

NASSCO PACP Quality Control

Sewer defect coding has become of paramount importance for the worldwide sewer rehabilitation industry to ascertain critical information regarding the underground infrastructure. NASSCO PACP has enabled the wastewater industry to provide standardization and consistency in the way we evaluate sewer pipe condition and how we manage TV inspection results. The decisions made by engineers are based on the data collected and the accuracy and quality of this data is essential in making rehabilitation decisions for wastewater collection systems. The need for Quality Control of PACP data is essential and the procedure should be easy to apply and even easier to audit.

CCTV contracting companies should have a Random Number Quality Control procedure in place that is then audited by the client. A random number is one of a series of numbers that have no detectable pattern, so that each and every item in a known population has an equal chance of being selected based upon the random number. The client can carry out their own QC but it must be based upon the Random Sampling system, so that discrepancies about the method of choice of the inspections to be Quality Controlled disappear. The intent is for the client to actually audit the CCTV contractors QC procedure rather than performing their own QC. If there is doubt about the results then the Client can ask for another differing set of Random Numbers to be created and be applied to the CCTV operator in question, thereby generating another different set of inspections to be checked. A QC history must be created for each CCTV operator and not created for each contract.

General Method

Unbiased selection of inspections that require checking is the backbone of any QC procedure. First it has to be decided the percentage of the inspections that need to be checked. I am proposing that NASSCO require a minimum of 5% of a CCTV operator's data be checked.

Population

A population is needed to account for the number of inspections for each CCTV operator from which the 5% is derived. The method would be based on the approximate number of inspections performed each year by a CCTV operator, calculated as follow:

1400' per day at 200' per inspection = 7 inspections per day
240 active work days per year = 240 days
Population = 1680 inspections per year, per CCTV operator

5% to be checked = 84 inspections

It does not matter whether the population is actually higher or lower than this as once the Random Numbers have run out then a new set is generated or the population equates to 1.5 years as opposed to 1 year. The result is still 5% being checked.

Generating the Random Numbers

A Random Number list, based upon the population and the selection percentage, is available from many web sites. The site we will use for this paper is: www.randomizer.org/form.htm. This site generates a list of random numbers that can be sorted in numerical order and printed. Each CCTV operator must have a different set of Random Numbers.

Selection of inspections to be checked

In the field the CCTV operator inspects each sewer segment and either types the PACP information into a computer database or manually writes the information on PACP forms for each sewer segment in the order the sewer segments are inspected. In the office, the QC employee / operator counts through the inspections, for each separate CCTV operator, in the order in which they were inspected. When an inspection coincides with a Random Number a copy of the inspection is made from the video tape/CD/DVD onto the CCTV operators master QC video tape/CD/DVD. A copy of the corresponding CCTV report is also printed from the computer. These are then kept in the CCTV operators QC folder until the QC is carried out by a qualified QC employee / operator. By using the Random Number sampling system a CCTV operator will not be able to "abuse" the system. The client can ask for the set of Random Numbers for each CCTV operator at the start of a project, or the client can provide a set of Random Numbers to be used for each operator associated with the project.

Quality Control of an Inspection

It is expected that the accuracy of the Header record exceed 90% as most of the field contents are based upon facts. The simplest method for QC of the Header record is as follows:

Each field completed, and those that are not but should have been, is counted, producing a "number of fields checked", say 32 (ignoring such fields as Cover and Invert levels and other unused fields)

Then the fields with mistakes are counted, irrelevant of the level of the mistake, creating an "error count" say for this example, 2.

Therefore the calculation is:

$$\begin{aligned} &(\text{error count} / \text{number of fields checked}) * 100 = \text{percentage error} \\ &100 - \text{error percentage} = \text{accuracy percentage} \end{aligned}$$

$$\begin{aligned} &(2 / 32) * 100 = 6.25\% \\ &100 - 6.25 = 93.75\% \text{ accuracy level} \end{aligned}$$

This percentage accuracy level is then entered onto a graph so that ongoing accuracy can easily be seen, again, for each CCTV operator.

Detail Information

As with the Header records, each field that has been completed in the Detail records is added up, irrelevant of whether it is a Clock At/To, the Continuous Defect field or Distance/Video digits. Each entry is treated as equally important. From this number of

entries made in the Detail section a figure is arrived. A qualified QC employee/operator then looks through the same inspection and checks the accuracy of each field and reaches two values, the number of entries that should have been made and an error count. No attempt should be made to create a new inspection from scratch, just check what has already been reported on. If a defect is not recorded then the number of fields that support the missed defect is added to the Error Count, for instance, if the CCTV operator misses an EMJ then the error count increases by at least 5 errors:

The Video Digit, Distance, Code, Clock At and To and the %

The 5 errors must also be added to the number of entries that should have been made as well as any other errors to reach a total number of entries. Therefore at the end each inspection there are two values, the number of entries that should have been made and the error count. The calculation for the Quality Control of each inspection is as follows:

$$(\text{Error Count} / \text{Number of entries that should have been made}) * 100 = \text{Percentage Error}$$

$$100 - \text{Percentage Error} = \text{Accuracy Level}$$

Assume that the number of entries made should have been 122
Assume that the Error Count is 8

$$(8 / 122) * 100 = 6.5\%$$

$$100\% - 6.5 = 93.5\% \text{ Accuracy Level}$$

This percentage Accuracy Level is then entered onto a graph so that ongoing level can be easily seen for each CCTV Operator.

Summary

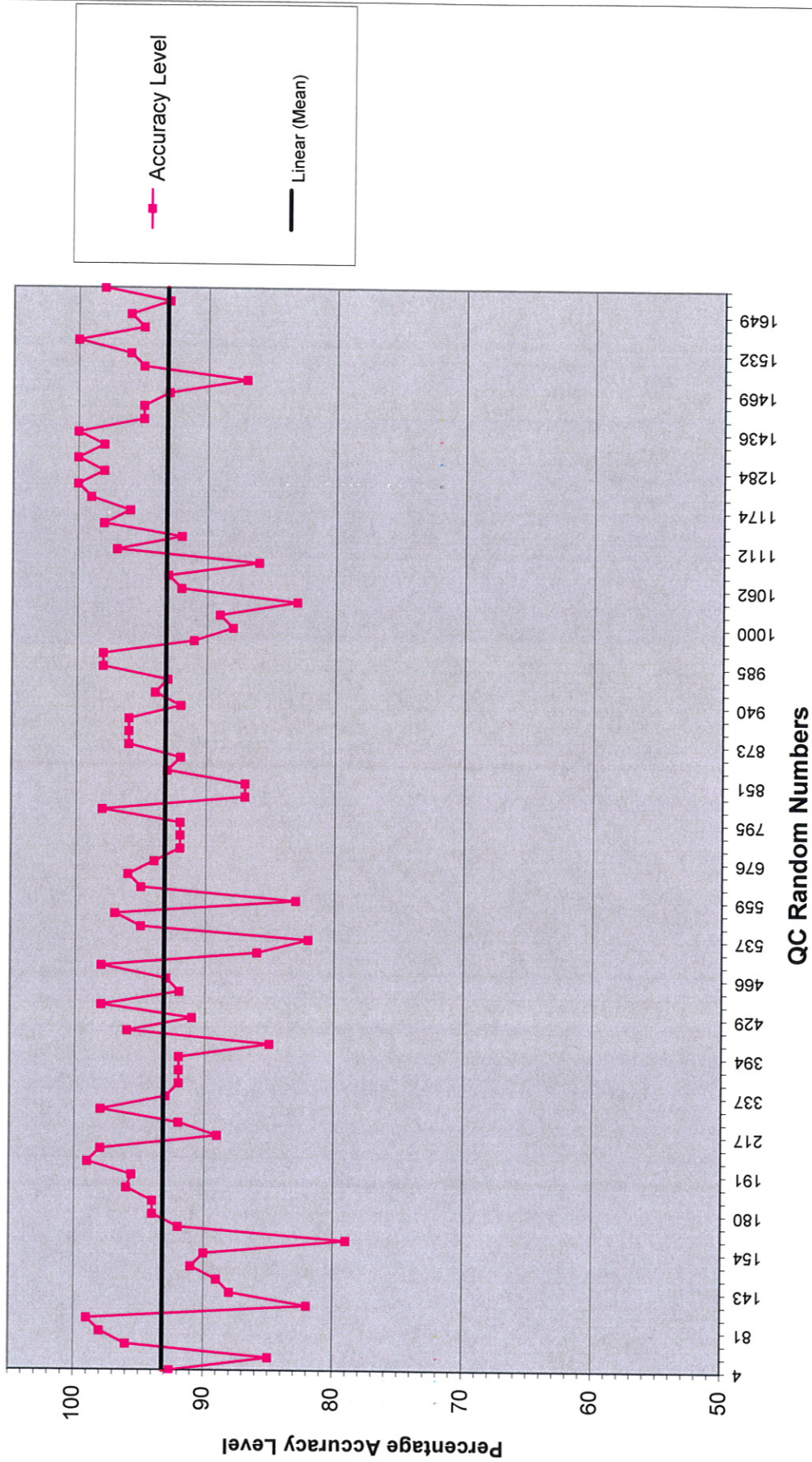
All QC inspection information for each sewer segment checked is entered into QC forms so that an Audit trail can be established. There must be hard copies of each inspection checked with the Errors and Omissions clearly marked. The Accuracy Level calculations must also be entered into the QC logs. The Random Number must be entered against each aspect of the QC procedure. A continuing Accuracy Level Graph must be kept up to date for each CCTV Operator; it is acknowledged that the results could be as much as one month behind the time of the inspection.

Research Randomizer Results:
 1 Set of 84 Unique Numbers Per Set
 Range: From 1 to 1680 -- Sorted
 Set 1

	Random Numbers	Accuracy Level
1	4	92.6
2	34	85
3	73	96
4	81	98
5	105	99
6	108	82
7	143	88
8	146	89
9	147	91
10	154	90
11	162	79
12	163	92
13	180	94
14	181	94
15	187	96
16	191	95.6
17	209	99
18	214	98
19	217	89
20	223	92
21	321	98
22	337	93
23	345	92
24	369	92
25	394	92
26	396	85
27	422	96
28	429	91
29	433	98
30	439	92
31	466	93
32	498	98
33	511	86
34	537	82
35	545	95
36	550	97
37	559	83
38	617	95
39	664	96
40	676	94
41	679	92
42	710	92
43	795	92
44	816	98
45	838	87
46	851	87

47	869	93
48	872	92
49	873	96
50	883	96
51	908	96
52	940	92
53	954	94
54	963	93
55	985	98
56	987	98
57	988	91
58	1000	88
59	1001	89
60	1003	83
61	1062	92
62	1074	93
63	1102	86
64	1112	97
65	1131	92
66	1168	98
67	1174	96
68	1177	99
69	1261	100
70	1284	98
71	1414	100
72	1422	98
73	1436	100
74	1441	95
75	1446	95
76	1469	93
77	1472	87
78	1519	95
79	1532	96
80	1571	100
81	1619	95
82	1649	96
83	1666	93
84	1672	98

CES CCTV Operator #05




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To generate a set of random numbers, simply enter your selections (integer values only):

How many sets of numbers do you want to generate? [Help](#)

How many numbers per set? [Help](#)

Number range (e.g., 1-50): From: To: [Help](#)

Do you wish each number in a set to remain unique? Yes ☐ [Help](#)

Do you wish to sort your outputted numbers? Yes: Least to Greatest ☐ [Help](#)

How do you wish to view your outputted numbers? Place Markers Off ☐ [Help](#)

[Randomize Now!](#)

Note: Research Randomizer may not work with AOL browsers or Netscape 6.x. Also, you may need to disable any pop-up ad blockers you are running because your random numbers will be displayed in a pop-up window (just configure your pop-up blocker to exclude this site.)

Instructions

To generate a set of random numbers, simply fill out the form, indicating:

- ✓ How many sets of random numbers you would like
- ✓ How many numbers you want in each set
- ✓ The range within which you want your numbers to fall
- ✓ Whether or not you want each number in a set to be unique
- ✓ Whether you would like the numbers in each set sorted, either from Least to Greatest or from Greatest to Least
- ✓ How you wish to view your outputted numbers

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Close 
For best results, close
this window after each use.

Print 

Download in Excel 

Research Randomizer Results

1 Set of **84 Unique** Numbers Per Set

Range: From **1** to **1680** -- **Sorted from Least to Greatest**

Job Status: **Finished**

Set #1:

58, 88, 98, 149, 161, 223, 235, 282, 339, 361, 368, 399, 410, 411, 436, 442, 487, 495,
498, 508, 590, 591, 618, 627, 645, 648, 681, 685, 698, 707, 728, 753, 772, 779, 839,
852, 878, 883, 897, 909, 929, 933, 950, 987, 991, 1006, 1012, 1040, 1058, 1067, 1098,
1102, 1114, 1143, 1151, 1203, 1219, 1225, 1240, 1243, 1256, 1269, 1323, 1342, 1362,
1395, 1398, 1431, 1484, 1486, 1498, 1507, 1524, 1529, 1555, 1556, 1577, 1579, 1609,
1622, 1627, 1628, 1656, 1661
