4.0 Introduction

As mentioned earlier also that feel of fabric or in other word hand value is one the most important fabric parameter related to the textiles intended to judge the apparel quality. Fabric hand value influences customer inclination towards the material and usefulness of the product and it has direct impact on the selling ability of the apparel. As reported in last chapter that an indigenously manufactured instrument has been developed to study fabric hand characteristics objectively by using nozzle extraction method.

In the process of development of any test equipment or instrument, the feature of the instrument is very important, but more importantly the repeatability or reproducibility is the key issue apart from the type and nature of the instrument.

In this chapter, the testing for the reproducibility of the newly developed instrument is reported. An effort has been made to study the variability of test results associated with this instrument. The natural variability of textile material is very high. Therefore, repeatability or reproducibility study of any instrument is very important under the checks and balances of the purview of the community. Applicability of the instrument is under the sole discretion of user the way they want to utilise the same.

4.1 Materials and Methods

4.1.1 Materials

Three suiting and one shirting fabric samples were used for this purpose. The particulars of the fabric samples used are given in the following Table No. 4.1.

Table No. 4.1: Fabric Sample Particulars

Sample No.	EPI	PPI	Count (Ne)		Thickness (mm)	GSM	Bending Length			G, mg.cm	q, kg/sq cm
			Warp	Weft			Warp (cm)	Weft (cm)	Avg (cm)		
SS2	64	56	14.6	14.5	0.41	259.5	1.7	1.6	1.64	115.3	3.40
SS14	38	34	7.2	7.1	0.50	258.6	1.8	1.6	1.68	121.5	2.92
SS28	136	76	20.0	20.8	0.48	268.1	3.2	2.6	2.87	632.8	15.82
SH27	94	54	25.4	31.1	0.29	130.1	2.9	2.0	2.46	194.2	8.13

4.1.2 Method Used

For each fabric samples 20 experiments were conducted. Experimental data were grouped from 2 to 10 and averages were calculated. Also variations of grouped data with different group number were calculated.

As mentioned earlier the said instrument records three types of forces generated during extracting through nozzle, namely one axial load and two radial – left and right loads. The above mentioned method followed for all the three forces and the data were analyzed for its accuracy level at different group number to determine the repeatability of the instrument and the optimum or minimum number of test required to be performed in the instrument.

4.2 Results and Discussions

The axial load recorded by the instrument for sample number SS2 in kg is tabulated in table no. 4.2 and also calculations are done by grouping of data from 2 to 10. It can be seen from the table that the column correspond to Avg 2 i.e. the third column in the table gives the estimation of averages by taking two test data namely (1,2), (2,3), (3,4) and so on. Similarly in the next column three test data are grouped viz (1,2,3), (2,3,4), (3,4,5) and so on. The subsequent columns are also tabulated in the same manner. Similarly the experimental data of radial load – right and left load cells are tabulated and computed in the Table Number 4.2(a) and 4.2(b) respectively and are given in Annexure-II. At the bottom of the table standard deviations (SD) also computed for each corresponding columns. The data for SD for axial load, radial – right and radial – left loads are combined in the Table Number 4.3. The data for the fabric Sample Number SS14 is tabulated and computed in the same manner (like SS2) for axial load, radial –right load, radial – left load and SD data in the Table Number 4.4, 4.4(a)(Annexure-II), 4.4(b)(Annexure-II) and 4.5 respectively.

Similarly, the data for the fabric Sample Number SS28 is tabulated and computed for axial load, radial –right load, radial – left load and SD data in the Table Number 4.6, 4.6(a)(Annexure-II), 4.6(b)(Annexure-II) and 4.7 respectively. And for the fabric sample number SH27 it is tabulated and computed for axial load, radial – right load, radial – left load and SD data in the Table Number 4.8, 4.8(a)(Annexure-II), 4.8(b)(Annexure-II) and 4.9 respectively.

From the Table 4.2 for sample SS2 it can be seen that when number of test data grouping increased from 2 to 10 the variability of results gradually decreases. The said phenomenon is better visualised from the graphical representation of the same in Fig 4.1(a), 4.1(b) and 4.1(c) given in Annexure-II.

Similarly the Table 4.6 for sample SS14 and corresponding graphical representation in Fig 4.2(a), 4.2(b) and 4.2(c); Table 4.6 for sample SS28 and corresponding graphical representation in Fig 4.3(a), 4.3(b) and 4.3(c) and Table 4.8 for sample SH27 and corresponding graphical representation in Fig 4.4(a), 4.4(b) and 4.4(c) commensurate the above mentioned phenomenon.

From the Table 4.3, 4.5, 4.7 and 4.9 it can be seen that standard deviations of the test data are within acceptable limits considering the inherent variability of textile materials. The graphical representation of the same is given in Fig 4.1, 4.2, 4.3 and 4.4 for Sample Number SS2, SS14, SS28 and SH27 respectively. From the Tables and the Figs it is clear that the standard deviations decreases significantly when number of test data considered up to 5 and thereafter no significant reduction in SD.

Table 4.2: Sample No. SS2 - Effect of Number Test on Axial Load

Test No.	Axial Load (kg)	Avg 2	Avg 3	Avg 4	Avg 5	Avg 6	Avg 7	Avg 8	Avg 9	Avg 10
1	0.1900									
2	0.2100	0.2000								
3	0.2150	0.2125	0.2050							
4	0.1850	0.2000	0.2033	0.2000						
5	0.1500	0.1675	0.1833	0.1900	0.1900					
6	0.2300	0.1900	0.1883	0.1950	0.1980	0.1967				
7	0.2450	0.2375	0.2083	0.2025	0.2050	0.2058	0.2036			
8	0.2500	0.2475	0.2417	0.2188	0.2120	0.2125	0.2121	0.2094		
9	0.2200	0.2350	0.2383	0.2363	0.2190	0.2133	0.2136	0.2131	0.2106	
10	0.2410	0.2305	0.2370	0.2390	0.2372	0.2227	0.2173	0.2170	0.2162	0.2136
11	0.2360	0.2385	0.2323	0.2368	0.2384	0.2370	0.2246	0.2196	0.2191	0.2182
12	0.1950	0.2155	0.2240	0.2230	0.2284	0.2312	0.2310	0.2209	0.2169	0.2167
13	0.2000	0.1975	0.2103	0.2180	0.2184	0.2237	0.2267	0.2271	0.2186	0.2152
14	0.2350	0.2175	0.2100	0.2165	0.2214	0.2212	0.2253	0.2278	0.2280	0.2202
15	0.2100	0.2225	0.2150	0.2100	0.2152	0.2195	0.2196	0.2234	0.2258	0.2262
16	0.1950	0.2025	0.2133	0.2100	0.2070	0.2118	0.2160	0.2165	0.2202	0.2227
17	0.2150	0.2050	0.2067	0.2138	0.2110	0.2083	0.2123	0.2159	0.2163	0.2197
18	0.1800	0.1975	0.1967	0.2000	0.2070	0.2058	0.2043	0.2083	0.2119	0.2127
19	0.2400	0.2100	0.2117	0.2075	0.2080	0.2125	0.2107	0.2088	0.2118	0.2147
20	0.2450	0.2425	0.2217	0.2200	0.2150	0.2142	0.2171	0.2150	0.2128	0.2151
Avg	**0.2144**	**0.2142**	**0.2137**	**0.2139**	**0.2144**	**0.2157**	**0.2167**	**0.2171**	**0.2173**	**0.2177**
SD	**0.0266**	**0.0203**	**0.0160**	**0.0140**	**0.0125**	**0.0100**	**0.0078**	**0.0062**	**0.0052**	**0.0040**

Table 4.3: Number of test data grouped Vs Standard Deviations

	2	3	4	5	6	7	8	9	10
Axial	0.021	0.016	0.014	0.013	0.010	0.008	0.006	0.005	0.004
Radial - Right	0.006	0.005	0.005	0.004	0.004	0.003	0.003	0.003	0.003
Radial - Left	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001

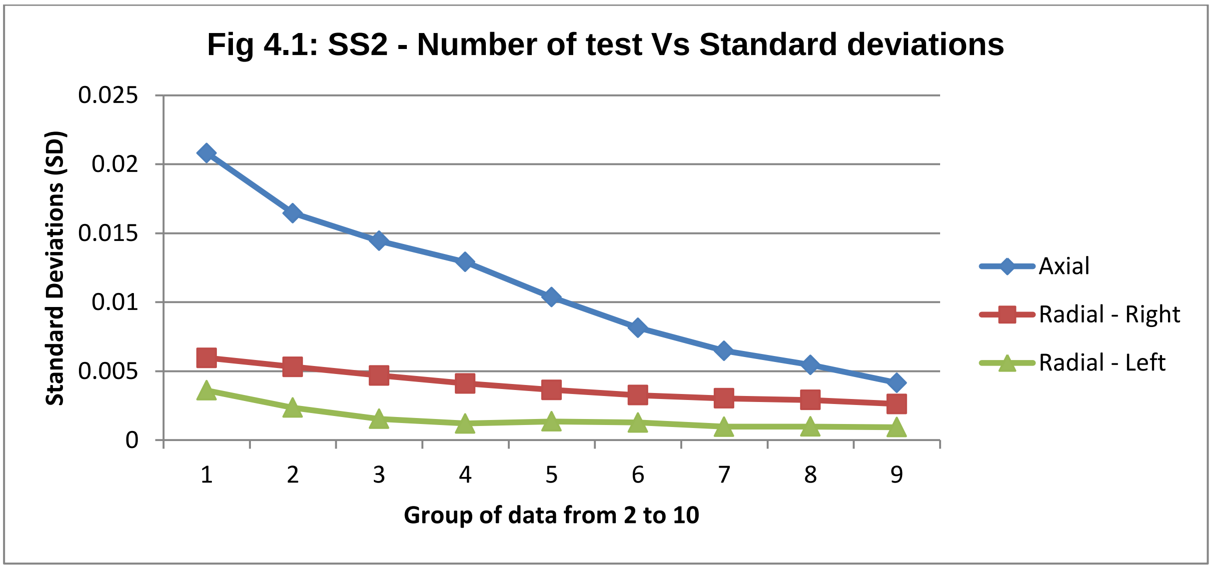


Table 4.4: Sample No. SS14 - Effect of Number Test on Axial Load

Test No.	Axial Load (kg)	Avg 2	Avg 3	Avg 4	Avg 5	Avg 6	Avg 7	Avg 8	Avg 9	Avg 10
1	0.3200									
2	0.3350	0.3275								
3	0.3500	0.3425	0.3350							
4	0.2900	0.3200	0.3250	0.3238						
5	0.2850	0.2875	0.3083	0.3150	0.3160					
6	0.3100	0.2975	0.2950	0.3088	0.3140	0.3150				
7	0.3250	0.3175	0.3067	0.3025	0.3120	0.3158	0.3164			
8	0.3400	0.3325	0.3250	0.3150	0.3100	0.3167	0.3193	0.3194		
9	0.3450	0.3425	0.3367	0.3300	0.3210	0.3158	0.3207	0.3225	0.3222	
10	0.3200	0.3325	0.3350	0.3325	0.3280	0.3208	0.3164	0.3206	0.3222	0.3220
11	0.3550	0.3375	0.3400	0.3400	0.3370	0.3325	0.3257	0.3213	0.3244	0.3255
12	0.3600	0.3575	0.3450	0.3450	0.3440	0.3408	0.3364	0.3300	0.3256	0.3280
13	0.3450	0.3525	0.3533	0.3450	0.3450	0.3442	0.3414	0.3375	0.3317	0.3275
14	0.3300	0.3375	0.3450	0.3475	0.3420	0.3425	0.3421	0.3400	0.3367	0.3315
15	0.2900	0.3100	0.3217	0.3313	0.3360	0.3333	0.3350	0.3356	0.3344	0.3320
16	0.2850	0.2875	0.3017	0.3125	0.3220	0.3275	0.3264	0.3288	0.3300	0.3295
17	0.3150	0.3000	0.2967	0.3050	0.3130	0.3208	0.3257	0.3250	0.3272	0.3285
18	0.3400	0.3275	0.3133	0.3075	0.3120	0.3175	0.3236	0.3275	0.3267	0.3285
19	0.3500	0.3450	0.3350	0.3225	0.3160	0.3183	0.3221	0.3269	0.3300	0.3290
20	0.3150	0.3325	0.3350	0.3300	0.3210	0.3158	0.3179	0.3213	0.3256	0.3285
Avg	**0.3253**	**0.3257**	**0.3252**	**0.3243**	**0.3243**	**0.3252**	**0.3264**	**0.3274**	**0.3281**	**0.3282**
SD	**0.0239**	**0.0203**	**0.0178**	**0.0144**	**0.0121**	**0.0104**	**0.0089**	**0.0068**	**0.0046**	**0.0027**

Table 4.5: SS14 - Number of test data grouped Vs Standard Deviations

	2	3	4	5	6	7	8	9	10
Axial	0.0208	0.0178	0.0148	0.0125	0.0107	0.0089	0.0068	0.0046	0.0027
Radial - Right	0.0063	0.0043	0.0033	0.0028	0.0029	0.0029	0.0025	0.0020	0.0019
Radial - Left	0.0060	0.0047	0.0036	0.0029	0.0025	0.0022	0.0022	0.0019	0.0016

Fig 4.2 : SS14 - Number of test Vs Standard deviations

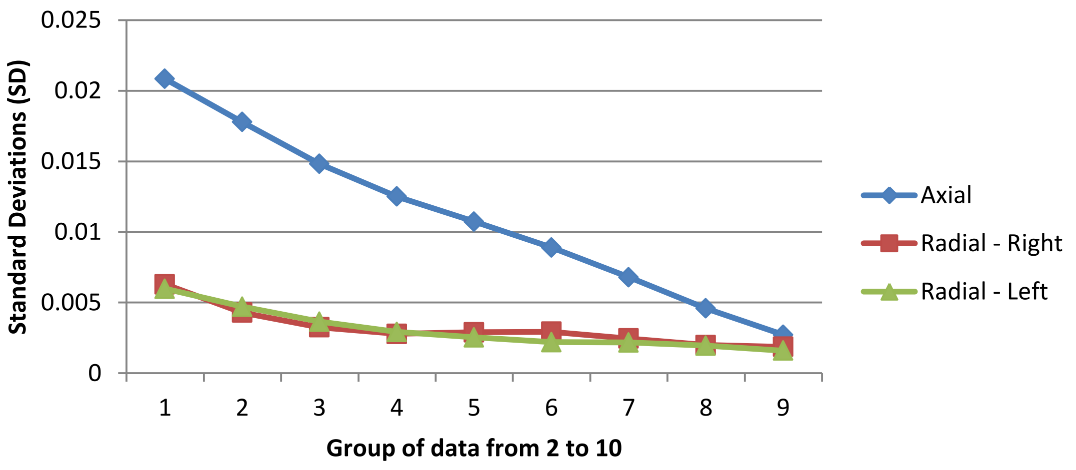


Table 4.6: SS28: Effect of Number Test on Axial Load

Test No.	Axial Load (kg)	Avg 2	Avg 3	Avg 4	Avg 5	Avg 6	Avg 7	Avg 8	Avg 9	Avg 10
1	0.4850									
2	0.4930	0.4890								
3	0.4880	0.4905	0.4887							
4	0.4960	0.4920	0.4923	0.4905						
5	0.4900	0.4930	0.4913	0.4918	0.4904					
6	0.4800	0.4850	0.4887	0.4885	0.4894	0.4887				
7	0.5000	0.4900	0.4900	0.4915	0.4908	0.4912	0.4903			
8	0.4750	0.4875	0.4850	0.4863	0.4882	0.4882	0.4889	0.4884		
9	0.4880	0.4815	0.4877	0.4858	0.4866	0.4882	0.4881	0.4888	0.4883	
10	0.4950	0.4915	0.4860	0.4895	0.4876	0.4880	0.4891	0.4890	0.4894	0.4890
11	0.4980	0.4965	0.4937	0.4890	0.4912	0.4893	0.4894	0.4903	0.4900	0.4903
12	0.4730	0.4855	0.4887	0.4885	0.4858	0.4882	0.4870	0.4874	0.4883	0.4883
13	0.4780	0.4755	0.4830	0.4860	0.4864	0.4845	0.4867	0.4859	0.4863	0.4873
14	0.4910	0.4845	0.4807	0.4850	0.4870	0.4872	0.4854	0.4873	0.4864	0.4868
15	0.4900	0.4905	0.4863	0.4830	0.4860	0.4875	0.4876	0.4860	0.4876	0.4868
16	0.4790	0.4845	0.4867	0.4845	0.4822	0.4848	0.4863	0.4865	0.4852	0.4867
17	0.5060	0.4925	0.4917	0.4915	0.4888	0.4862	0.4879	0.4888	0.4887	0.4873
18	0.4900	0.4980	0.4917	0.4913	0.4912	0.4890	0.4867	0.4881	0.4889	0.4888
19	0.4850	0.4875	0.4937	0.4900	0.4900	0.4902	0.4884	0.4865	0.4878	0.4885
20	0.4860	0.4855	0.4870	0.4918	0.4892	0.4893	0.4896	0.4881	0.4864	0.4876
Avg	**0.4883**	**0.4884**	**0.4885**	**0.4885**	**0.4882**	**0.4880**	**0.4880**	**0.4878**	**0.4878**	**0.4879**
SD	**0.0085**	**0.0052**	**0.0036**	**0.0028**	**0.0024**	**0.0018**	**0.0014**	**0.0013**	**0.0014**	**0.0011**

Table 4.7: SS28 - Number of test data grouped Vs Standard Deviations

	2	3	4	5	6	7	8	9	10
Axial	0.0053	0.0036	0.0029	0.0024	0.0018	0.0014	0.0013	0.0014	0.0011
Radial - Right	0.0069	0.0054	0.0047	0.0038	0.0037	0.0032	0.0030	0.0028	0.0023
Radial - Left	0.0052	0.0043	0.0039	0.0036	0.0032	0.0028	0.0023	0.0021	0.0018

Fig. 4.3: SS28 - Number of test Vs Standard deviations

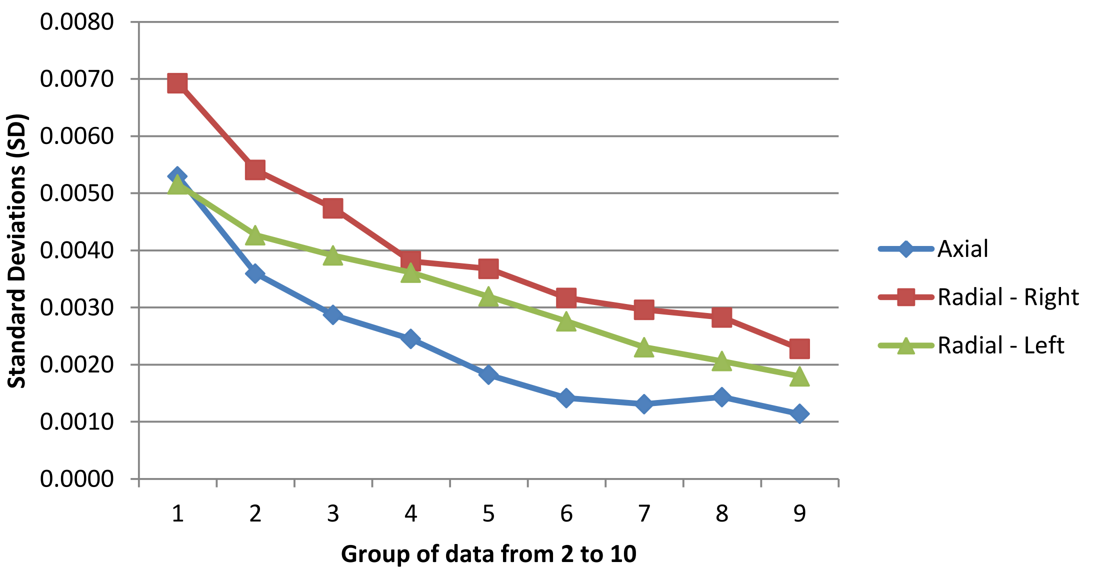


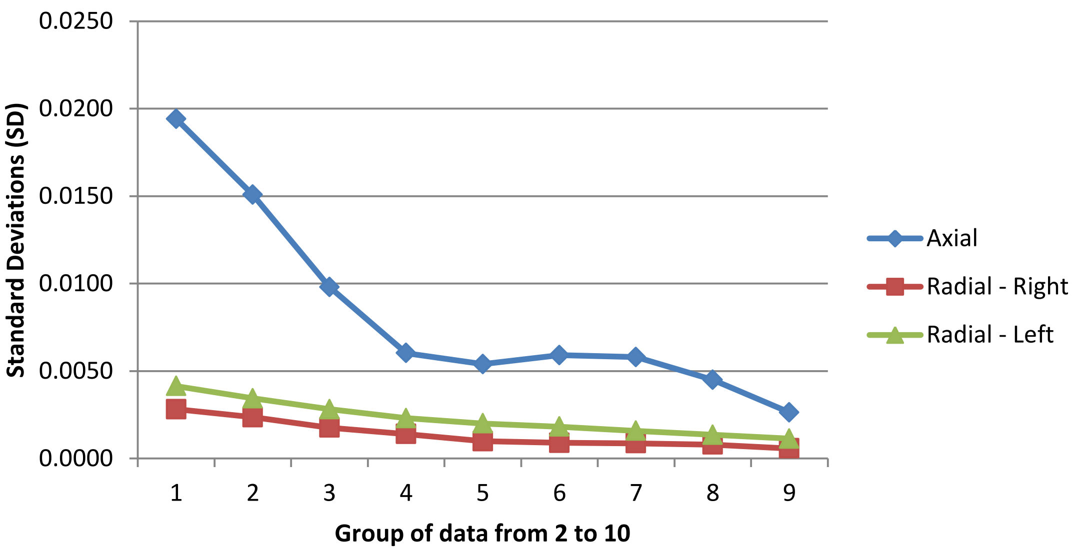
Table 4.8: Sample No. SH27: Effect of Number Test on Axial load

Test No.	Axial Load (kg)	Avg 2	Avg 3	Avg 4	Avg 5	Avg 6	Avg 7	Avg 8	Avg 9	Avg 10
1	0.0900									
2	0.1100	0.1000								
3	0.0850	0.0975	0.0950							
4	0.1150	0.1000	0.1033	0.1000						
5	0.1200	0.1175	0.1067	0.1075	0.1040					
6	0.1350	0.1275	0.1233	0.1138	0.1130	0.1092				
7	0.0950	0.1150	0.1167	0.1163	0.1100	0.1100	0.1071			
8	0.1140	0.1045	0.1147	0.1160	0.1158	0.1107	0.1106	0.1080		
9	0.1250	0.1195	0.1113	0.1173	0.1178	0.1173	0.1127	0.1124	0.1099	
10	0.1500	0.1375	0.1297	0.1210	0.1238	0.1232	0.1220	0.1174	0.1166	0.1139
11	0.1450	0.1475	0.1400	0.1335	0.1258	0.1273	0.1263	0.1249	0.1204	0.1194
12	0.1000	0.1225	0.1317	0.1300	0.1268	0.1215	0.1234	0.1230	0.1221	0.1184
13	0.0850	0.0925	0.1100	0.1200	0.1210	0.1198	0.1163	0.1186	0.1188	0.1184
14	0.0800	0.0825	0.0883	0.1025	0.1120	0.1142	0.1141	0.1118	0.1143	0.1149
15	0.1600	0.1200	0.1083	0.1063	0.1140	0.1200	0.1207	0.1199	0.1171	0.1189
16	0.1500	0.1550	0.1300	0.1188	0.1150	0.1200	0.1243	0.1244	0.1232	0.1204
17	0.1150	0.1325	0.1417	0.1263	0.1180	0.1150	0.1193	0.1231	0.1233	0.1224
18	0.0950	0.1050	0.1200	0.1300	0.1200	0.1142	0.1121	0.1163	0.1200	0.1205
19	0.0900	0.0925	0.1000	0.1125	0.1220	0.1150	0.1107	0.1094	0.1133	0.1170
20	0.1320	0.1110	0.1057	0.1080	0.1164	0.1237	0.1174	0.1134	0.1119	0.1152
Avg	**0.1146**	**0.1147**	**0.1154**	**0.1164**	**0.1172**	**0.1174**	**0.1169**	**0.1171**	**0.1176**	**0.1181**
SD	**0.0246**	**0.0189**	**0.0151**	**0.0095**	**0.0058**	**0.0052**	**0.0059**	**0.0058**	**0.0045**	**0.0025**

Table 4.9: SH27 - Number of test data grouped Vs Standard Deviations

	2	3	4	5	6	7	8	9	10
Axial	0.0194	0.0151	0.0098	0.0060	0.0054	0.0059	0.0058	0.0045	0.0026
Radial - Right	0.0028	0.0024	0.0018	0.0014	0.0010	0.0009	0.0009	0.0008	0.0006
Radial - Left	0.0041	0.0034	0.0028	0.0023	0.0020	0.0018	0.0016	0.0014	0.0011

Fig. 4.4: SH27 - Number of test Vs Standard deviations



4.3 Conclusion

From the abovementioned study it is hereby concluded that the newly developed fabric feel tester accurate enough to conduct study on handle characteristics of textile fabrics. To increase the accuracy of results, the number of test per samples should be minimum five. Hence, it is hereby claimed that the said instrument is validated for its use to study the handle characteristics in various format depending upon the researchers or application areas as applicable. As mentioned earlier that the newly developed instrument is having many features that may be useful to study and derive a fabric feel factor and that are reported in the subsequent chapters.