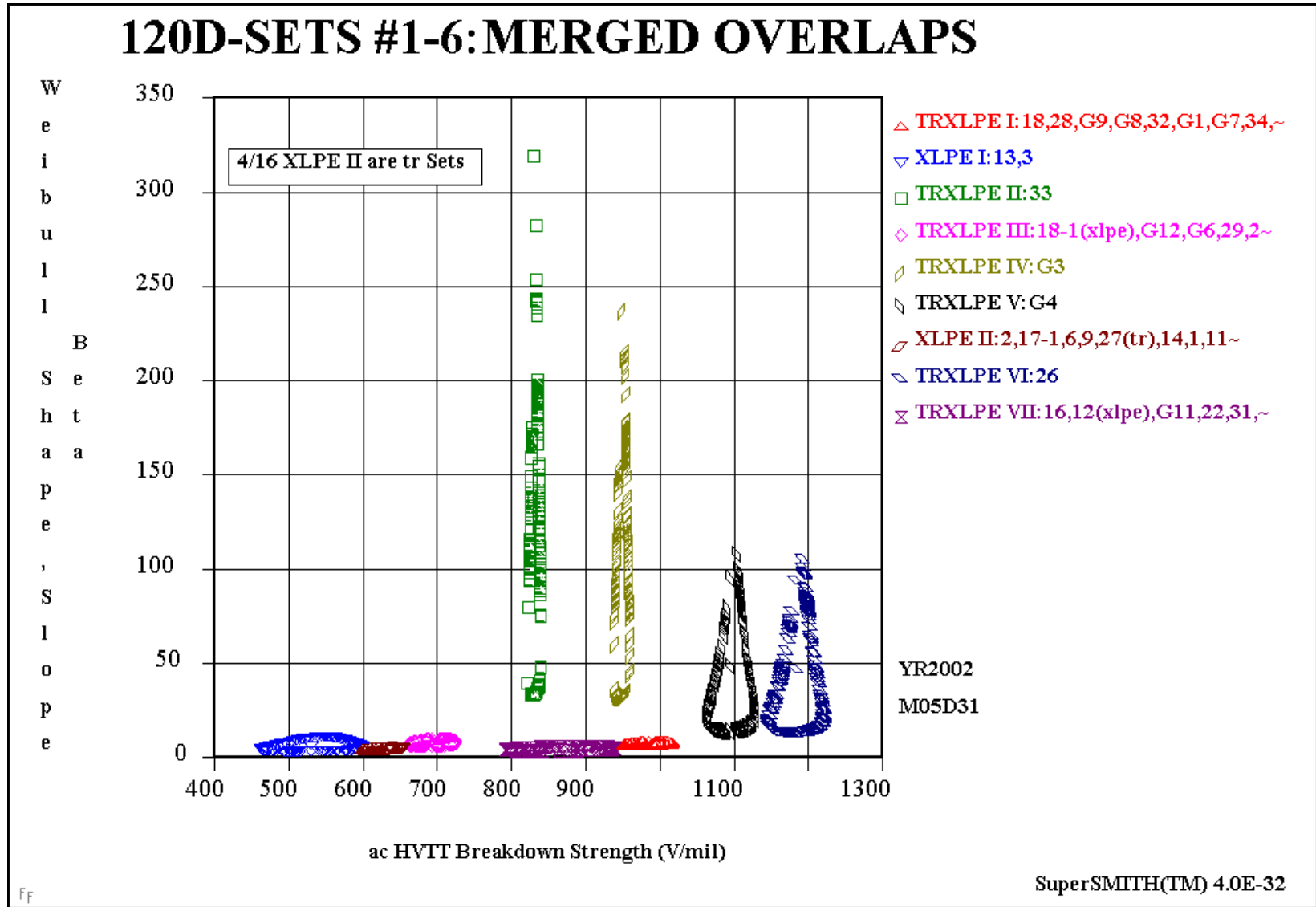
# 120D AWTT HVTT Merged Data Sets 4 - 6: - Combined via Contours Overlap



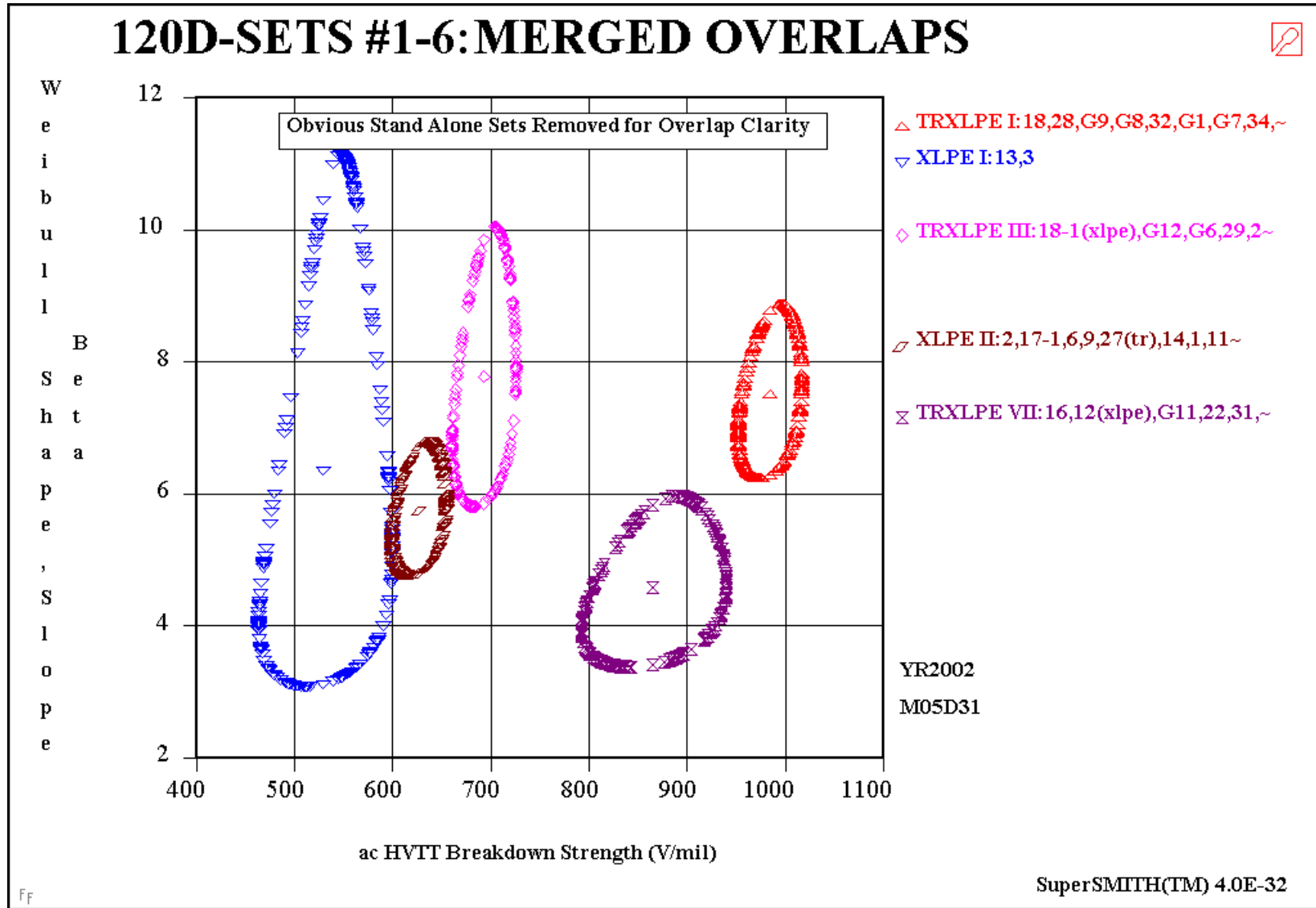
# 120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps



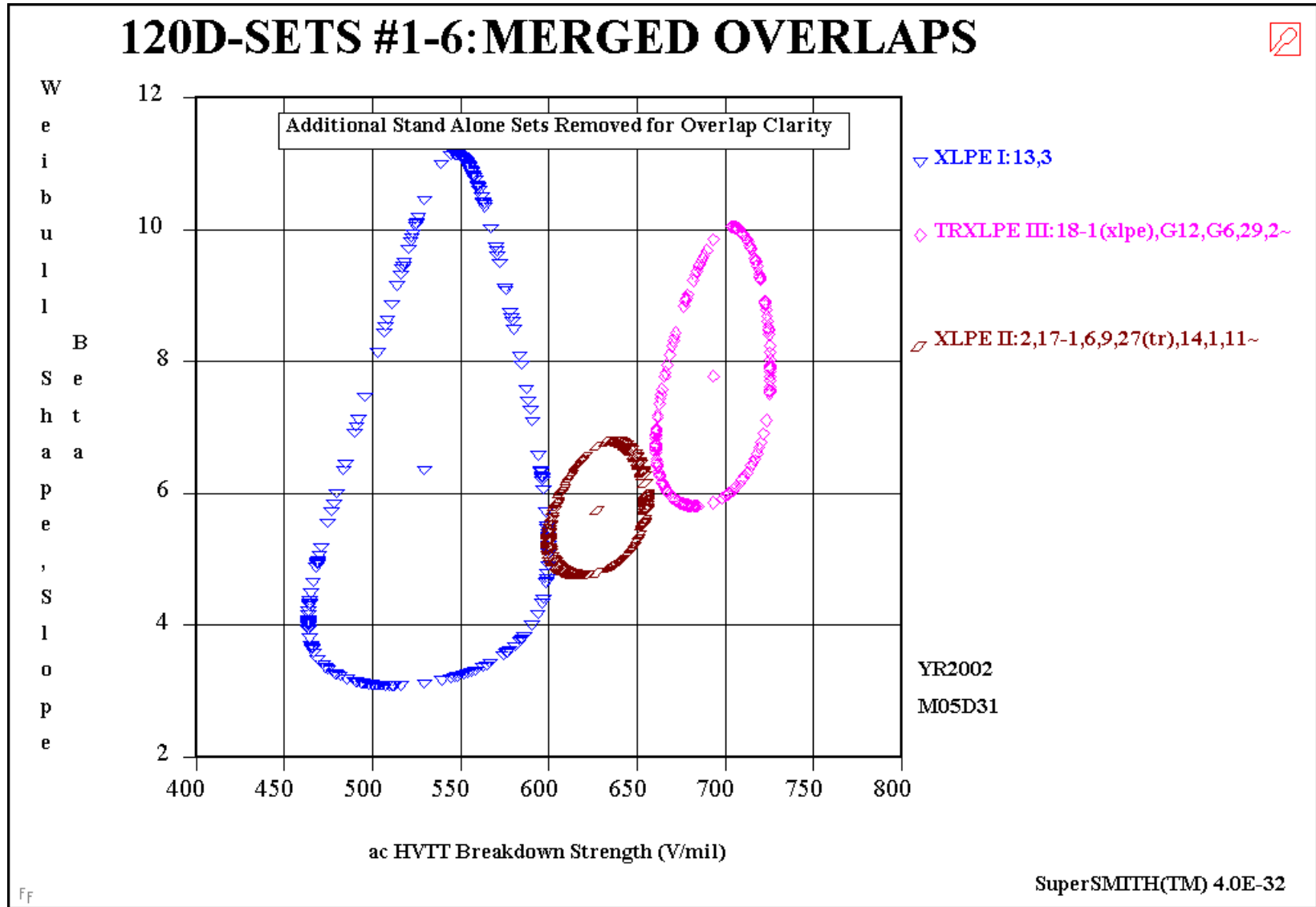
# 120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - mmle/RBA Contours



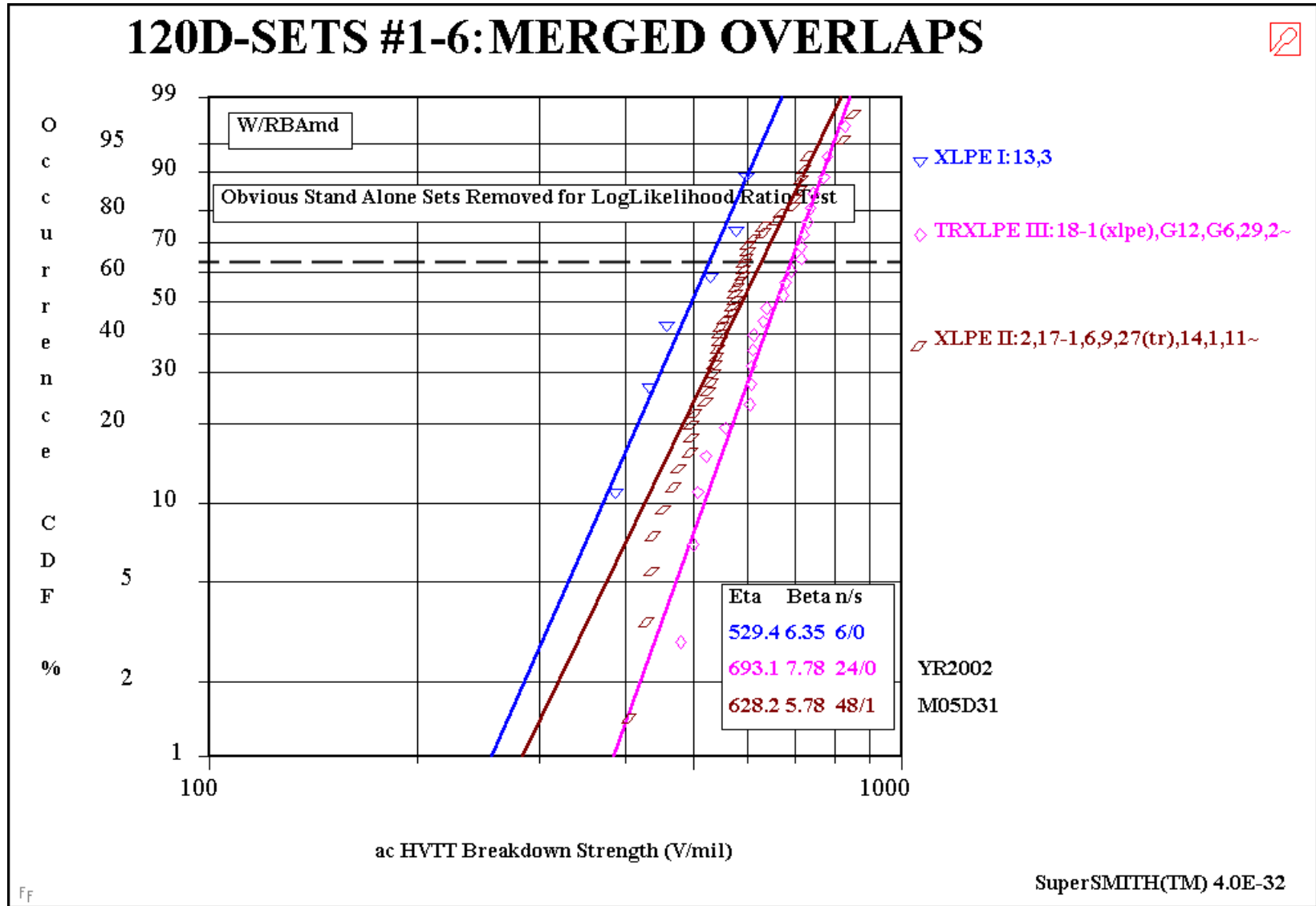
# 120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - mmle/RBA Contours



# 120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - mmle/RBA Contours



# 120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - LogLikelihood Test Confirmation of Overlap for XLPE I, TRXLPE III and XLPE II



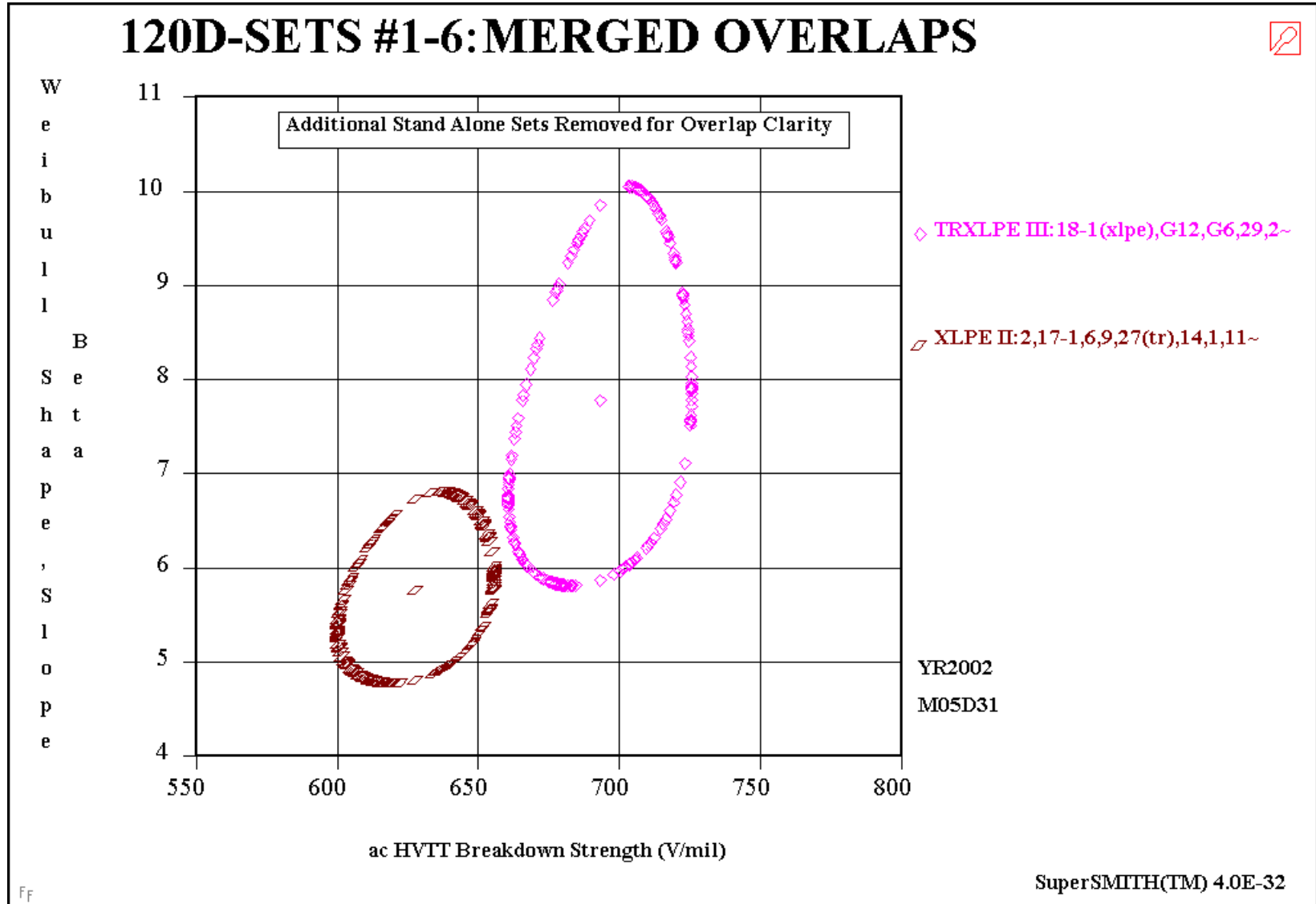
120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - LogLikelihood Test  
Confirmation of Overlap for XLPE I, TRXLPE III and XLPE II

**Weibull Log Likelihood (LL) Comparison: Set Quantity = 3**

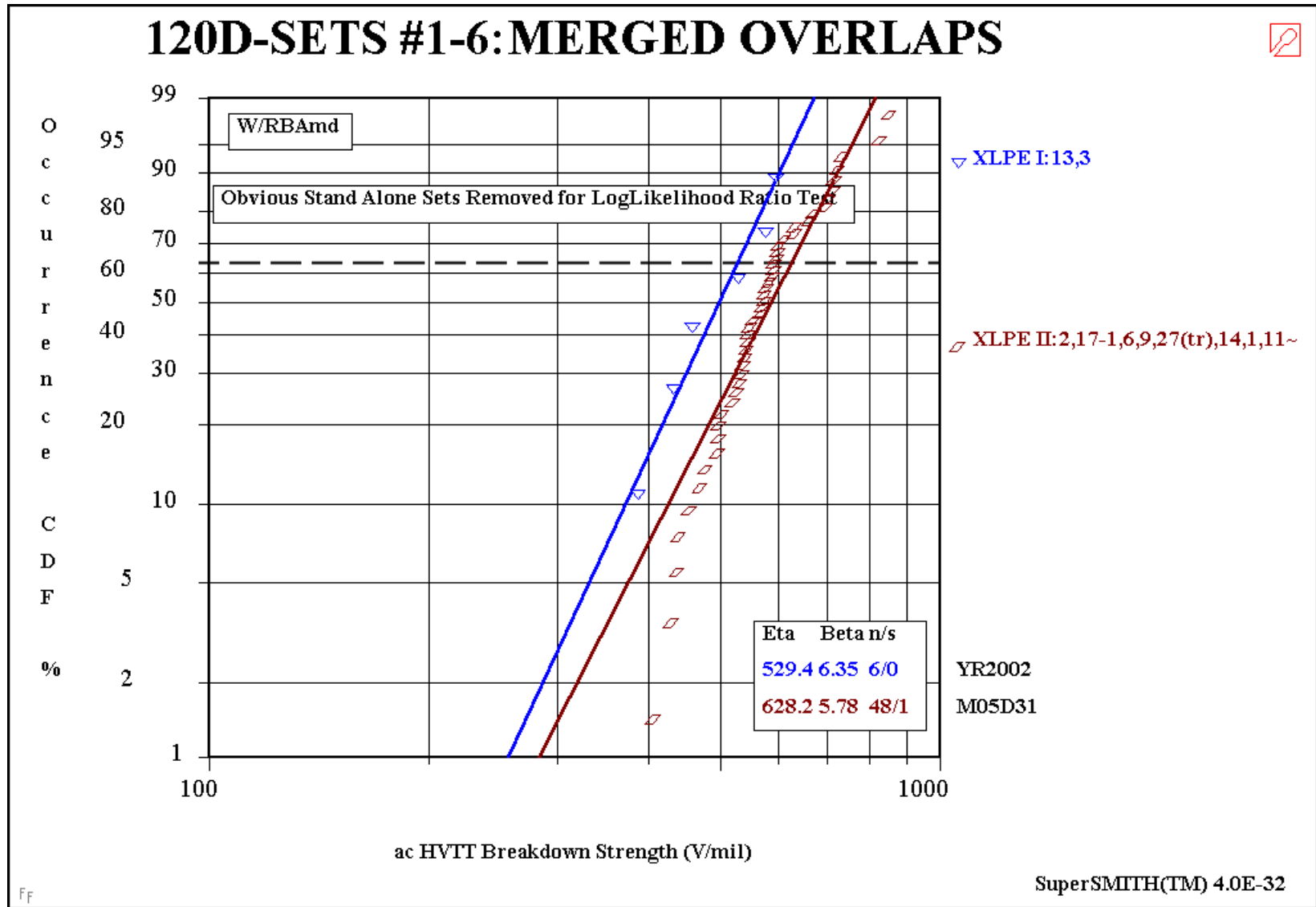
**98.6 % pff-Value Confidence**  
**Set 2-4-7 Difference Significance**

**(99.32 % p-Value With Standard mle Test Bias)**  
**(LL3 Set Quantity 3 = -464.6716)**  
**(LL1 All 1 Set = -471.7531)**  
**(LL3-LL1 = 14.16309 / 2)**

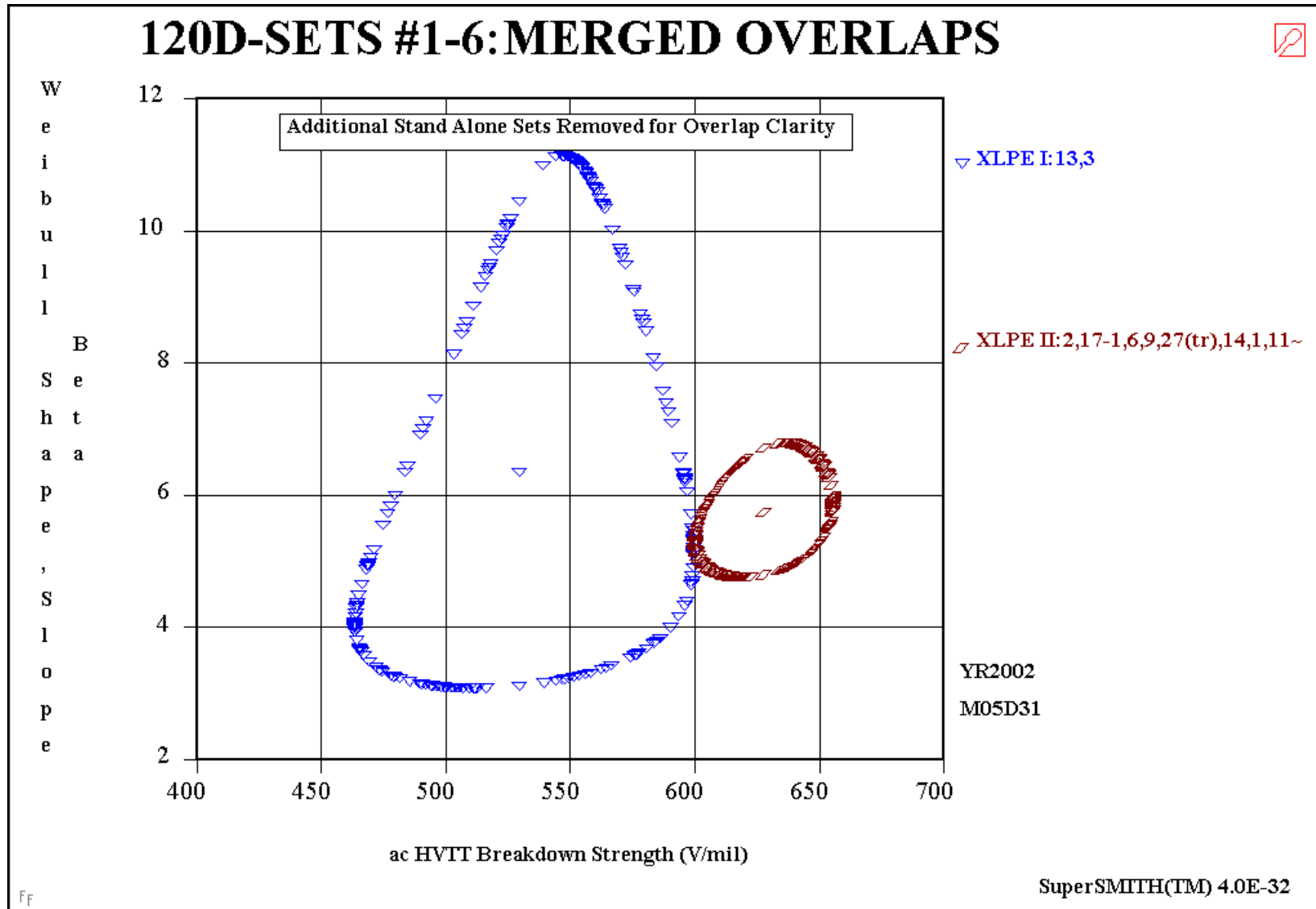
120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - mmle/RBA Contours  
 Confirmation of LogLikelihood Test for Overlap of TRXLPE III and XLPE II



# 120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - LogLikelihood Test Confirmation of Overlap for XLPE I and XLPE II



120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - LogLikelihood Test  
Confirmation of Overlap for XLPE I, TRXLPE III and XLPE II



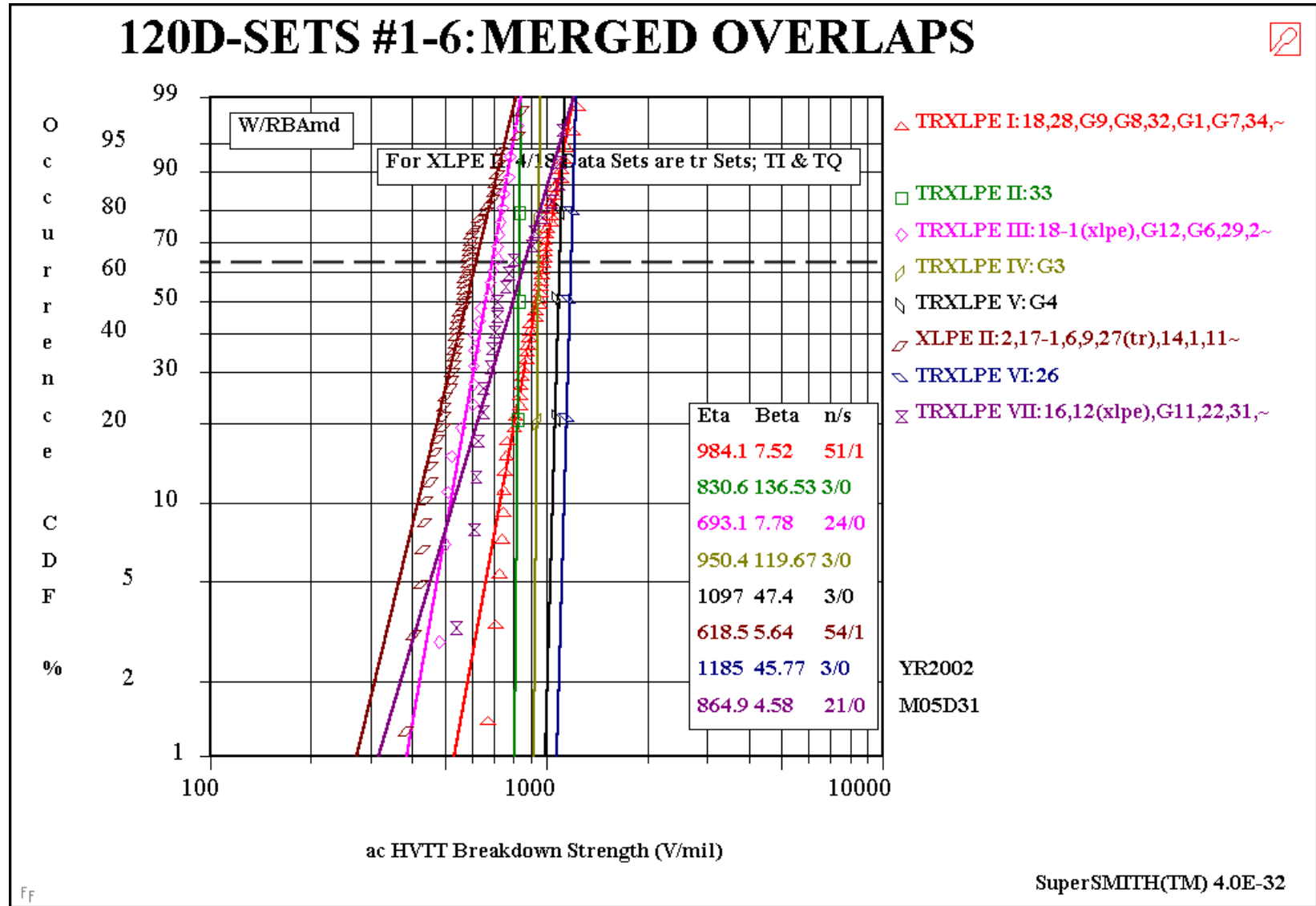
120D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - LogLikelihood Test  
Confirmation of Overlap for XLPE I and XLPE II

**Weibull Log Likelihood (LL) Comparison: Set Quantity = 2**

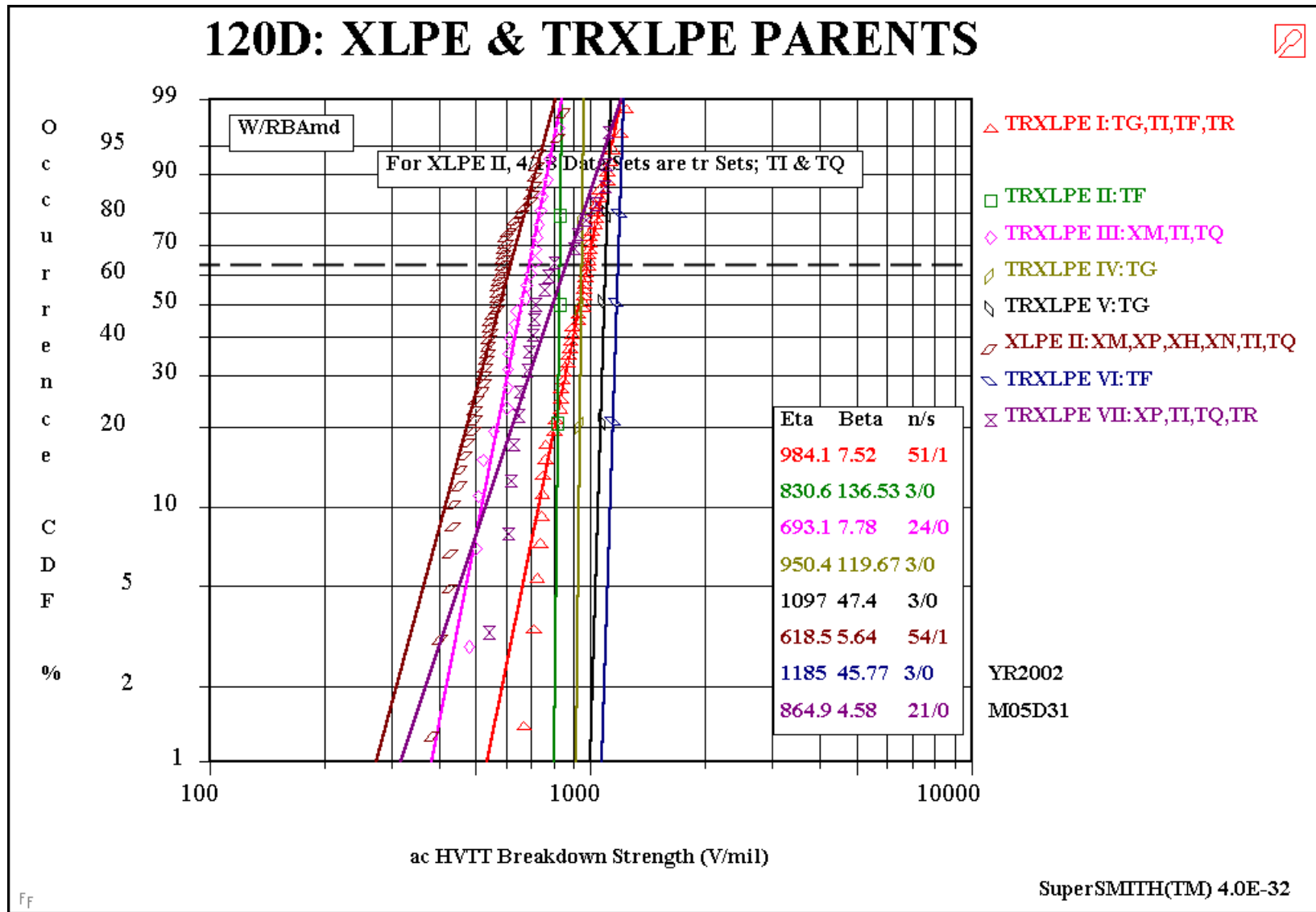
**89.25 % pff-Value Confidence**  
**Set 2-7 Difference Significance**

**(92.6 % p-Value With Standard mle Test Bias)**  
**(LL2 Set Quantity 2 = -321.8479)**  
**(LL1 All 1 Set = -324.452)**  
**(LL2-LL1 = 5.208158 / 2)**

# 120D AWTT HVTT PARENT POPULATIONS



# 120D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



## 120D AWTT HVTT PARENT POPULATIONS - Test for Outliers

### **Outlier Test: Extreme Point P-Value (%)**

**Note: For All Occurrence Only**

**Set 1: 78.14461 (Lower Okay) ... 99.12993 (Upper Okay)**

**Set 2: Plot Point Quantity < 3**

**Set 3: .0889693 (Lower <1.35!) ... 48.89521 (Upper Okay)**

**Set 4: 62.16627 (Lower Okay) ... 84.16019 (Upper Okay)**

**Set 5: 64.46032 (Lower Okay) ... 100 (Upper >99.55!)**

**Set 6: 64.46014 (Lower Okay) ... 100 (Upper >99.55!)**

**Set 7: 78.04605 (Lower Okay) ... 99.99526 (Upper >99.55!)**

**Set 8: 33.01181 (Lower Okay) ... 99.66966 (Upper >99.55!)**

**Set 9: 68.72868 (Lower Okay) ... 93.79952 (Upper Okay)**

**Outlier Value (s) in Upper CDF range of XLPE II (Set 7).**

**Remove and Re-test for Outliers**

## 120D AWTT HVTT PARENT POPULATIONS - 2 Outlier Values Removed

### Outlier Test: Extreme Point P-Value (%)

**Note: For All Occurrence Only**

**Set 1: 78.14461 (Lower Okay) ... 99.12993 (Upper Okay)**

**Set 2: Plot Point Quantity < 3**

**Set 3: .0889693 (Lower <1.35!) ... 48.89521 (Upper Okay)**

**Set 4: 62.16627 (Lower Okay) ... 84.16019 (Upper Okay)**

**Set 5: 64.46032 (Lower Okay) ... 100 (Upper >99.55!)**

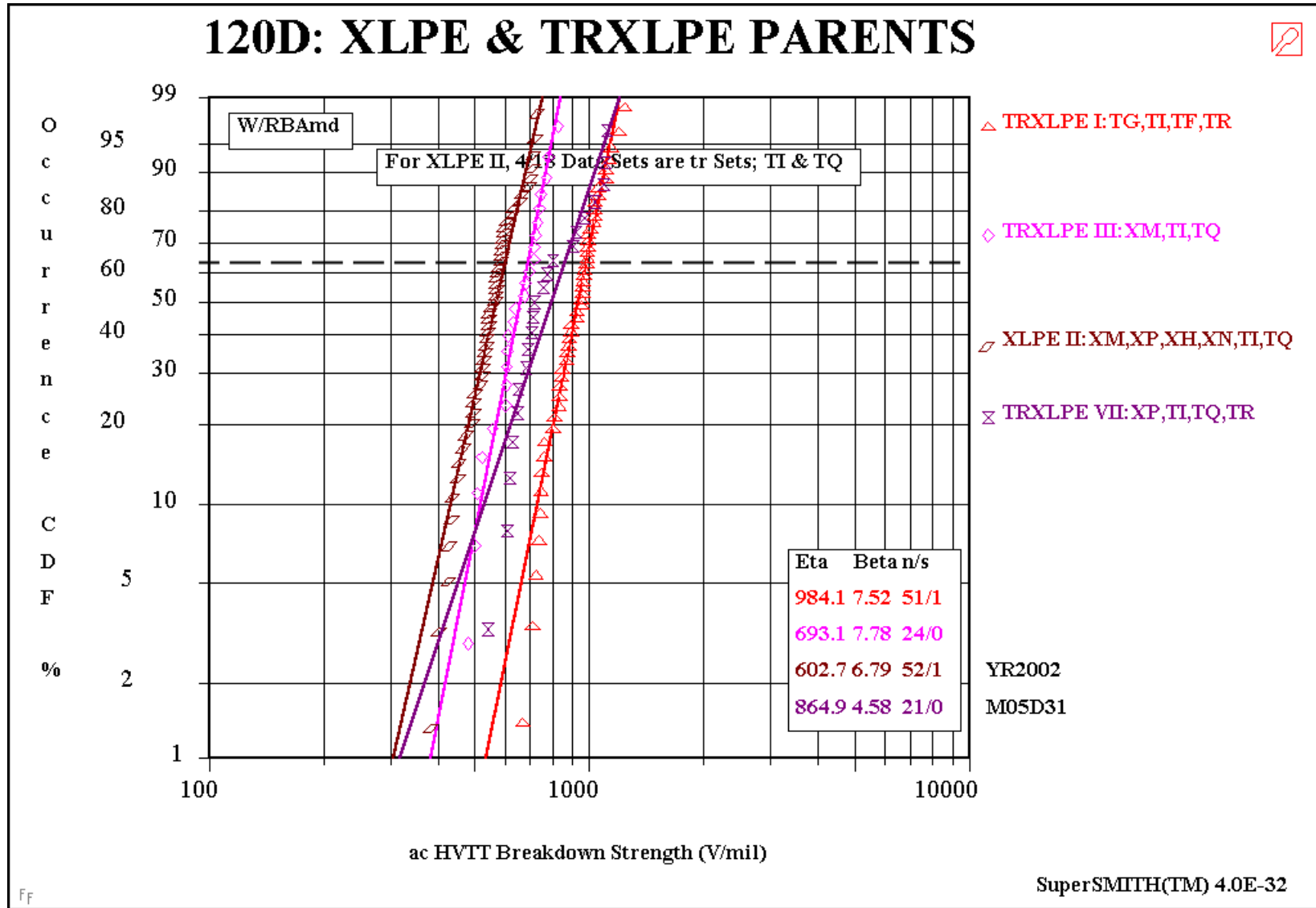
**Set 6: 64.46014 (Lower Okay) ... 100 (Upper >99.55!)**

**Set 7: 71.45324 (Lower Okay) ... 84.73547 (Upper Okay)**

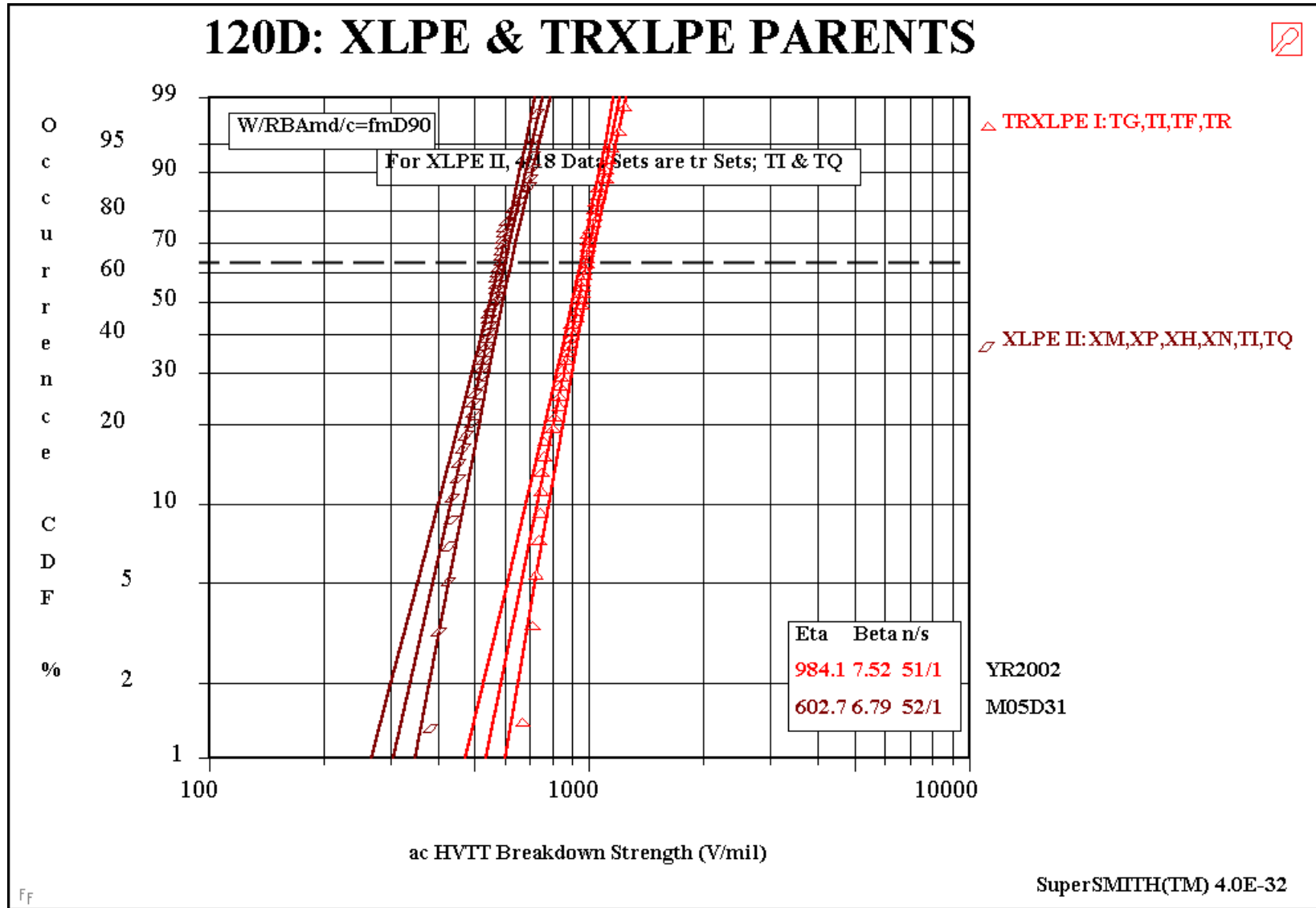
**Set 8: 33.01181 (Lower Okay) ... 99.66966 (Upper >99.55!)**

**Set 9: 68.72868 (Lower Okay) ... 93.79952 (Upper Okay)**

# 120D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



# 120D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



## 120D AWTT HVTT PARENT POPULATIONS - B10 Minimum Values

**Set 7 - XLPE II:XM,XP,XH,XN,TI,TQ ... Beta = 6.786928 Eta = 602.661**

**From ac HVTT Breakdown Strength = 400.5602 To 467.1725 (V/mil)**

**.1 (10%) Will Occur**

**.9 (90%) Will NOT Occur**

**[Confidence = 90%]**

**Set 1 - TRXLPE I:TG,TL,TF,TR ... Beta = 7.52053 Eta = 984.1429**

**From ac HVTT Breakdown Strength = 680.4982 To 782.3148 (V/mil)**

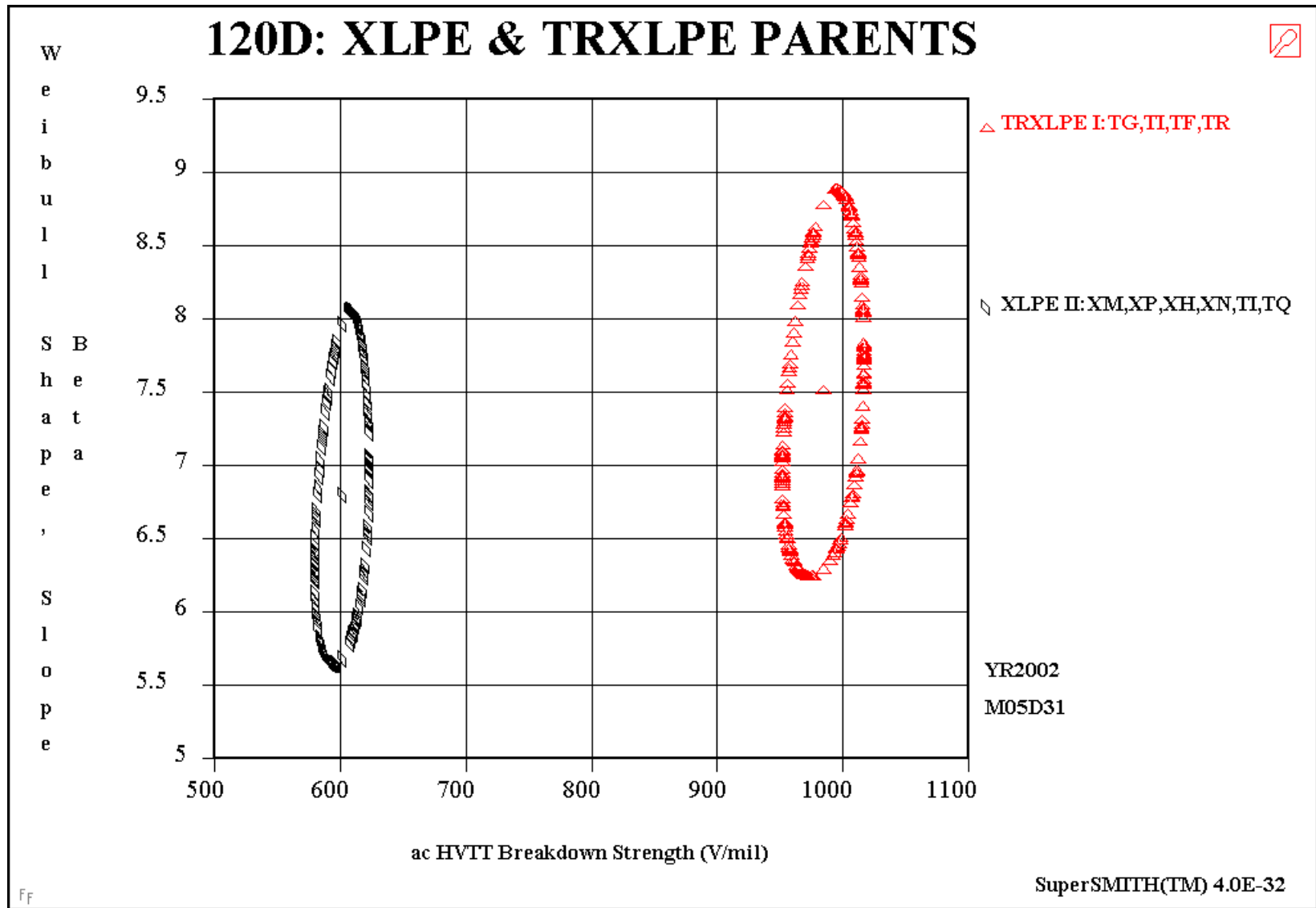
**.1 (10%) Will Occur**

**.9 (90%) Will NOT Occur**

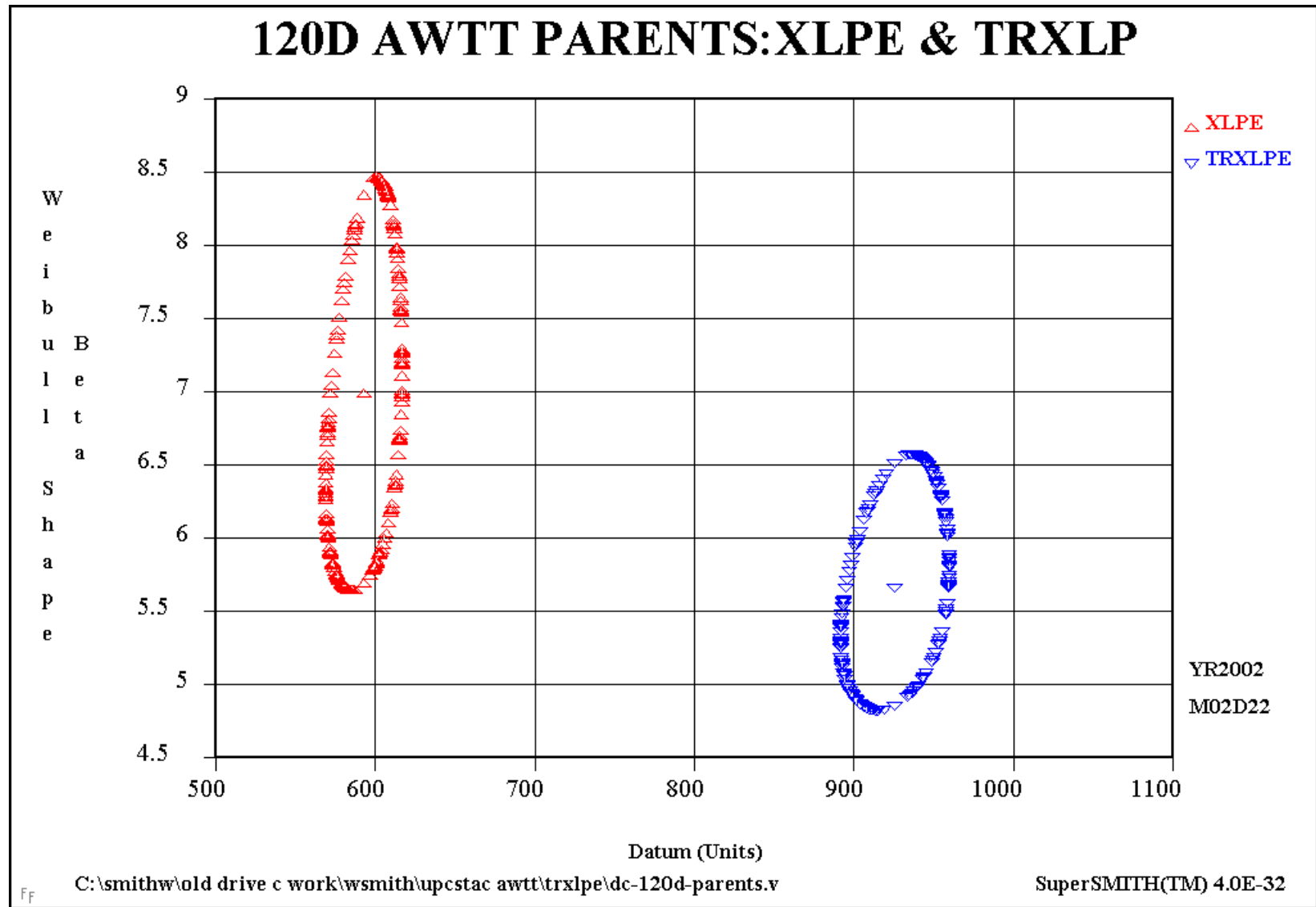
**[Confidence = 90%]**

**Obviously No Overlap of XLPE Upper 90% Confidence Bound B10 Value  
and TRXLPE Lower 90% Confidence Bound B10 Value.**

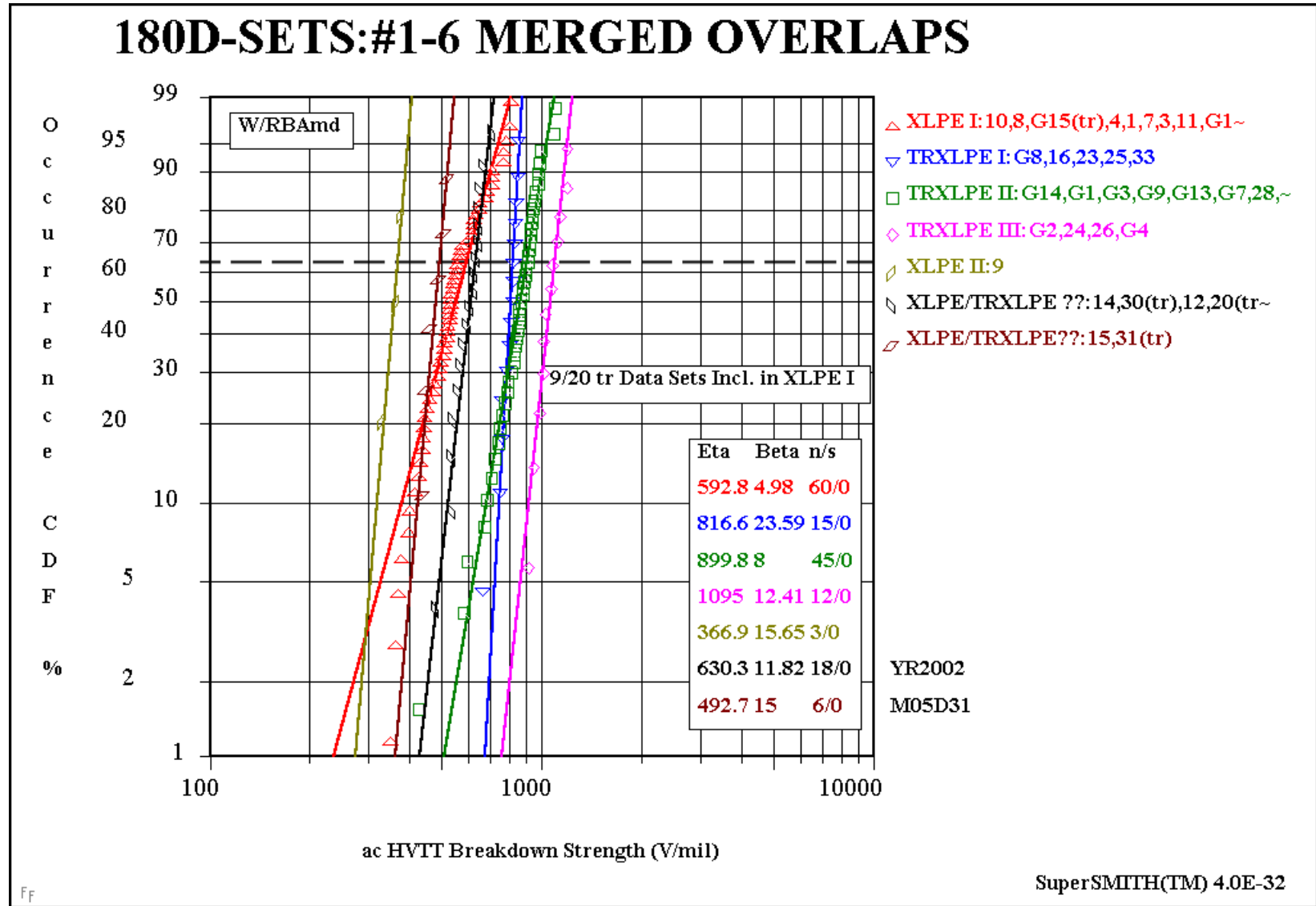
# 120D AWTT HVTT PARENT POPULATION - RANDOMIZED ANALYSIS



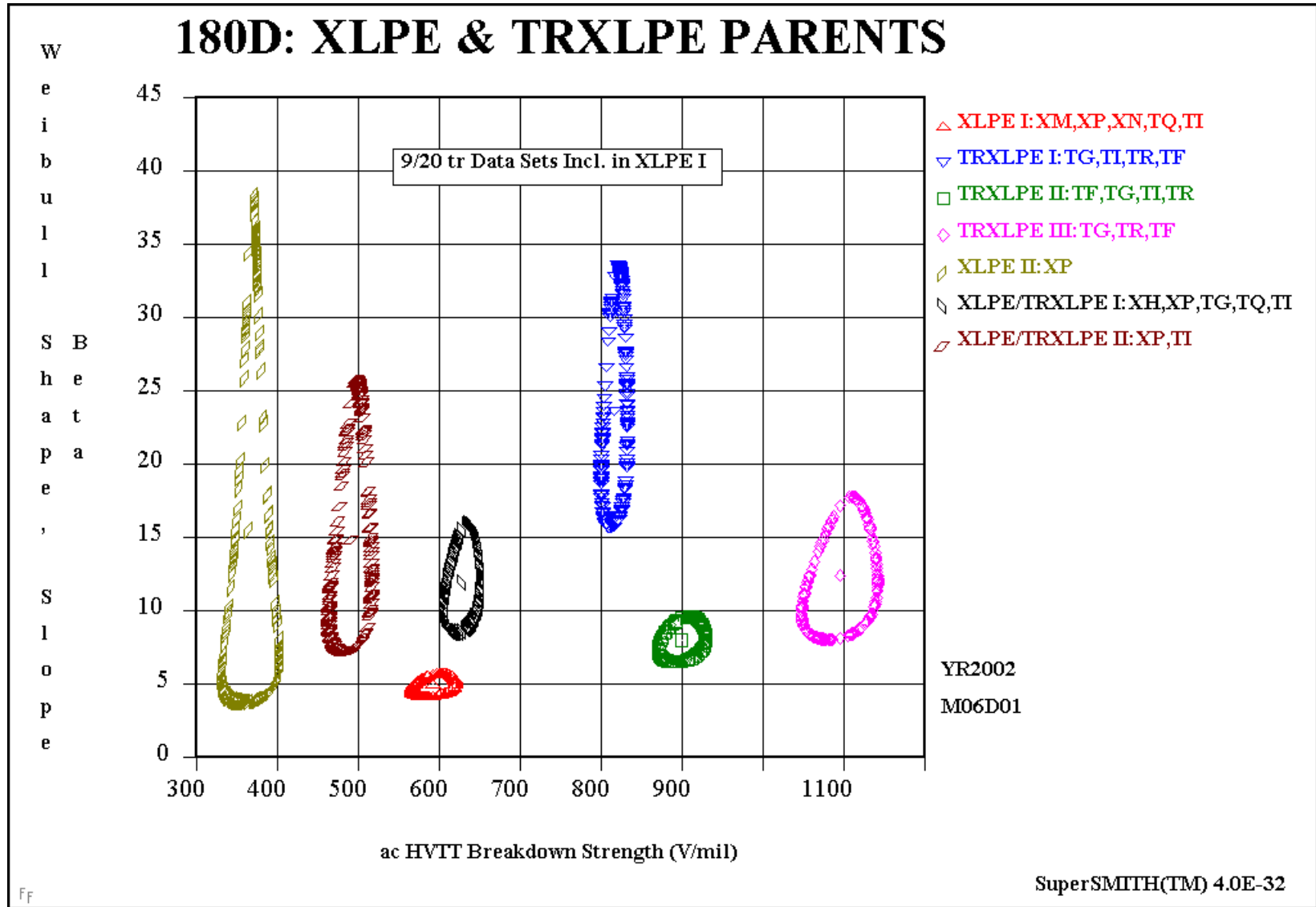
# 120D AWTT HVTT PARENT POPULATION - PREVIOUS SEPARATE ANALYSIS



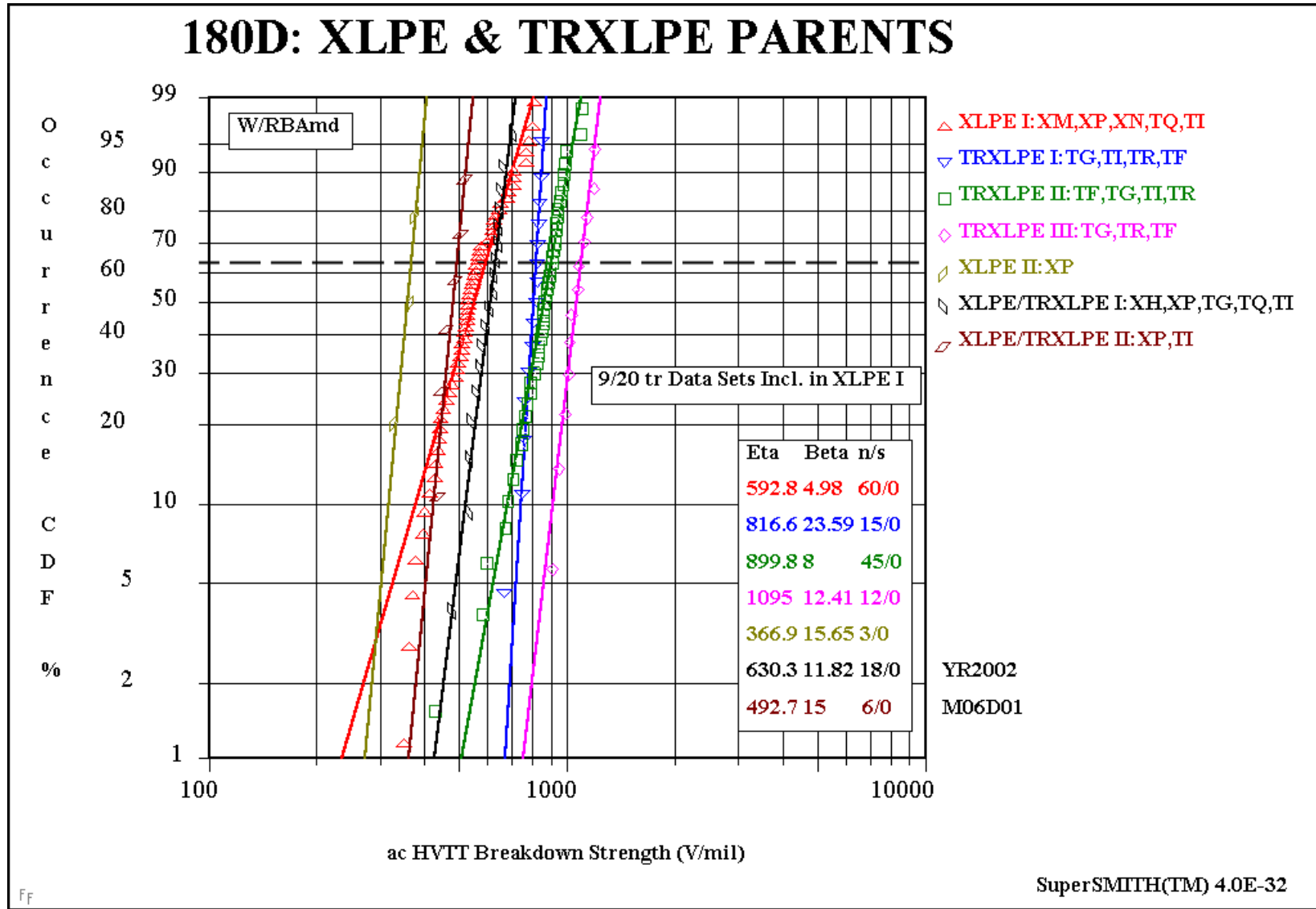
# 180D AWTT HVTT Data Sets: 1- 6 Combined Overlaps



# 180D AWTT HVTT Data Sets: 1- 6 Combined Overlaps - By Material



# 180D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



## 180D AWTT HVTT PARENT POPULATIONS - Test for Outliers

### **Outlier Test: Extreme Point P-Value (%)**

**Note: For All Occurrence Only**

**Set 1: 88.45823 (Lower Okay) ... 98.02634 (Upper Okay)**

**Set 2: 3.904979 (Lower Okay) ... 12.0788 (Upper Okay)**

**Set 3: 5.658309 (Lower Okay) ... 59.58661 (Upper Okay)**

**Set 4: 46.07695 (Lower Okay) ... 83.80704 (Upper Okay)**

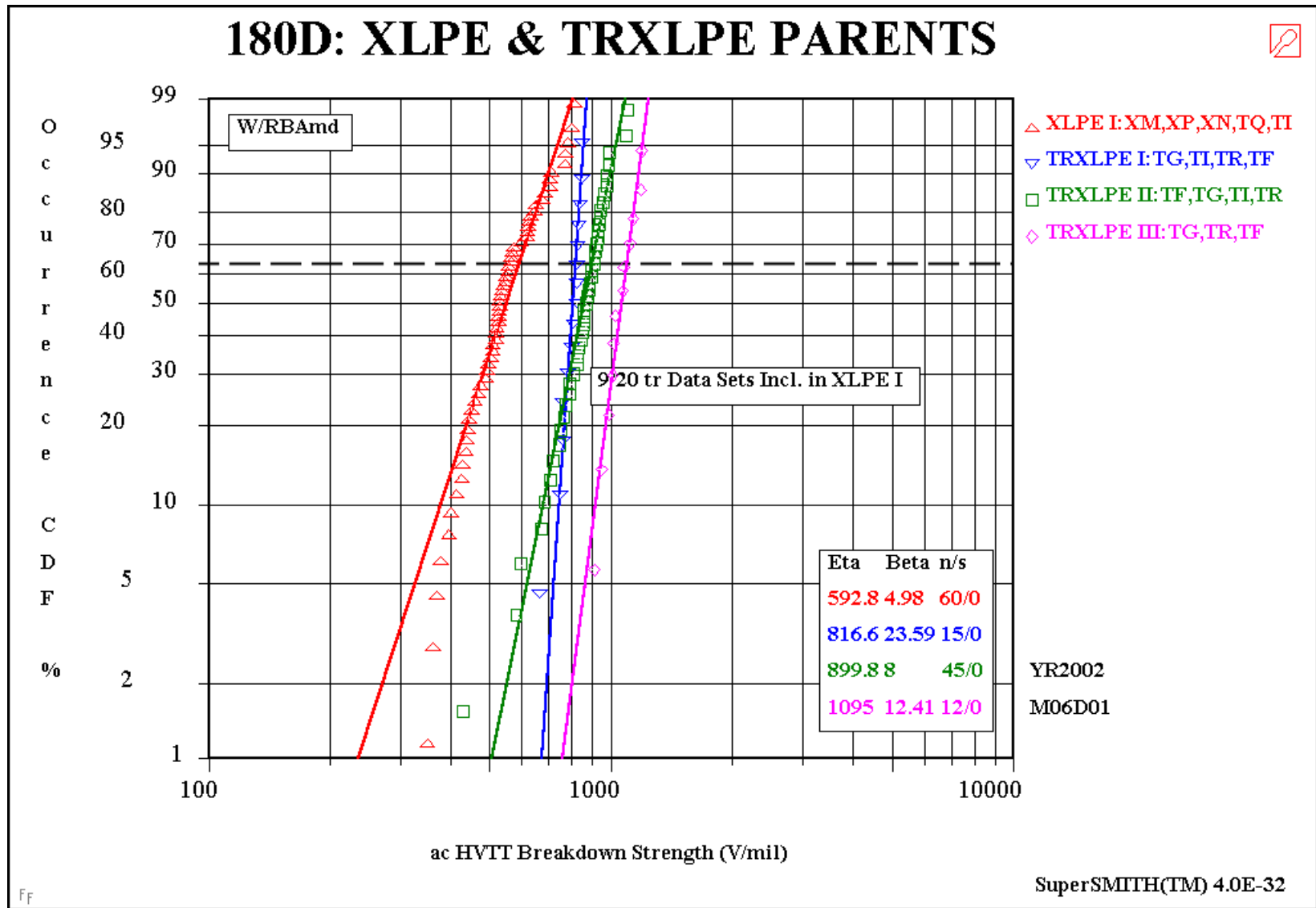
**Set 5: 2.904958 (Lower Okay) ... 62.90029 (Upper Okay)**

**Set 6: 28.41261 (Lower Okay) ... 93.01439 (Upper Okay)**

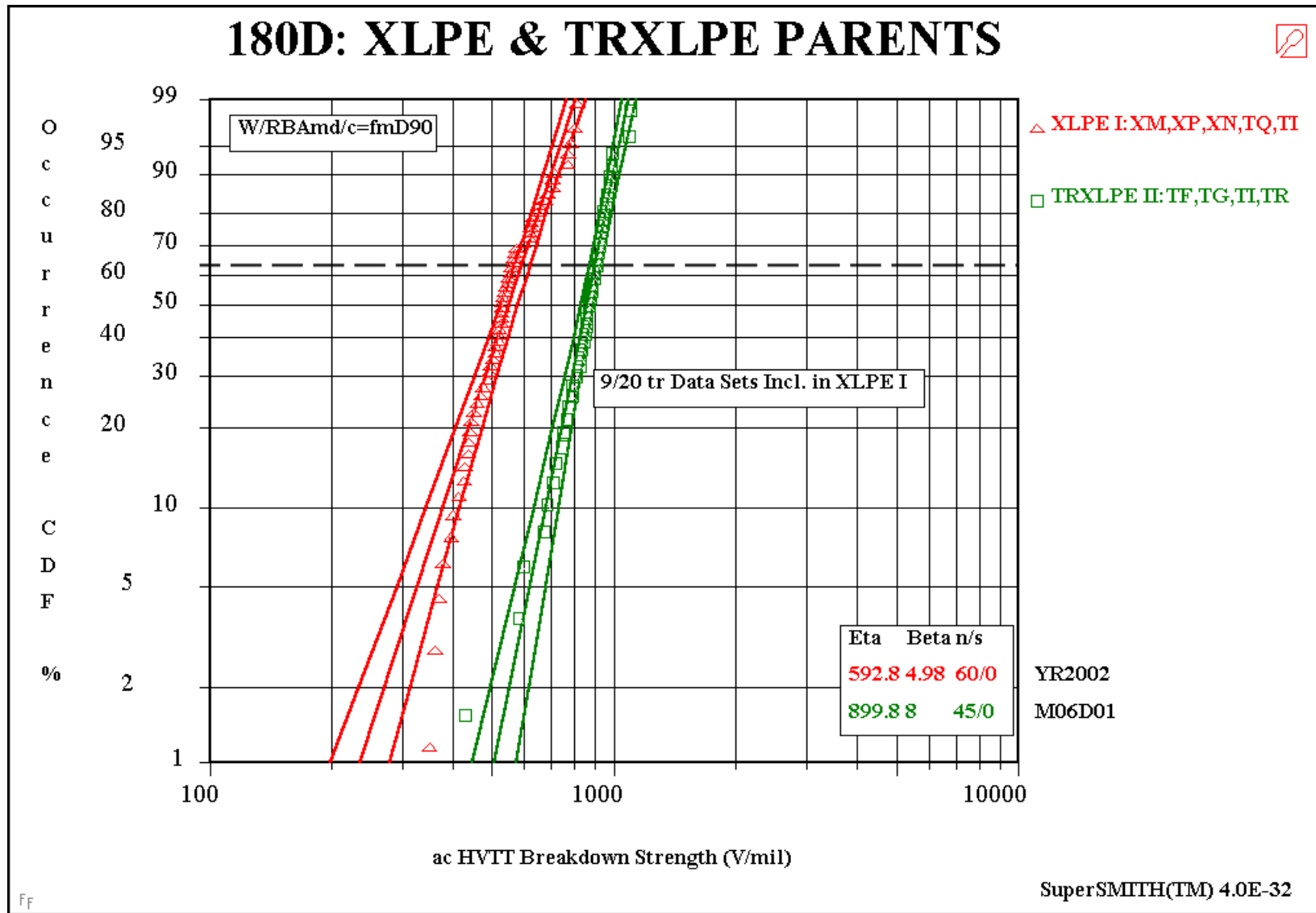
**Set 7: 48.66671 (Lower Okay) ... 89.20644 (Upper Okay)**

**No Outliers**

# 180D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



# 180D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



## 180D AWTT HVTT PARENT POPULATIONS - B10 Minimum Values

**Set 1 - XLPE I:XM,XP,XN,TQ,TI ... Beta = 4.98066 Eta = 592.8156**

**From ac HVTT Breakdown Strength = 342.7474 To 415.3537 (V/mil)**

**.1 (10%) Will Occur**

**.9 (90%) Will NOT Occur**

**[Confidence = 90%]**

**Set 3 - TRXLPE II:TF,TG,TI,TR ... Beta = 8.000343 Eta = 899.8226**

**From ac HVTT Breakdown Strength = 633.0821 To 728.6751 (V/mil)**

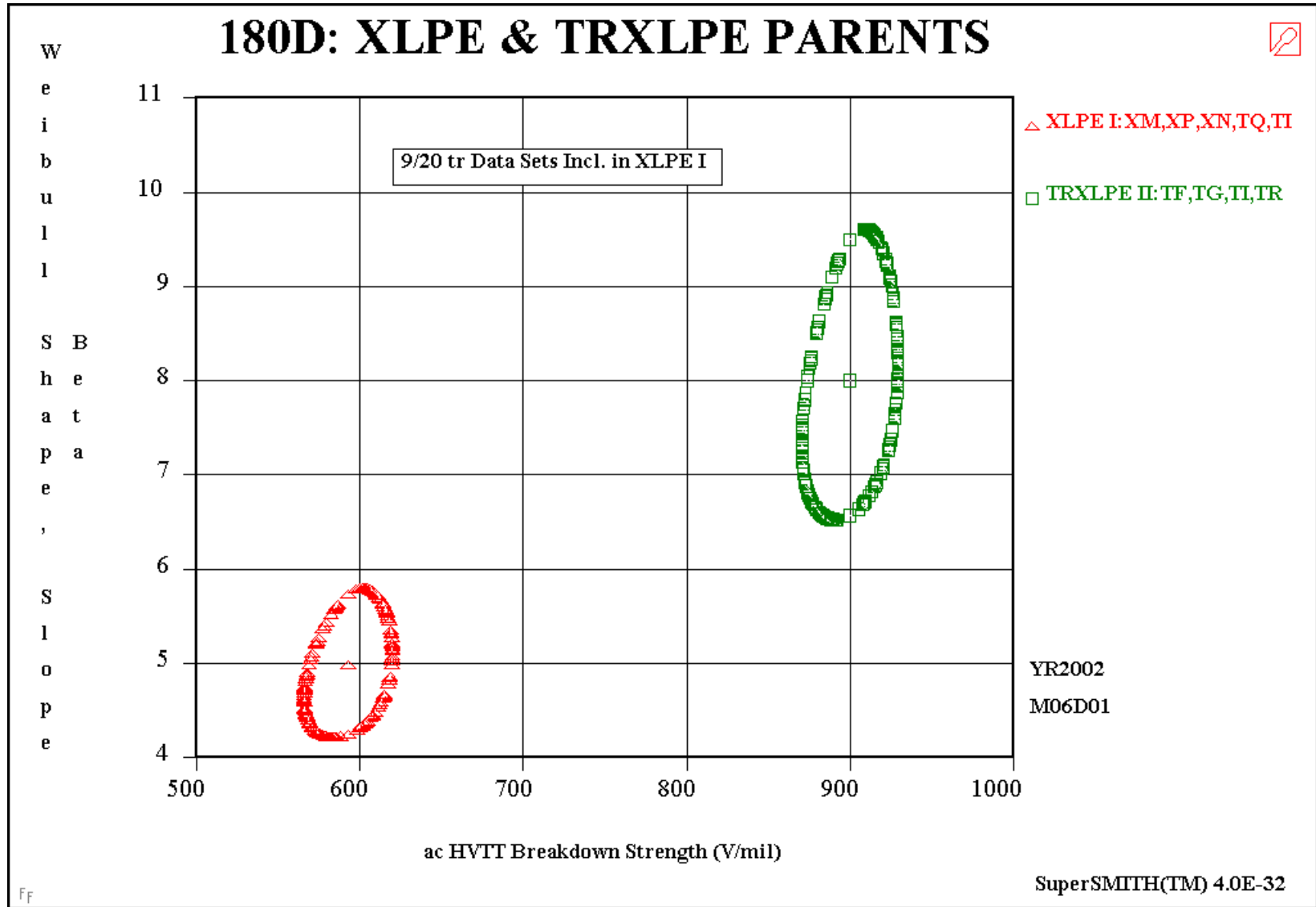
**.1 (10%) Will Occur**

**.9 (90%) Will NOT Occur**

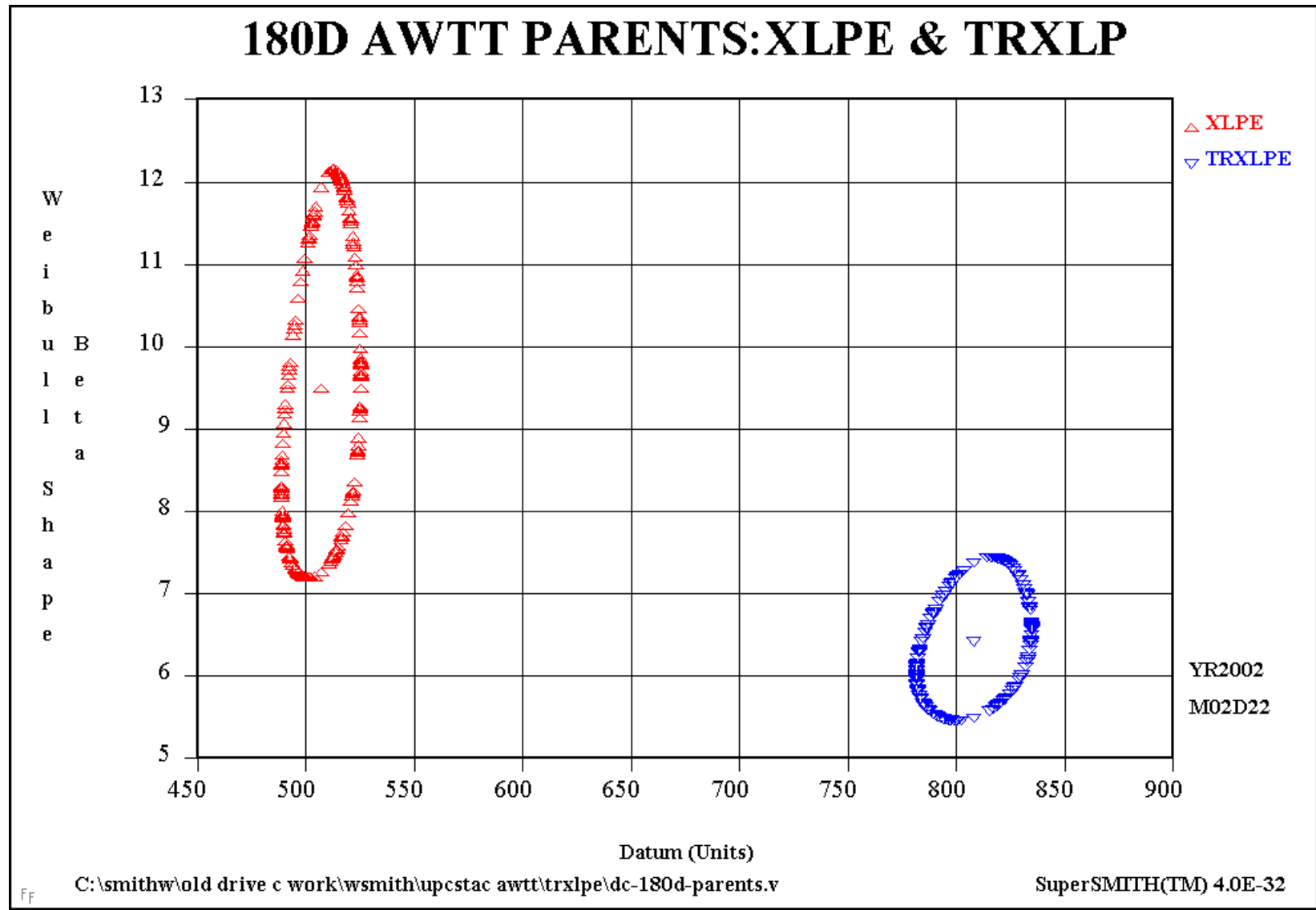
**[Confidence = 90%]**

**Obviously No Overlap Exists of XLPE Upper 90% Confidence Bound B10 Value and TRXLPE Lower 90% Confidence Bound B10 Value.**

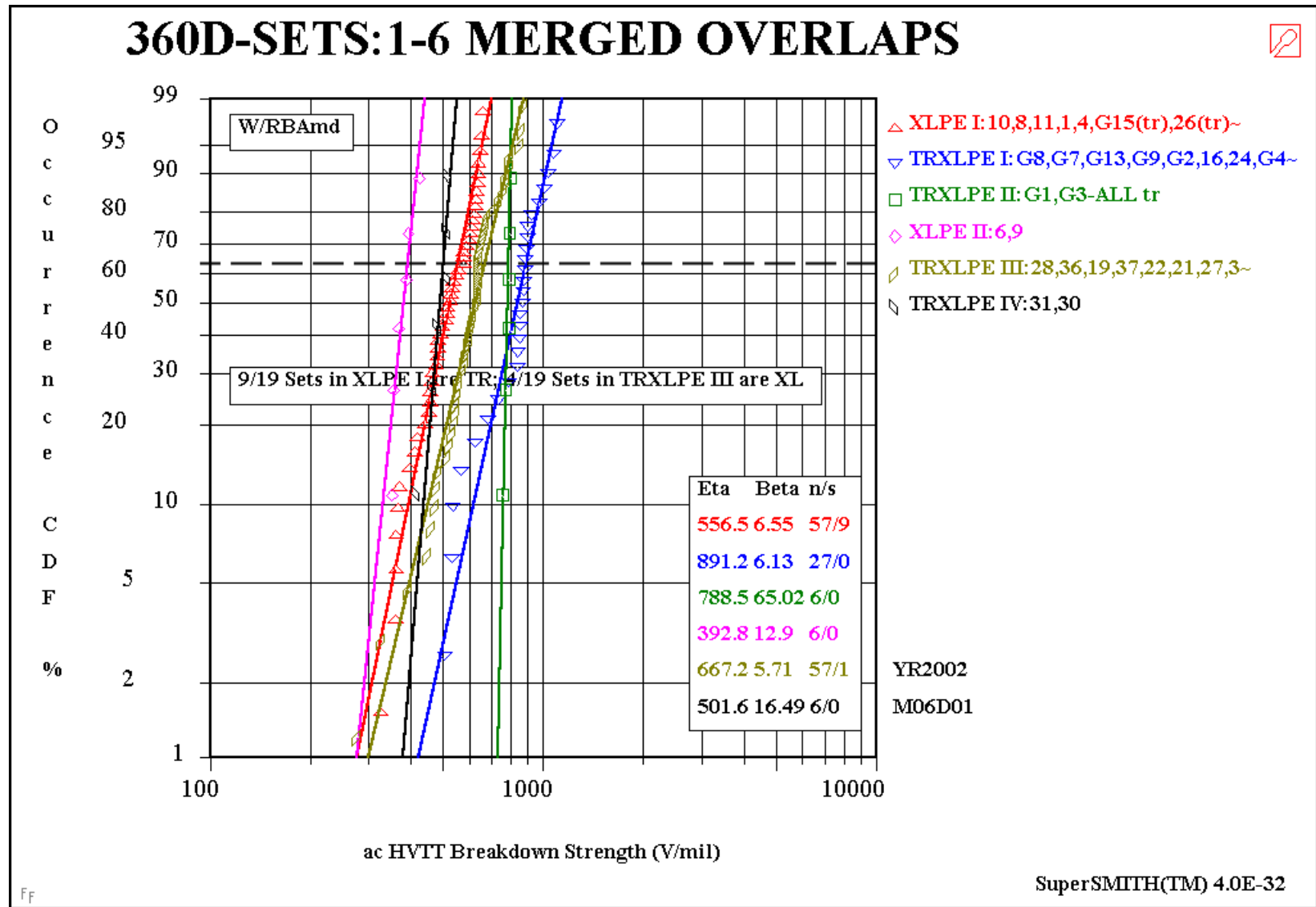
# 180D AWTT HVTT PARENT POPULATION - RANDOMIZED ANALYSIS



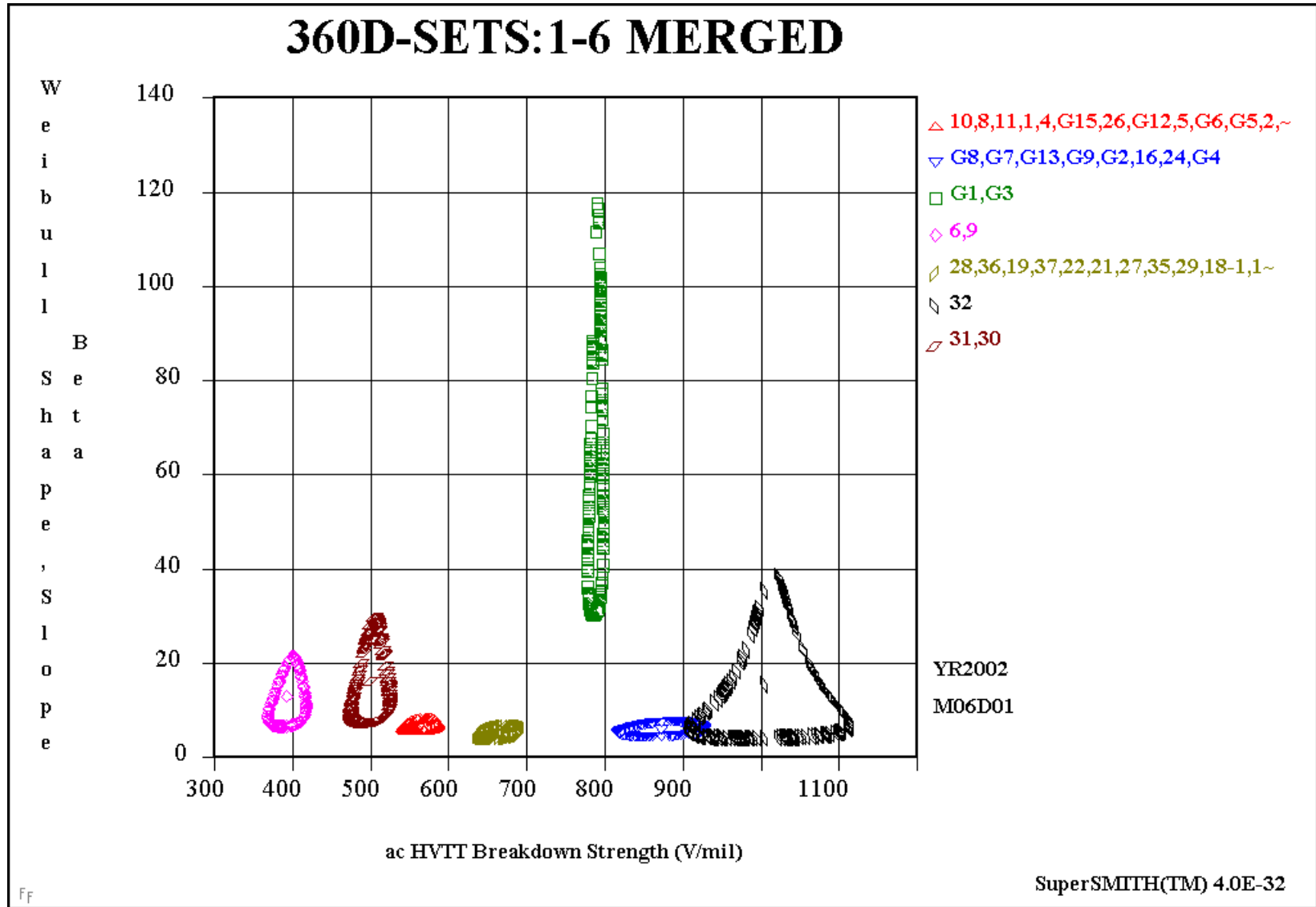
# 180D AWTT HVTT PARENT POPULATION - PREVIOUS SEPARATE ANALYSIS



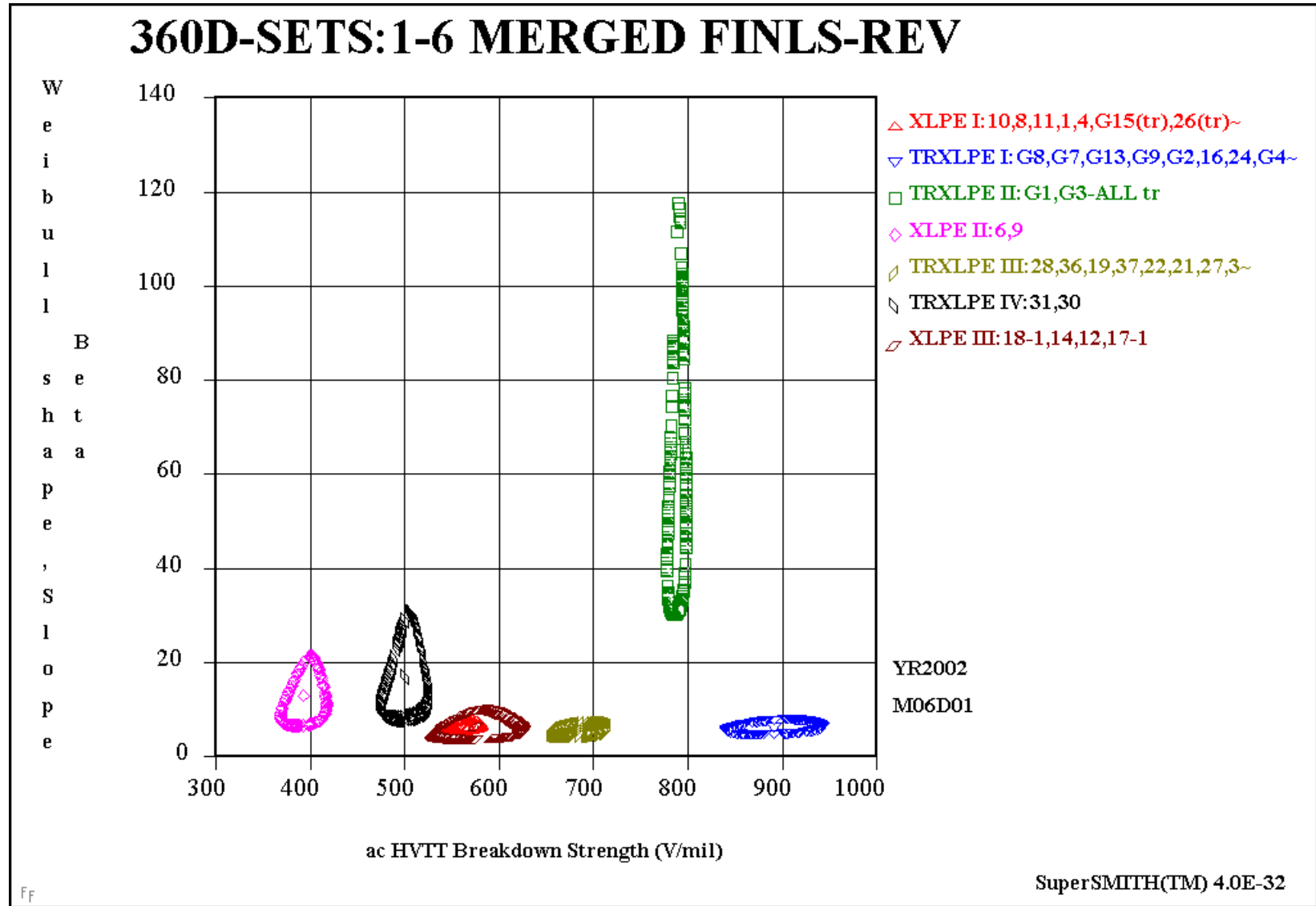
# 360D AWTT HVTT Data Sets: 1- 6 Combined Overlaps



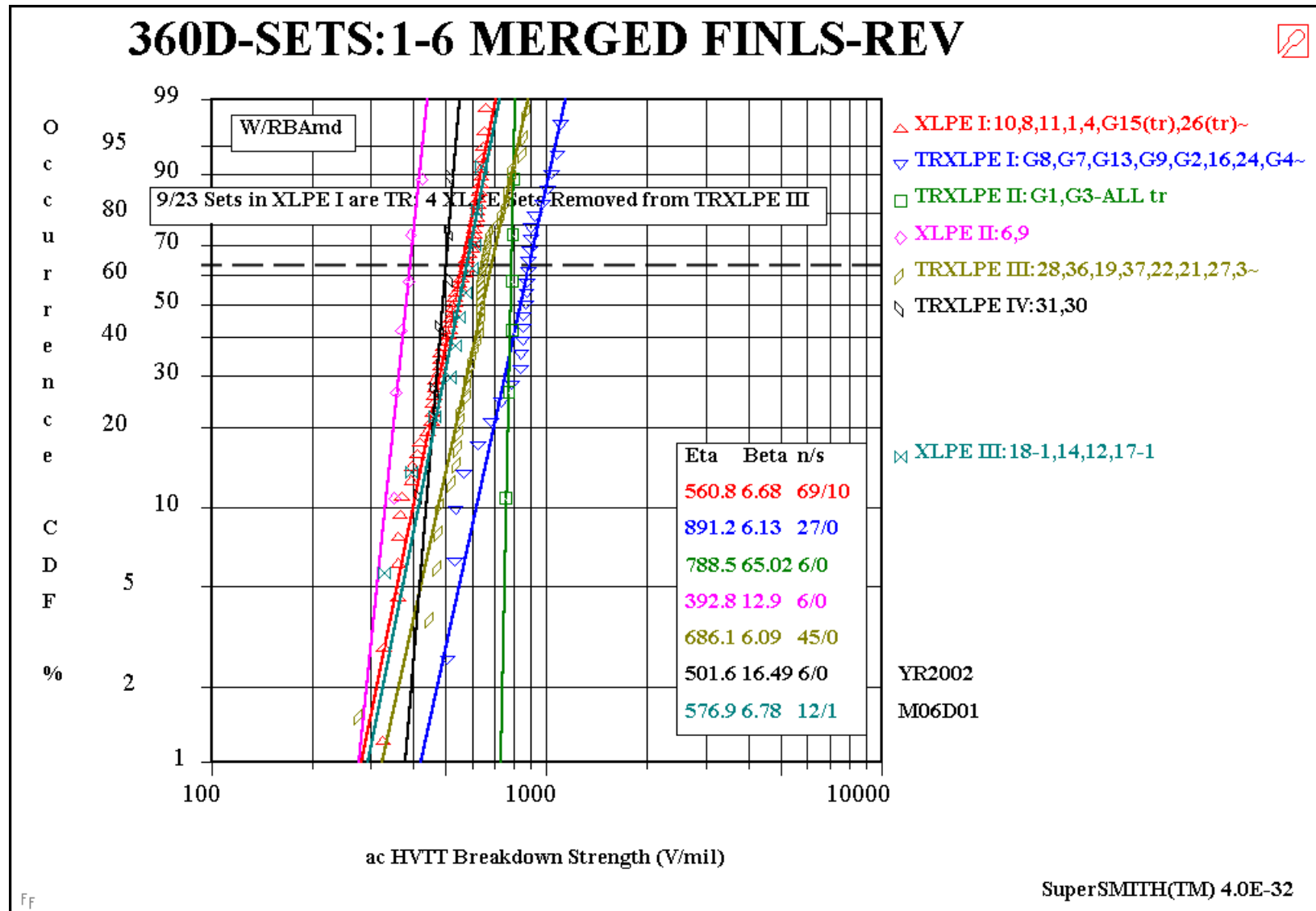
### 360D AWTT HVTT Data Sets: 1- 6 Combined Overlaps



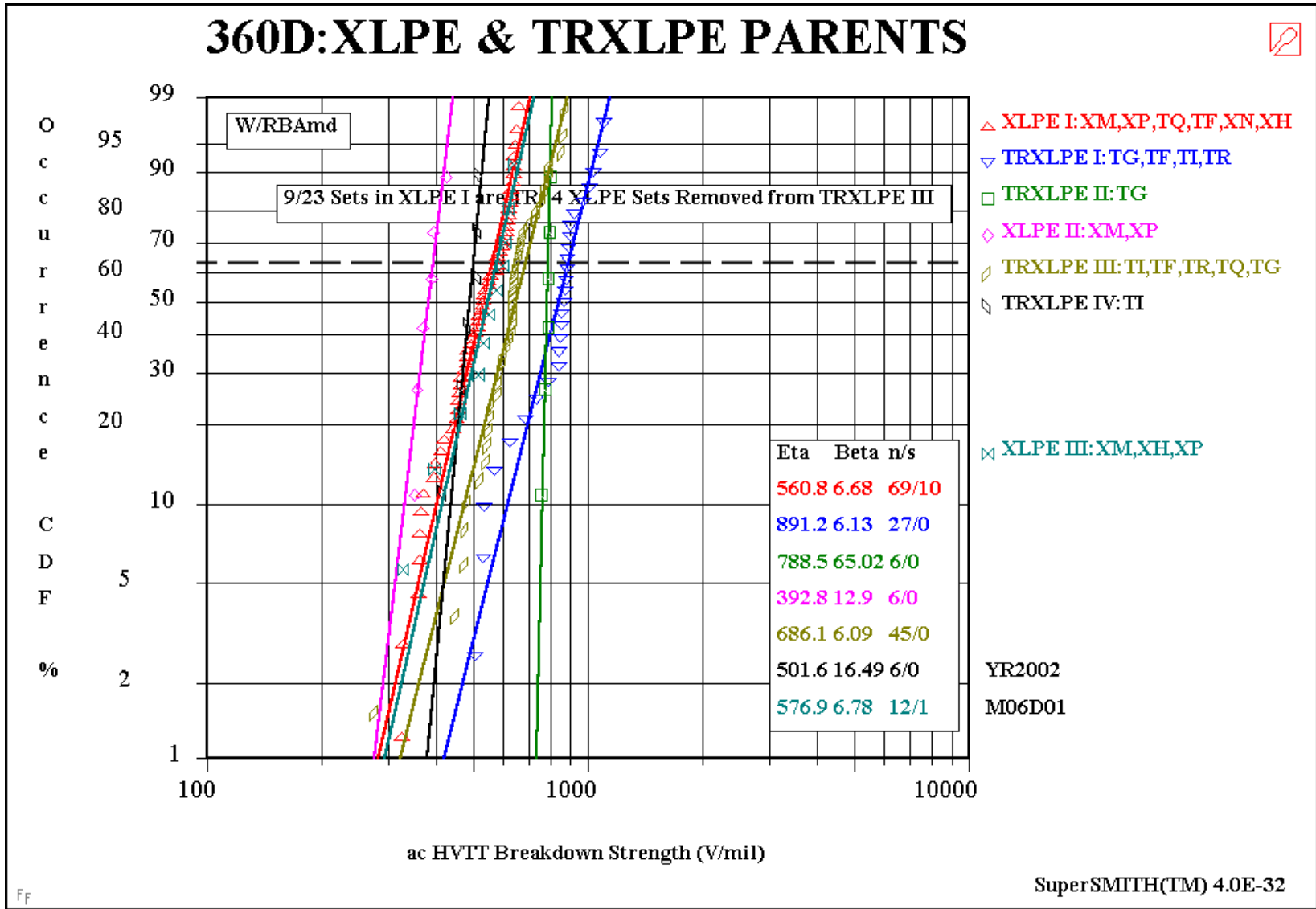
# 360D AWTT HVTT Data Sets: 1- 6 Combined Overlaps



# 360D AWTT HVTT Data Sets: 1- 6 Combined Overlaps



# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



## 360D AWTT HVTT PARENT POPULATIONS - Test for Outliers

### **Outlier Test: Extreme Point P-Value (%)**

#### **Note: For All Occurrence Only**

**Set 1: 77.88086 (Lower Okay) ... 3.128995 (Upper Okay)**

**Set 2: 52.43605 (Lower Okay) ... 50.19629 (Upper Okay)**

**Set 3: 7.207746 (Lower Okay) ... 42.63275 (Upper Okay)**

**Set 4: 57.49379 (Lower Okay) ... 99.99489 (Upper >99.55!)**

**Set 5: 3.489504 (Lower Okay) ... 74.85468 (Upper Okay)**

**Set 6: 4.724848 (Lower Okay) ... 29.08934 (Upper Okay)**

**Set 7: Plot Point Quantity < 3**

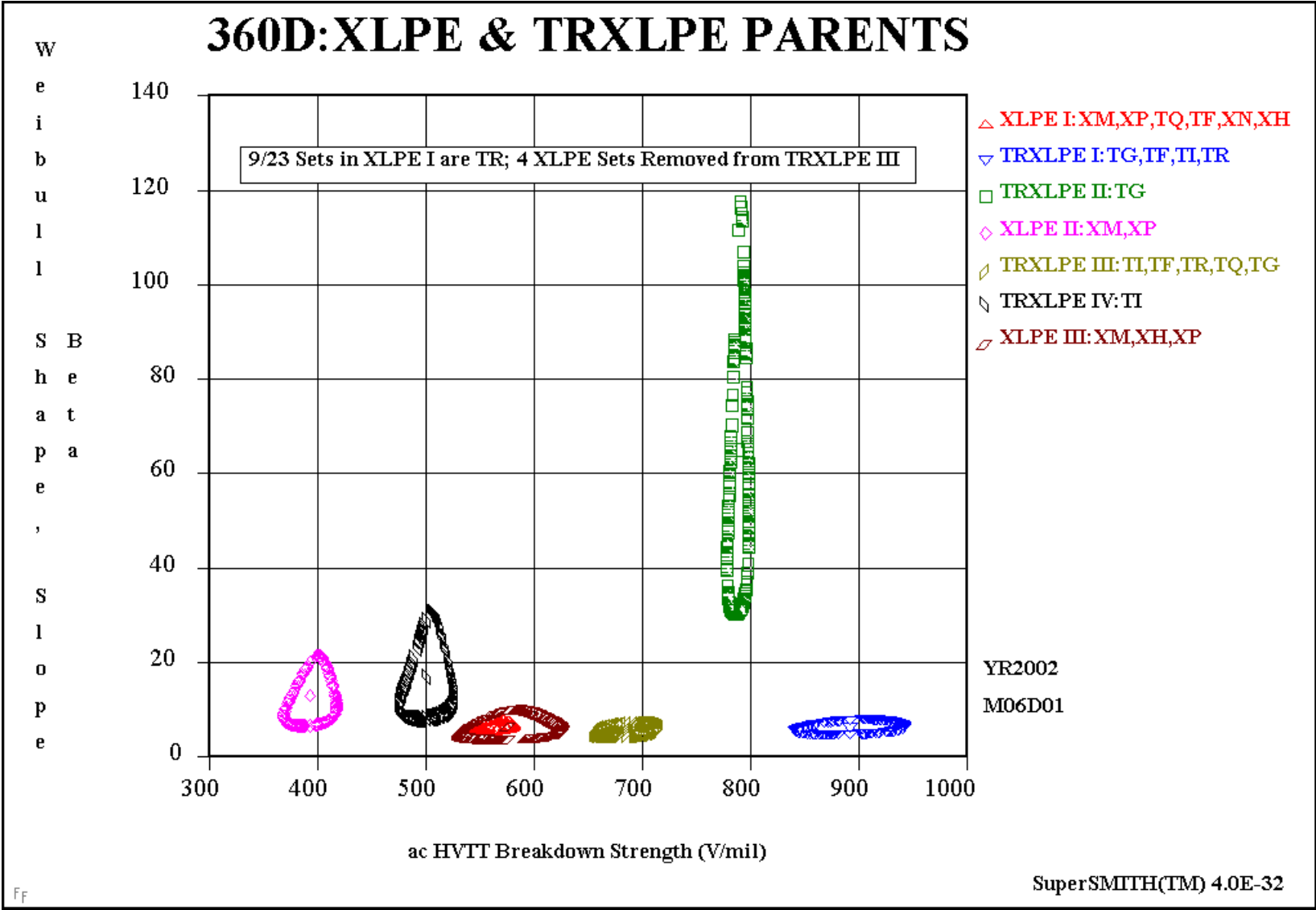
**Set 8: Plot Point Quantity < 3**

**Set 9: Plot Point Quantity < 3**

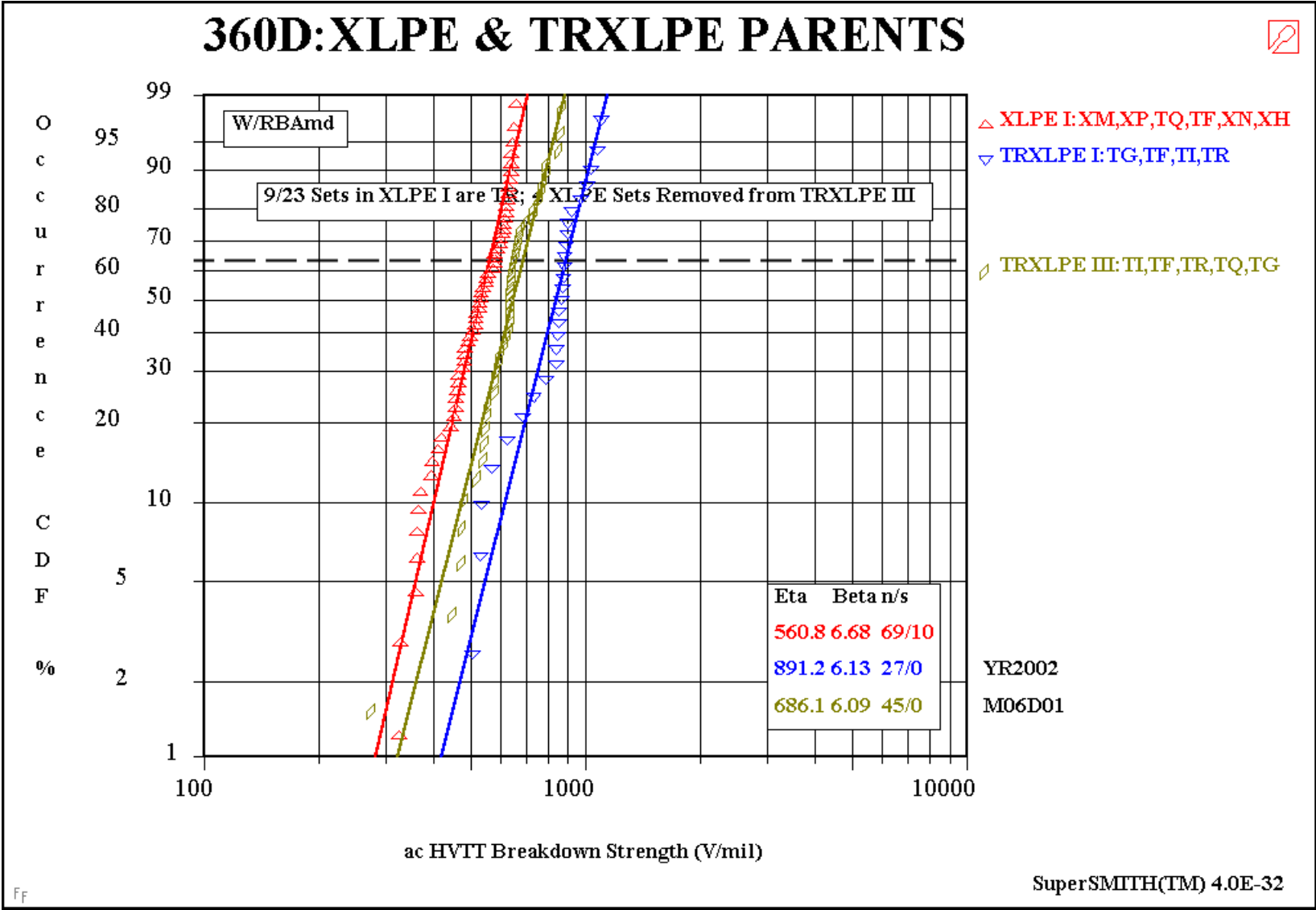
**Set 10: 11.73942 (Lower Okay) ... 11.31444 (Upper Okay)**

**No Outliers**

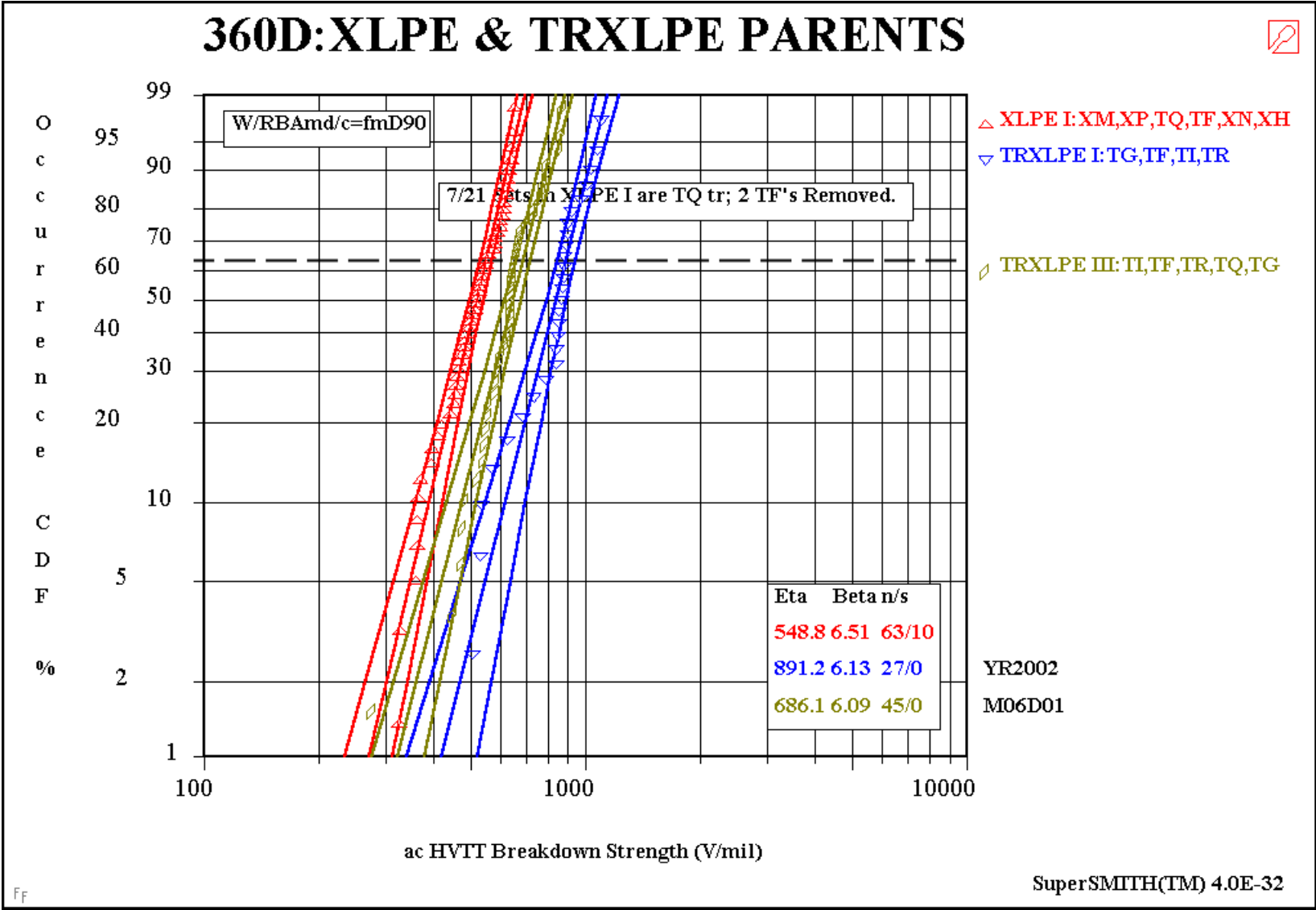
# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



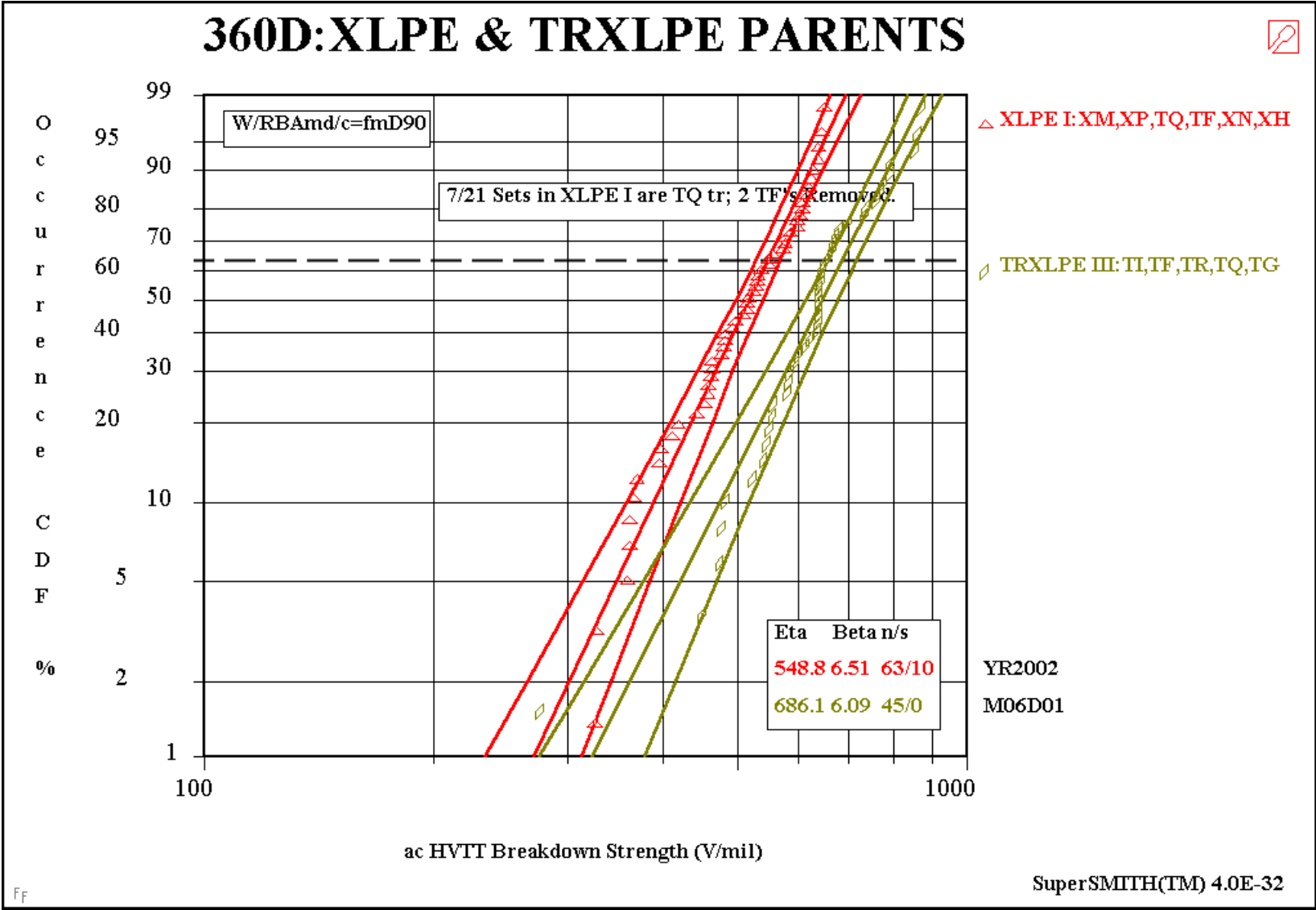
# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



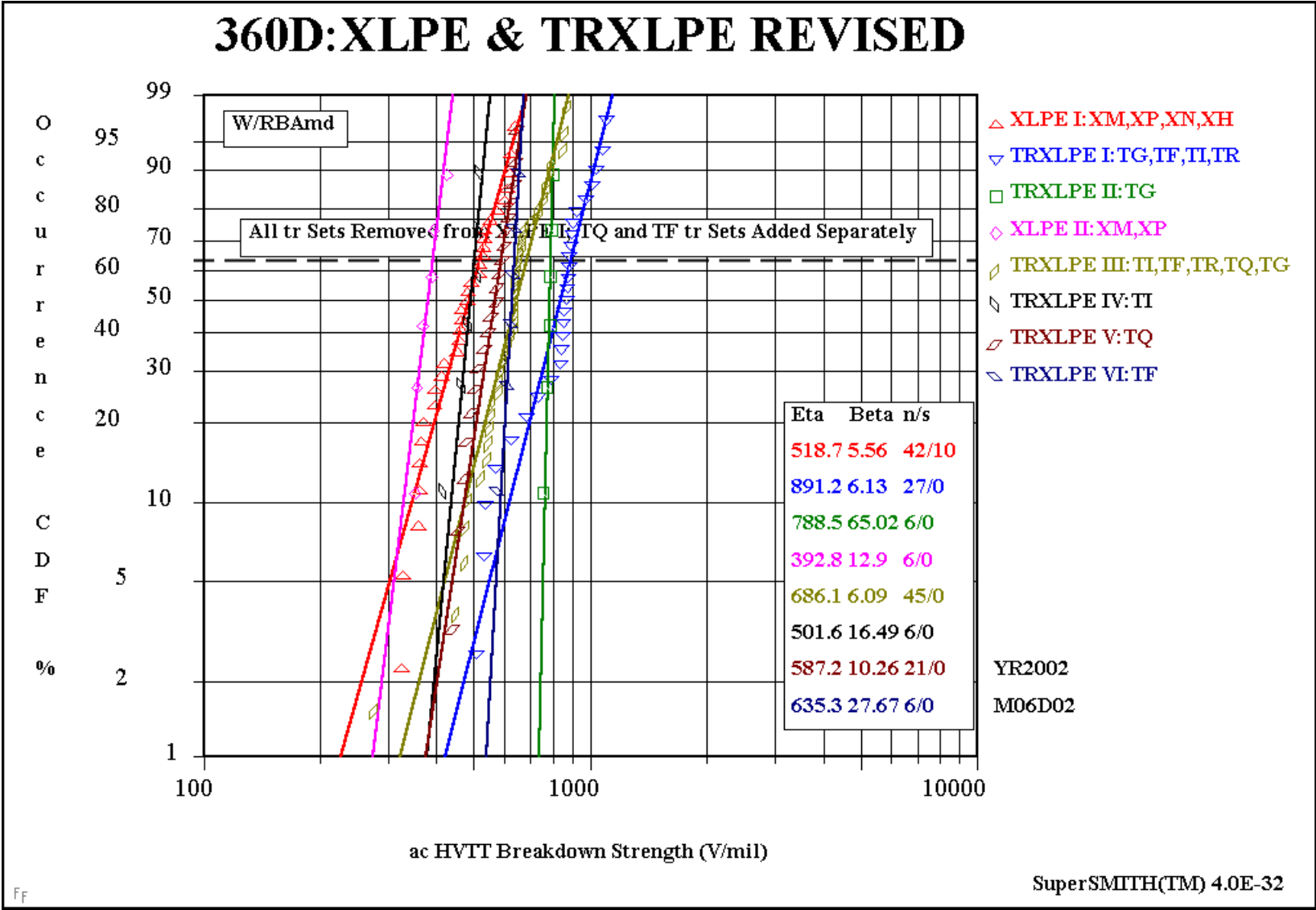
# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



## 360D AWTT HVTT PARENTS - REVISED: Test for Outliers

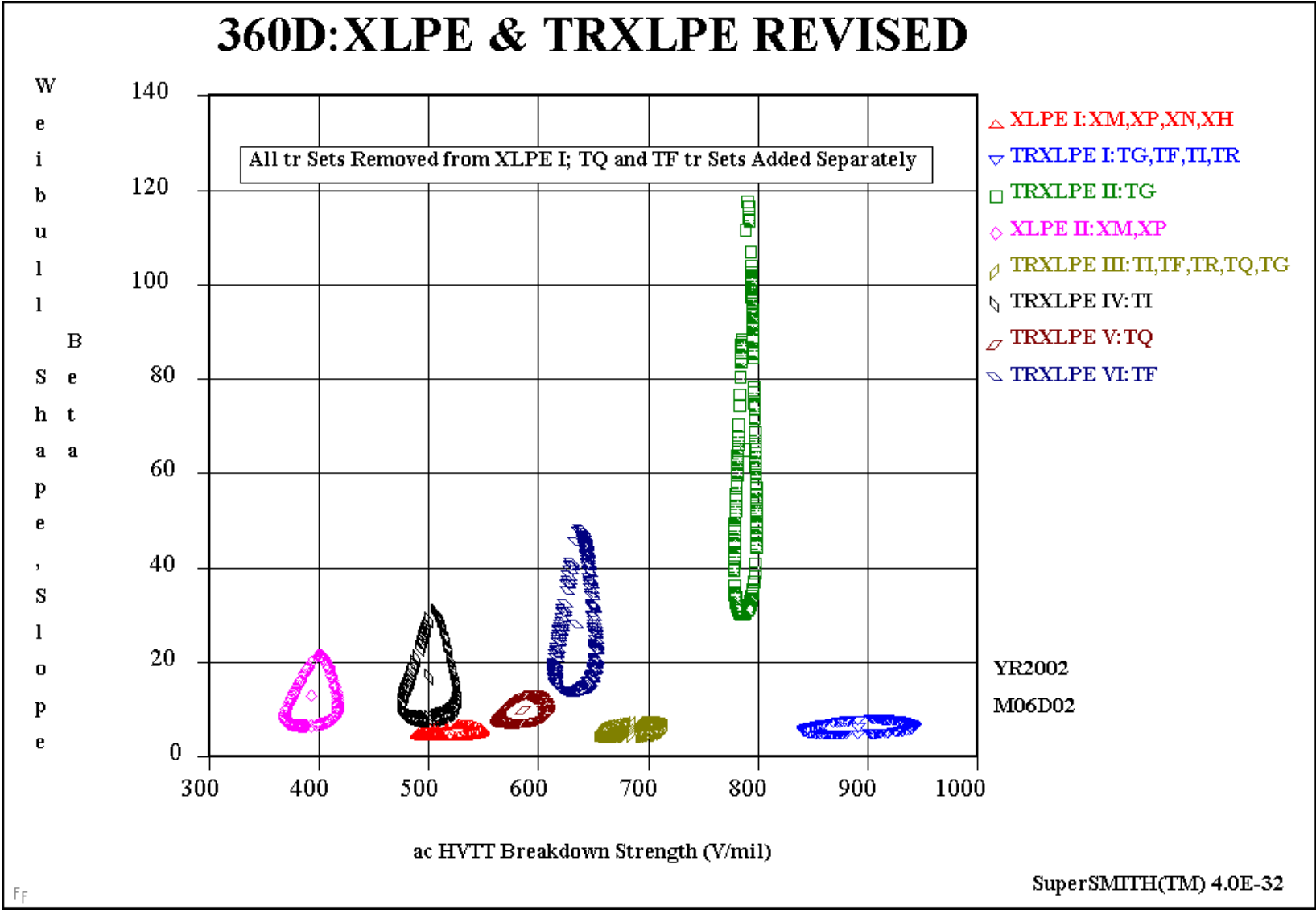
### **Outlier Test: Extreme Point P-Value (%)**

**Note: For All Occurrence Only**

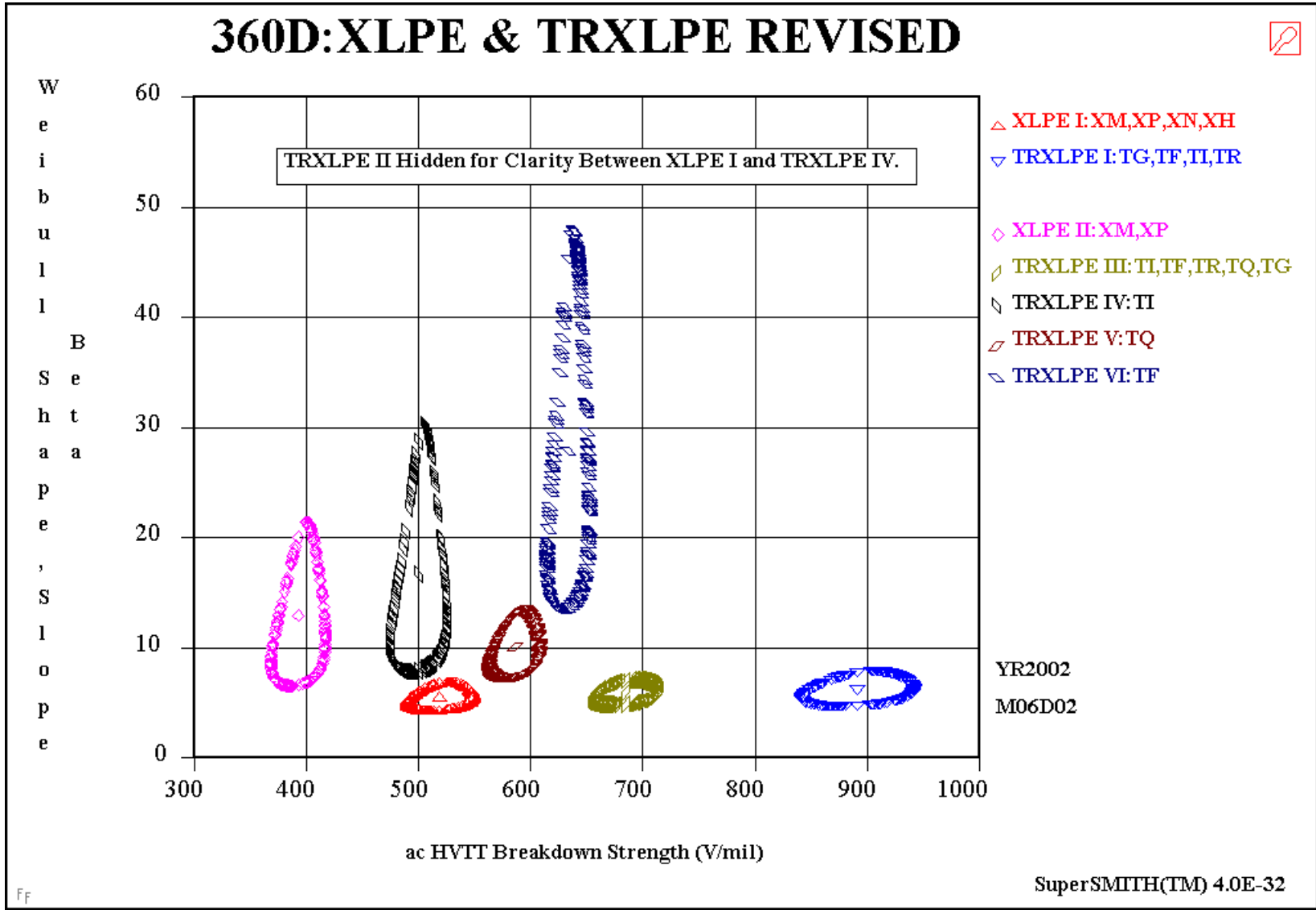
**Set 1: 80.76228 (Lower Okay) ... 59.76201 (Upper Okay)**  
**Set 2: 52.43605 (Lower Okay) ... 50.19629 (Upper Okay)**  
**Set 3: 7.207746 (Lower Okay) ... 42.63275 (Upper Okay)**  
**Set 4: 57.49379 (Lower Okay) ... 99.99489 (Upper >99.55!)**  
**Set 5: 3.489504 (Lower Okay) ... 74.85468 (Upper Okay)**  
**Set 6: 4.724848 (Lower Okay) ... 29.08934 (Upper Okay)**  
**Set 7: 58.18041 (Lower Okay) ... 39.56797 (Upper Okay)**  
**Set 8: 6.464027 (Lower Okay) ... 73.77369 (Upper Okay)**

**No Outliers in Potential Parents**

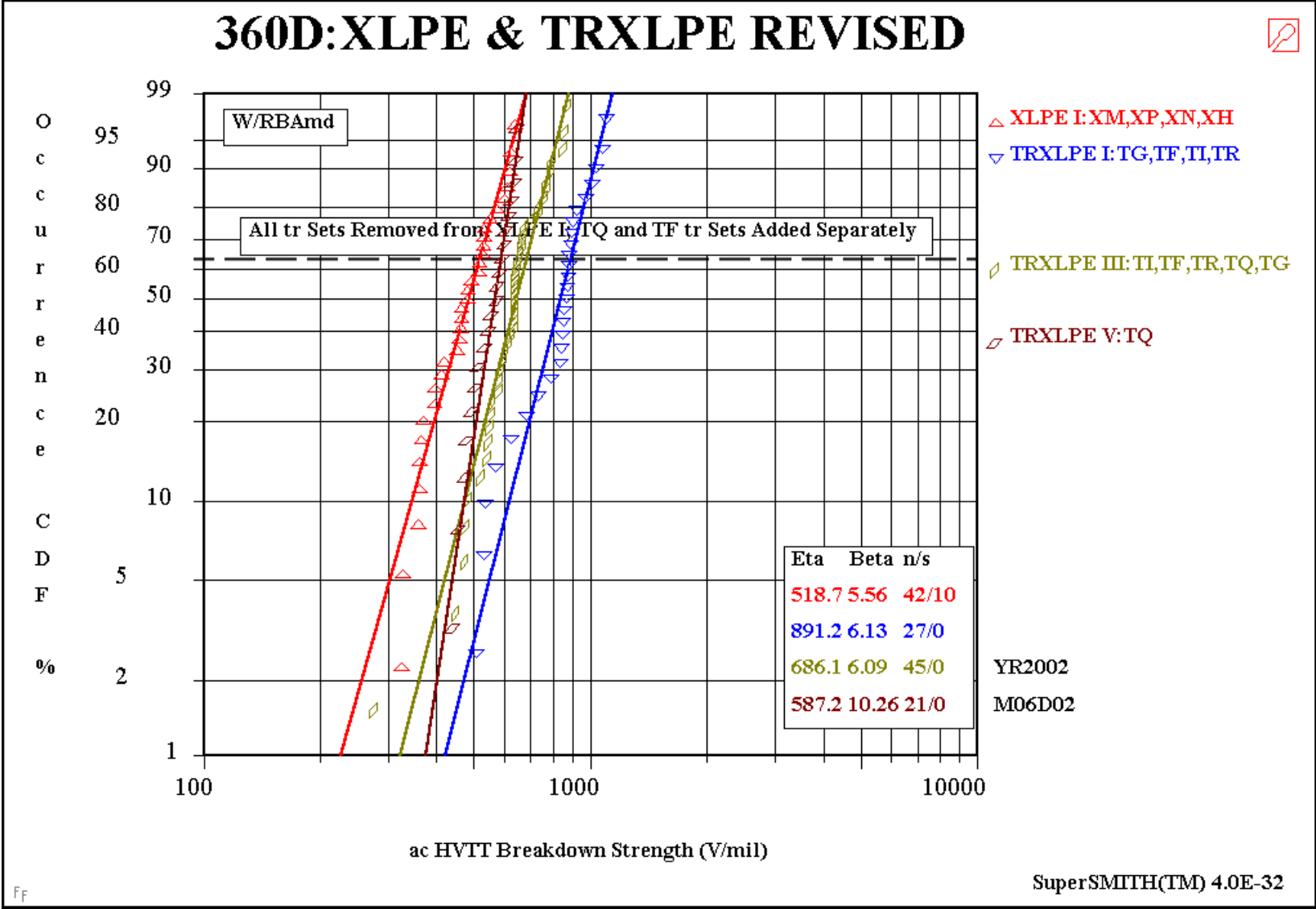
# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



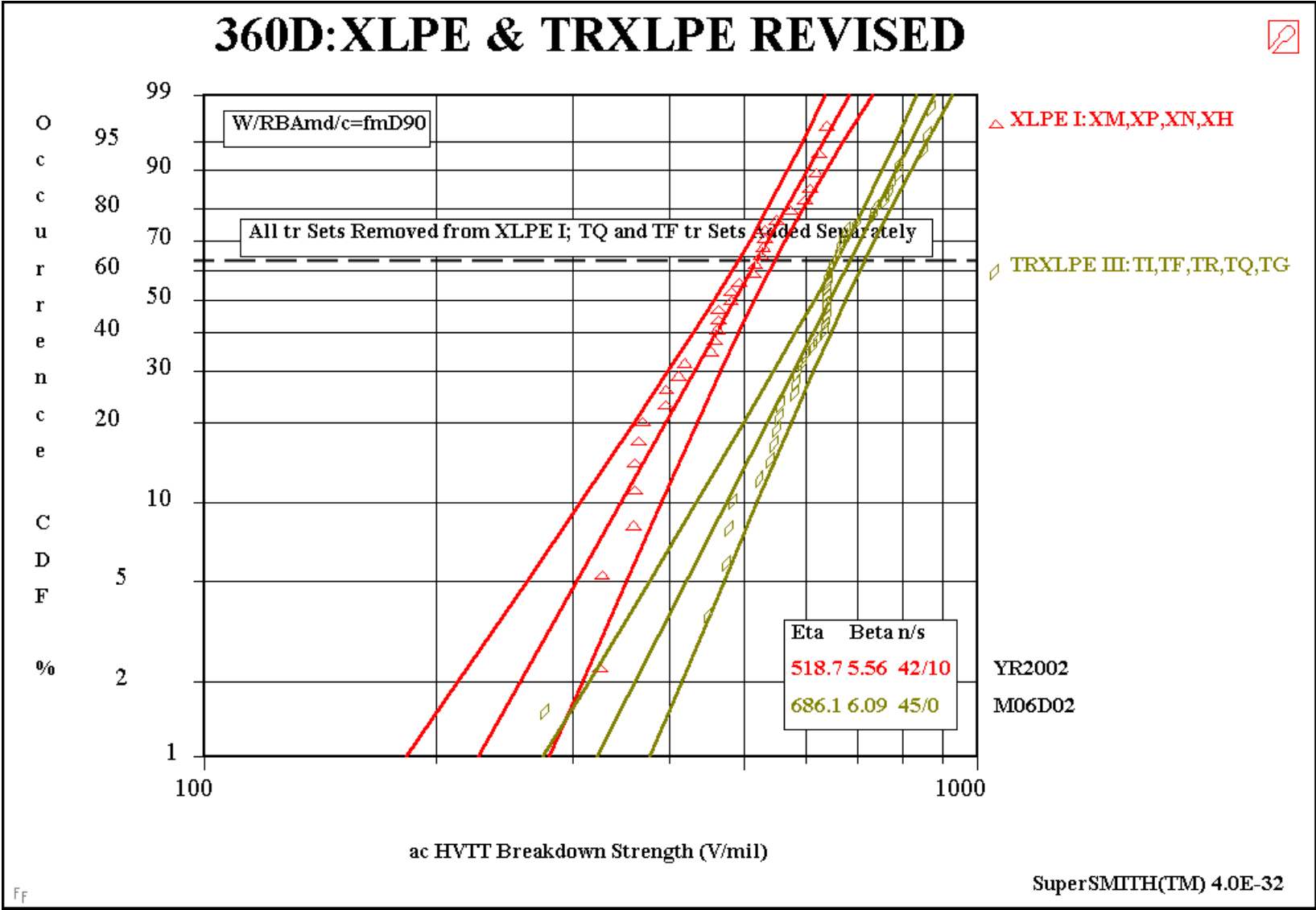
# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



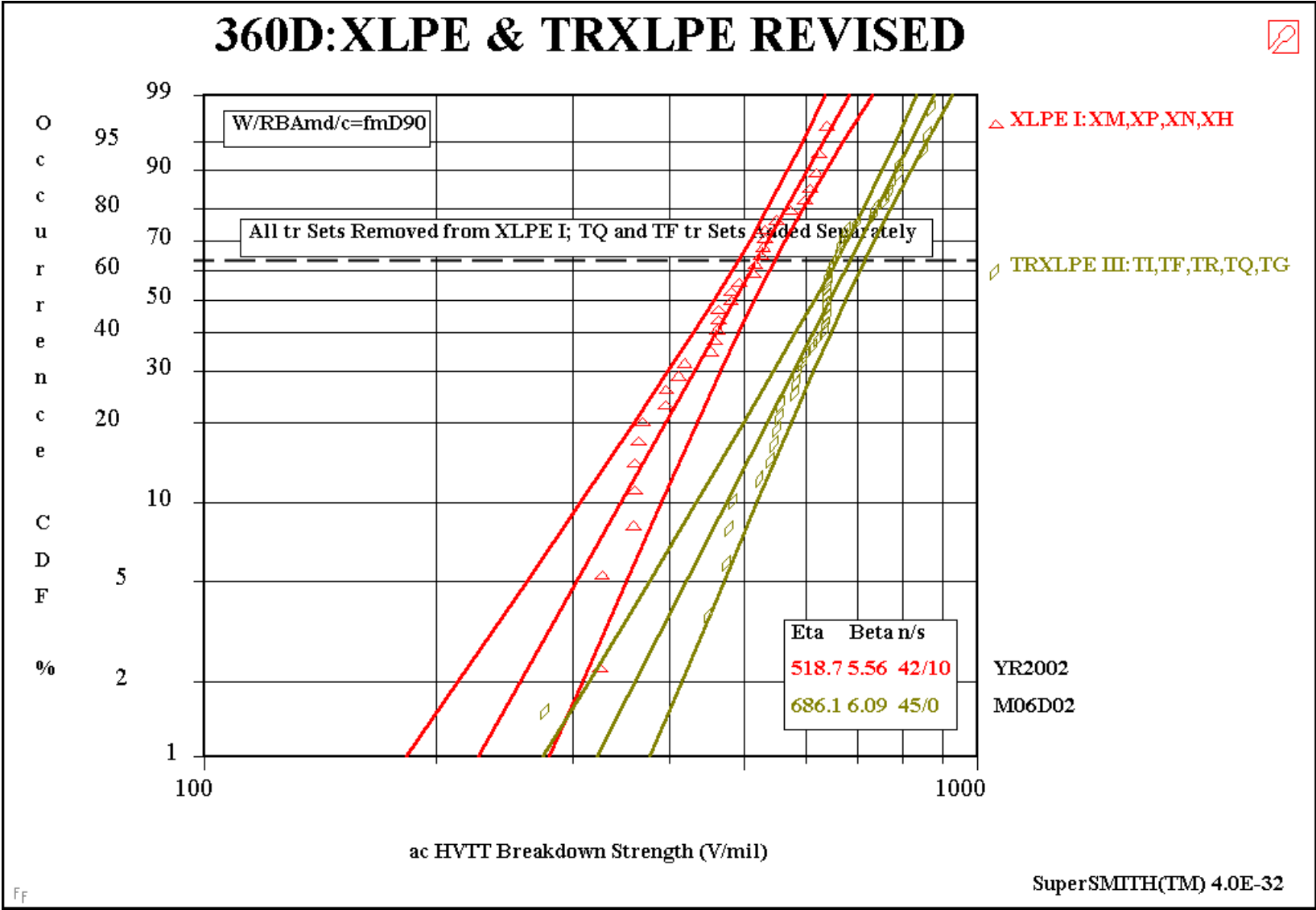
# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



# 360D AWTT HVTT PARENT POPULATIONS COMPOSITIONS By Material



## 360D AWTT HVTT PARENT POPULATIONS - B10 Minimum Values

**Set 1 - XLPE I:XM,XP,XN,XH ... Beta = 5.555401 Eta = 518.719**

**From ac HVTT Breakdown Strength = 306.6405 To 390.2921 (V/mil)**

**.1 (10%) Will Occur**

**.9 (90%) Will NOT Occur**

**[Confidence = 90%]**

**Set 5 - TRXLPE III:TI,TF,TR,TQ,TG ... Beta = 6.089205 Eta = 686.0714**

**From ac HVTT Breakdown Strength = 432.7503 To 519.3974 (V/mil)**

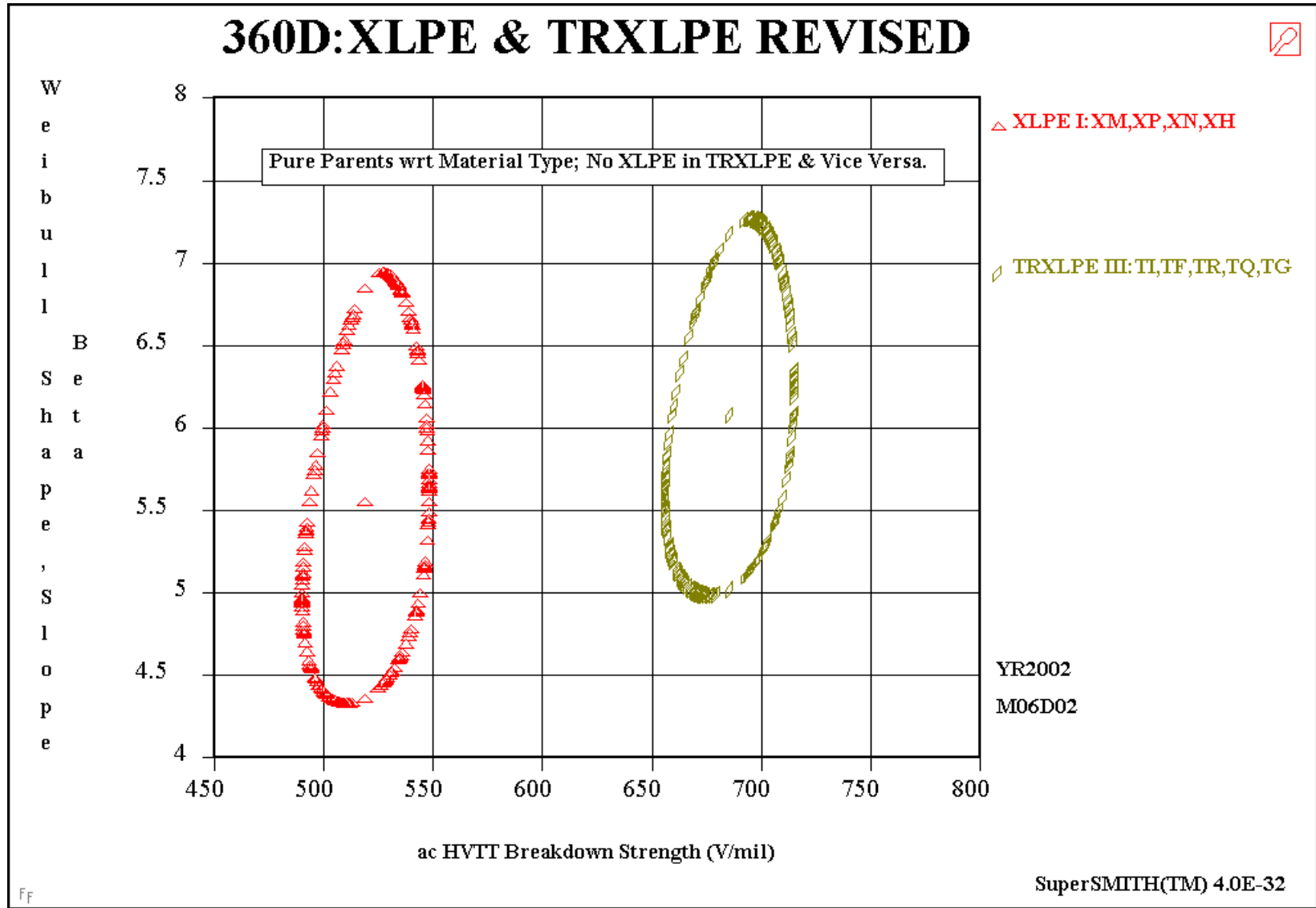
**.1 (10%) Will Occur**

**.9 (90%) Will NOT Occur**

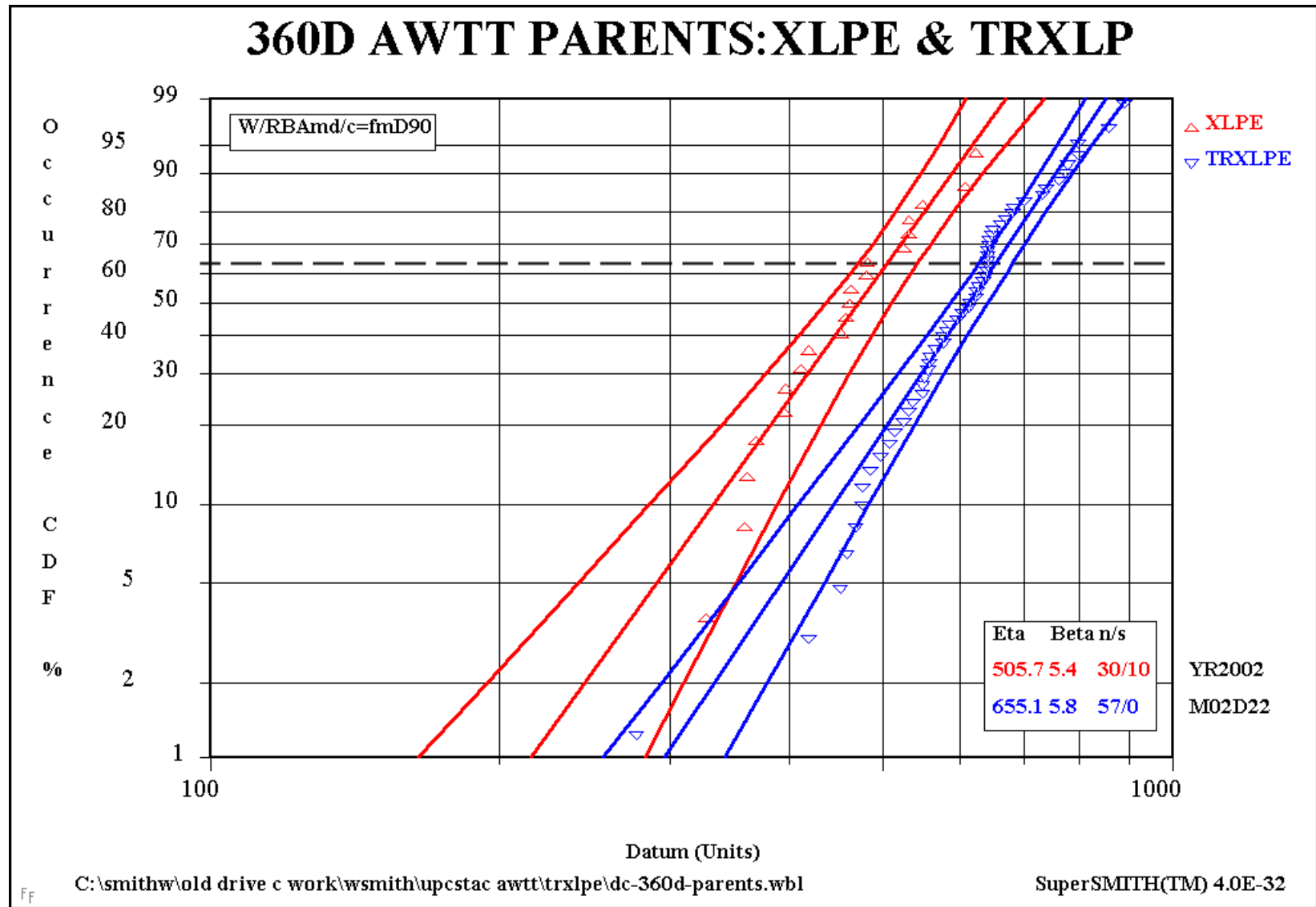
**[Confidence = 90%]**

**Obviously No Overlap Exists of XLPE Upper 90% Confidence Bound B10 Value and TRXLPE Lower 90% Confidence Bound B10 Value.**

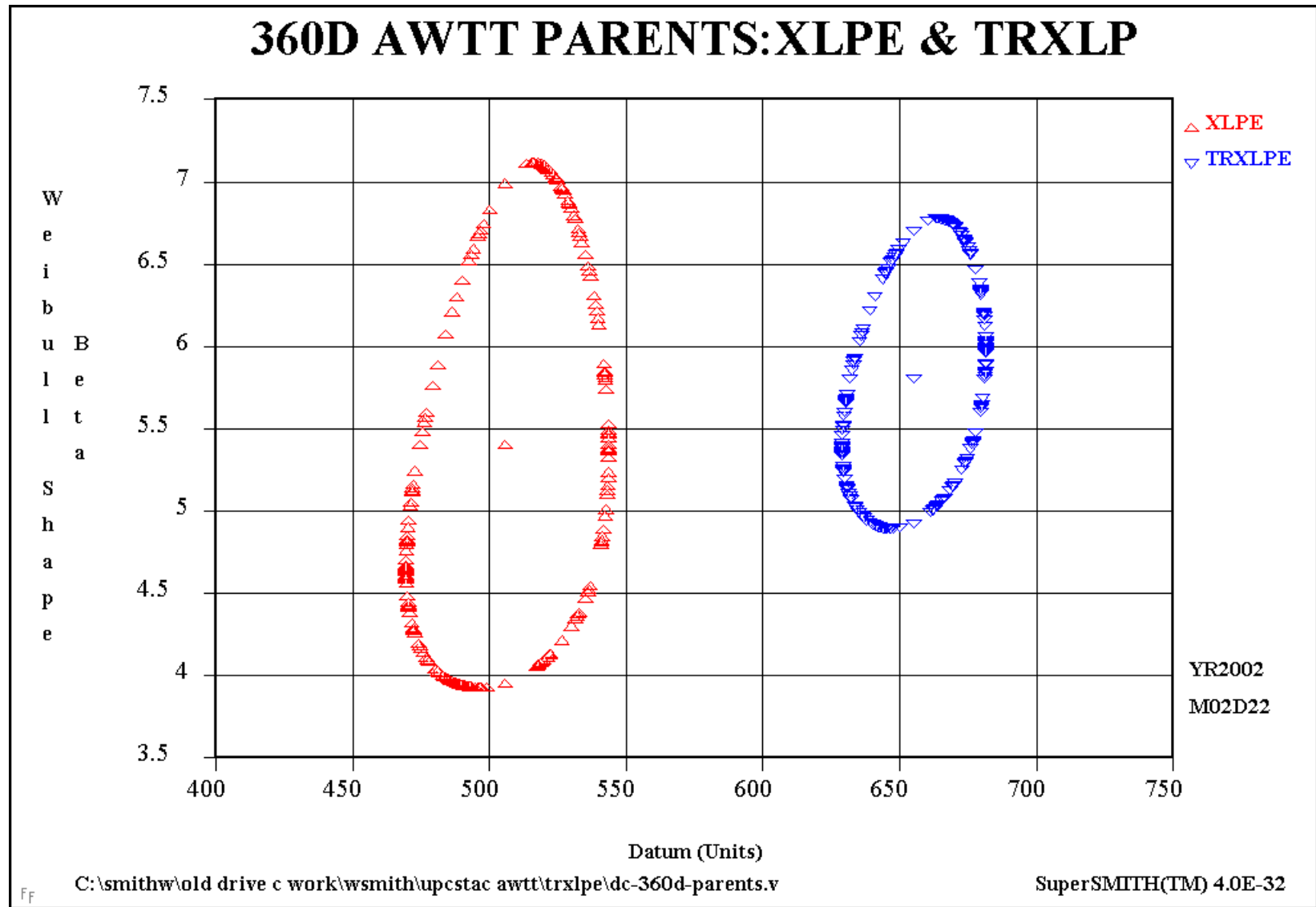
# 360D AWTT HVTT PARENT POPULATION - RANDOMIZED ANALYSIS



# 360D AWTT HVTT PARENT POPULATION - PREVIOUS SEPARATE ANALYSIS



# 360D AWTT HVTT PARENT POPULATION - PREVIOUS SEPARATE ANALYSIS



**TABULATION OF RESULTS: 90% Lower & Upper Values @ B10**

<b>90% LOWER HVTT @ B10, V/mil: MINIMUM CRITERIA/ALL SAMPLES/EACH PERIOD</b>							
<b>SEPARATE ANALYSIS RESULTS</b>				<b><i>RANDOMIZED</i> ANALYSIS RESULTS</b>			
<b>TEST/AWTT TIME</b>	<b>XLPE Parent</b>	<b>Major TRXLPE Parent</b>	<b>Minor TRXLPE Parent</b>	<b>TEST/AWTT TIME</b>	<b>XLPE Parent</b>	<b>Major TRXLPE Parent</b>	<b>Minor TRXLPE Parent</b>
<b>Unaged</b>	<b>835</b>	<b>737</b>	<b>842</b>	<b>Unaged</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>
<b>90% U/L Conf. Bounds</b>	<b>835-1034</b>	<b>737-807</b>	<b>842-912</b>	<b>90% U/L Conf. Bounds</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>
<b>Aged, 0 Days AWTT</b>	<b>896</b>	<b>641</b>	<b>1106</b>	<b>Aged, 0 Days AWTT</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>
<b>90% U/L Conf. Bounds</b>	<b>896-1139</b>	<b>641-840</b>	<b>1106-1215</b>	<b>90% U/L Conf. Bounds</b>	<b>ND</b>	<b>ND</b>	<b>ND</b>
<b>120 Days AWTT</b>	<b>395</b>	<b>574</b>	<b>455</b>	<b>120 Days AWTT</b>	<b>401</b>	<b>681</b>	<b>433</b>
<b>90% U/L Conf. Bounds</b>	<b>395-468</b>	<b>574-674</b>	<b>455-596</b>	<b>90% U/L Conf. Bounds</b>	<b>401 - 467</b>	<b>681 - 782</b>	<b>433 - 633</b>
<b>180 Days AWTT</b>	<b>370</b>	<b>530</b>	<b>769</b>	<b>180 Days AWTT</b>	<b>343</b>	<b>633</b>	<b>711</b>
<b>90% U/L Conf. Bounds</b>	<b>370-433</b>	<b>530-611</b>	<b>769-911</b>	<b>90% U/L Conf. Bounds</b>	<b>343 - 415</b>	<b>633 - 729</b>	<b>711 - 775</b>
<b>360 Days AWTT</b>	<b>286</b>	<b>409</b>	<b>523</b>	<b>360 Days AWTT</b>	<b>307</b>	<b>433</b>	<b>547</b>
<b>90% U/L Conf. Bounds</b>	<b>286-389</b>	<b>409-483</b>	<b>523-670</b>	<b>90% U/L Conf. Bounds</b>	<b>307 - 390</b>	<b>433 - 519</b>	<b>547 - 697</b>

**VALIDATION OF PASS/FAIL CRITERIA USING *RANDOMIZED* AND *SEPARATE* ANALYSES**  
**RESULTS via B10 LOWER 90% BOUNDS TRXLPE HVTT VALUES**

EVALUATION OF DATA SETS via TWO (2) TRXLPE DEFINITION REQUIREMENTS												
	120D AWTT (680)/(574)			180D AWTT (633)/(530)			360D AWTT (433)/(409)					
ID	13	14	15	16	17	18	19	20	21	TYPE	Passes Random Req'mnt	Passes Separate Req'mnt
13	432	386	529	319						XLPE	NO	NO
35	440	479	551	546	675	564	559	451	485	TR	NO	NO
29	827	480	693	808	349	554	739	653	585	TR	NO	NO
16	540	500	540	500	380	340	420	260	340		N/A	N/A
18-1	631	508	680	508	631	621	574	516	463	XLPE	NO	NO
14	573	543	534	481	543	537	549	395	327	XLPE	NO	NO
15	500	571	545	490	449	439	369	Failed	Failed	XLPE	NO	NO
38	660	580	460	540	540	580	420	460	500	TR	N/A	N/A
23	1031	618	704	830	846	780	738	642	549	TR	YES	YES
17-1	664	726	736	628	711	537	638	598	618	XLPE	NO	YES
20	607	731	607	635	581	597	773	670	701	TR	YES	YES
18	707	736	893	648	655	669	583	645	648	TR	YES	YES
30	674	738	603	563	646	628	514	486	519	TR	NO	YES
25	-666	742	1056	836	797	747	762	604	525	TR	YES	YES
12	689	773	650	650D	574	610	611T	532	608	XLPE	NO	YES
33	820	833	831	820	757	664	642	662	597	TR	YES	YES
28	1032	834	1030	428	928	582	681	796	640	TR	NO	NO
27	557	854	828	743	810	683	476	642	642	TR	NO	NO
32	927	875	953	914	772	1088	896	1033	1009	TR	YES	YES
21	668	963	989	705	791	920	675	588	479	TR	NO	YES
22	1113	969	1098	942	841	749	543	875	865	TR	YES	YES
34	1026	970	836	672	974	827	642	638	668	TR	YES	YES
37	723	987	1031	910	855	879	797	857	558	TR	YES	YES
39	940	1020	900	940	1100	940	1100	1020	860	TR	N/A	N/A
31	540	1091	608	521	463	508	418	468	514	TR	NO	NO
19	847	1106	966	937	927	1097	625	777	645	TR	YES	YES
36	759	1141	831	719	866	831	616	277	552	TR	NO	NO
24	1102	1198	988	1069	1075	1025	870	838	506	TR	YES	YES
26	1154	1199	1173	1187	1134	909	656	638	627	TR	YES	YES

**VALIDATION OF PASS/FAIL CRITERIA USING *SEPARATE* AND *RANDOMIZED* ANALYSES  
RESULTS via B10 LOWER 90% BOUNDS TRXLPE HVTT VALUES**

EVALUATION OF DATA SETS via TWO (2) TRXLPE DEFINITION REQUIREMENTS												
	120D AWTT (680)/(574)			180D AWTT (633)/(530)			360D AWTT (433)/(409)					
ID	13	14	15	16	17	18	19	20	21	TYPE	Passes Random Req'mnt	Passes Separate Req'mnt
<b>G4</b>	1078W	1110W	1078W	1013W	946W	987W	899D	970D	880D	TR	YES	YES
<b>8</b>	500W	438D	540W	564W	440D	488D	Failed	361D	463D	XLPE	NO	NO
<b>11</b>	406W	455W	603W	519W	442W	508W	361W	365W	325W	XLPE	NO	NO
<b>3</b>	577D	458D	596D	529W	516W	529W	396D	Failed	Failed	XLPE	NO	NO
<b>7</b>	497D	471D	577W	525W	376W	438W	Failed	418W	Failed	XLPE	NO	NO
<b>1</b>	523W	592W	505W	555D	399D	428D	514D	528D	492D	XLPE	NO	NO
<b>4</b>	549D	595W	586W	567W	413W	458W	480W	359D	Failed	XLPE	NO	NO
<b>G15</b>	635W	599W	549D	616W	540D	425D	515W	482W	442W	TR	NO	NO
<b>G12</b>	746W	610W	772W	645W	395W	648W	645W	603W	608W	TR	NO	NO
<b>6</b>	594D	613W	430D	503W	474W	369W	393W	352W	425W	XLPE	NO	NO
<b>G11</b>	715W	627W	756W	619W	766D	704W	650W	556W	577D	TR	NO	YES
<b>9</b>	577W	635W	716W	331W	378W	365W	356W	369W	389W	XLPE	NO	NO
<b>G10</b>	802D	681W	712W	435W	492W	596W	638W	497W	458W	TR	NO	NO
<b>17</b>	528 W	699 W	-710	494 W	525 W	548 W	476 W	537 W	508 W	TR	NO	NO
<b>2</b>	602W	704W	674D	531W	450W	526D	452D	481D	Failed	XLPE	NO	NO
<b>G5</b>	638W	716W	500W	767D	624W	780D	549D	628W	586W	TR	NO	NO
<b>G6</b>	780W	716W	556W	704W	708W	798W	620W	577W	598W	TR	NO	NO
<b>5</b>	537W	719W	580W	573W	537W	361W	525W	624W	457W	XLPE	NO	NO
<b>10</b>	522W	723W	611W	516W	682W	468W	531W	411D	461W	XLPE	NO	NO
<b>G8</b>	1126D	749D	981D	806W	758W	825W	889W	624D	567W	TR	YES	YES
<b>G14</b>	870D	762W	844W	596D	856W	910W	613W	577W	635W	TR	NO	YES
<b>G1</b>	960D	801W	927W	847D	932W	856D	754W	788D	793D	TR	YES	YES
<b>G2</b>	1003W	808W	1056W	1115W	1192W	1008W	865W	875D	788W	TR	YES	YES
<b>16</b>	648 W	922 W	905 W	847 W	822 W	822 W	836 W	880 W	850 W	TR	NO	YES
<b>G3</b>	944W	944W	955W	960W	893W	987W	772D	797D	788D	TR	YES	YES
<b>G9</b>	895D	960W	880D	884D	953D	788W	851D	921D	847D	TR	YES	YES
<b>G13</b>	746D	987D	1237W	825W	896D	991D	683W	531W	732W	TR	YES	YES
<b>G7</b>	951W	991W	885W	979W	763W	875W	1099D	534D	1075D	TR	YES	YES

## RECOMMENDED PASS/FAIL CRITERIA FROM SEPARATE ANALYSIS

### **1. Use B10 V/mil Values as Minimum Breakdown Strength Value for Each Sample at Each AWTT Test Time (120, 180, 360 days) as Minimum Pass/Fail Criteria for XLPE and TRXLPE.**

- **B10 (not Population Mean) is Recommended by IEEE Standard 930 as Best Method for Comparing Differences (Hypothesis Testing) of Data Sets.**
  - **Unaged: XLPE, 835; TRXLPE, 737**
  - **Aged: XLPE, 896; TRXLPE, 641**
  - **120Day: XLPE, 395; TRXLPE, 574**
  - **180Day: XLPE, 379; TRXLPE, 530**
  - **360Day: XLPE, 286; TRXLPE, 409**
- **“Breakdown” Values Could Be Converted to “Nominal Minimum Withstand” Values, if so Desired.**

### **2. Two (2) XLPE’s in the Database Meet the TRXLPE B10 V/mil Criteria Values.**

- **One (1) Steam Cure & One (1) Dry Cure Set**
- **XLPE Steam Cure Data is Equivalent to Dry Cure @ Unaged, Aged and 120-Days AWTT**
- **XLPE Steam Cure Data is Superior to Dry Cure @ 180 and 360-Days AWTT**

### **3. TRXLPE’s in Database Represented in Both Passing Group/Failing Group (P/F)**

- **TQ: - 2/7**
- **TG: - 9/0**
- **TF: - 6/0**
- **TI: - 5/5**
- **TR: - 3/0**
  - **Realistically Reflects the Industry Variation Between Test Facilities; Low/High Values of TQ or TI Can be Observed Due to Wide Variations in Test Environment Control.**

## RECOMMENDED PASS/FAIL CRITERIA FROM RANDOMIZED ANALYSIS

### 1. Use TRXLPE B10 Values of Major Parent as Minimum Pass/Fail Criteria for XLPE and TRXLPE.

#### – B10 Recommended by IEEE Standard 930

- Unaged: XLPE, ND; TRXLPE, ND
- Aged: XLPE, ND; TRXLPE, ND
- 120Day: XLPE, 401; TRXLPE, 681
- 180Day: XLPE, 343; TRXLPE, 633
- 360Day: XLPE, 307; TRXLPE, 433

### 2. No XLPE's in the Database Meet the TRXLPE B10 V/mil Criteria Values.

### 3. TRXLPE's in Database Represented in Both Passing Group/Failing Group (P/F)

- TQ: - 1/8
- TG: - 9/0
- TF: - 5/1
- TI: - 2/8
- TR: - 3/0

### 4. TRXLPE Materials in Major Parent

<u>120D</u>	<u>180D</u>	<u>360D</u>
TG	TG	TG
TI	TI	TI
TF	TF	TF
TR	TR	TR