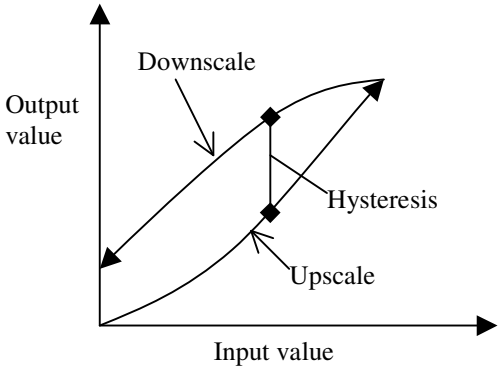
SEQUENTIAL VS RANDOM CALIBRATION

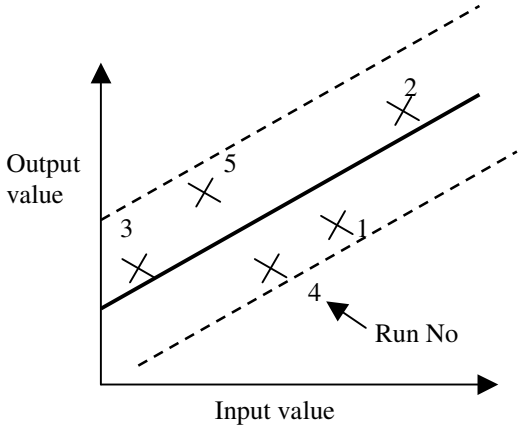
Principle:

A *sequential test* applies a sequential variation in the input value over the desired input range. This can be done by increasing the input value (upscale) and / or by decreasing the input value (downscale) over the full input range. This is helpful in identifying the hysteresis error in a measuring system. *Hysteresis error* is the difference in values found between going upscale and downscale in a sequential test.

A *random test* applies a randomly selected sequence of values of a known input over the intended calibration range. The random application of input tends to minimise the impact of interference. It breaks up hysteresis effects and observation errors. It ensures that each application of input value is independent of the previous. Such a random variation in input value more closely represents the actual measurement situation.

Procedure:





1. For the sequential test, start from zero input to maximum and then back to zero. Note the corresponding output values for each input.
2. Considering all readings simultaneously (both increasing and decreasing), determine the standard uncertainty S_{xseq}.
3. For the random test, decide on the number of input readings to be taken. For the comparison to be balanced, this should equal the total number of readings for the sequential test.
4. Select the nominal input / output values so that the range of calibration is covered.
5. Allot serial numbers to these values in increasing (or decreasing) order. This order is called *the standard order*.
6. Using a calculator or random number tables or drawing lots, generate random numbers covering all the Standard order numbers and allot in order. Take care to avoid duplication. The test is carried out in this order and this order is also called the run order.

Replication	1				2			
Nominal Input / Output	0.2	0.4	0.6	0.8	0.2	0.4	0.6	0.8
Standard order	1	2	3	4	5	6	7	8
Run order	5	7	4	1	6	3	2	8
Output	…							

7. Adjust the input values according to the run order and note the corresponding output values. Determine the standard uncertainty S_{xrand}.

Discussion:

1. Compare S_{xseq} and S_{xrand}. Explain the difference.

Possible Random Run Orders for Experiments

8 Runs				
1	5	8	6	5
6	7	4	4	3
4	4	6	2	4
8	1	3	7	1
5	6	5	5	2
3	3	7	1	7
7	2	1	3	8
2	8	2	8	6

16 Runs				
10	1	11	14	5
2	5	9	13	4
4	2	4	4	14
16	6	16	1	7
9	11	13	10	15
5	3	12	16	2
8	8	14	2	1
3	12	6	5	3
7	7	10	12	8
11	13	5	9	11
1	4	2	6	12
12	15	15	8	16
14	10	8	15	10
15	14	7	3	6
6	9	1	7	9
13	16	3	11	13

32 Runs				
29	19	15	3	30
32	16	8	6	20
18	30	13	24	4
2	10	10	9	7
17	13	3	28	3
15	25	25	26	14
13	28	1	2	10
20	15	6	29	16
14	4	9	31	27
6	22	20	1	2
22	32	16	15	32
16	21	28	12	12
1	24	19	23	24
25	12	27	17	23
12	17	17	18	5
30	9	30	27	25
5	20	2	30	8
23	2	26	32	28
19	8	11	25	1
28	11	5	20	21
31	5	29	22	26
8	6	31	7	6
11	1	4	14	22
7	31	7	5	17
24	23	12	11	18
9	27	22	10	29
27	3	18	19	11
4	26	24	8	15
21	7	32	13	31
3	29	14	4	19
26	18	21	16	9
10	14	23	21	13