



CALIFORNIA DEPARTMENT OF  
FOOD & AGRICULTURE

Karen Ross, Secretary

January 7, 2016

Mahesh Albuquerque  
Chair, NCWM Specifications and Tolerances Committee  
Director, CDLE-Oil and Public Safety  
633 17th Street, Suite 500  
Denver, CO 80202

Don Onwiler, Executive Director  
National Conference on Weights and Measures  
1135 M Street, Suite 110  
Lincoln, NE 68508

Dear Mr. Albuquerque and Mr. Onwiler:

Re: NCWM S&T Item 339-2 Table T.2. Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices

The California Department of Food and Agriculture (CDFA) Division of Measurement Standards (DMS) supports the proposal to modify/amend Section 3.39. Hydrogen Gas-Measuring Devices - Tentative Code in the National Institute of Standards and Technology (NIST) Handbook 44 (HB 44), Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices by adopting California's expanded accuracy classes for retail gaseous hydrogen fuel dispensers.

Specifically, this proposal will add three Accuracy Classes: 3.0, 5.0, and 10.0. This will expand the acceptance and maintenance tolerances since current hydrogen gas-measuring devices cannot comply with the tolerances listed in Table T.2 of this code. In addition, this proposal limits the timeframe of applying these expanded tolerances based upon the device's accuracy class.

The commercialization of hydrogen fueling stations is one of the biggest critical barriers preventing the widespread market penetration of zero-emission hydrogen-fueled vehicles. A statement in the U.S. Department of Energy Request for Information: High-Accuracy Hydrogen Meters (DE-FOA-0000753, MODIFICATION 001, August 29, 2012) summarizes well the current dilemma:

“In order to enable the commercialization of hydrogen, fueling equipment that meets measurement standards must be available to sell hydrogen fuel to the public by weight or volume. Based on available information, no commercially available devices are capable of meeting the National Institute of Standards and Technology's (NIST's) Handbook 44 measurement accuracy requirements for hydrogen while being used under fueling conditions....”



Mr. Mahesh Albuquerque  
Mr. Don Onwiler  
January 7, 2016  
Page 2

California law adopts by reference the latest standards as adopted by the National Conference on Weights and Measures (NCWM) and published in NIST HB 44 “Specifications and Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.” California law also authorizes the CDFA Secretary to amend, modify, or reject portions of NIST HB 44, as necessary.

Accelerating the market for zero emission vehicles such as hydrogen fuel cell vehicles is a cornerstone of California’s long-term transportation strategy to reduce pollution and greenhouse gas emissions. Accordingly, CDFA promulgated regulations in 2014 that would facilitate the commercialization of hydrogen fuel. The California regulations removed the tentative status of Section 3.39. to make clear that this section of NIST HB 44 is the basis of enforcement for hydrogen gas-measuring devices. Based upon DMS’s previous test data and industry testimony that the tolerances in Section 3.39. were unattainable, the regulations also temporarily widened the accuracy tolerances to allow for successful testing during type evaluation, initial equipment testing, and testing of equipment already in use.

Attached are five charts with data obtained during type evaluation testing from 2014 to present. They clearly demonstrate that none of the current hydrogen dispenser designs are able to meet the current accuracy tolerances in Section 3.39. in NIST HB 44. It is important to note that the proposed Accuracy Class 10.0 maintenance tolerance of 10.0% is an estimate since this class of device has not been in service long enough to establish data if a smaller tolerance is acceptable.

CDFA DMS believes that it is imperative that the U.S. National Work Group for the Development of Commercial Hydrogen Measurement Standards support this proposal and NCWM act now to adopt these additional Accuracy Classes and respective expanded tolerances so that existing hydrogen gas-measuring devices may be approved for commercial service.

If you have questions, please contact Kevin Schnepf, Senior Environmental Scientist, at (916) 229-3458 or [kevin.schnepf@cdfa.ca.gov](mailto:kevin.schnepf@cdfa.ca.gov).

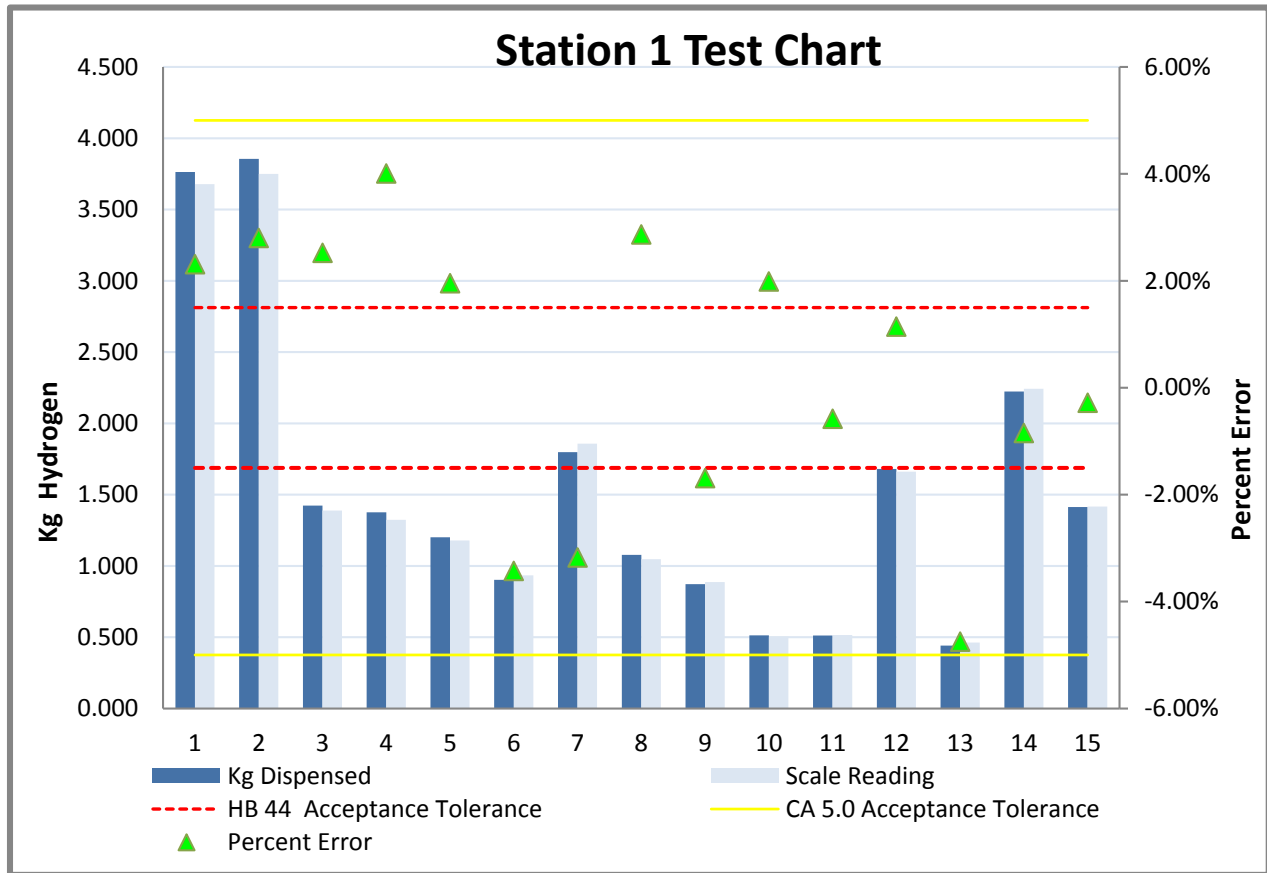
Best regards,



Kristin Macey  
Director

Attachments

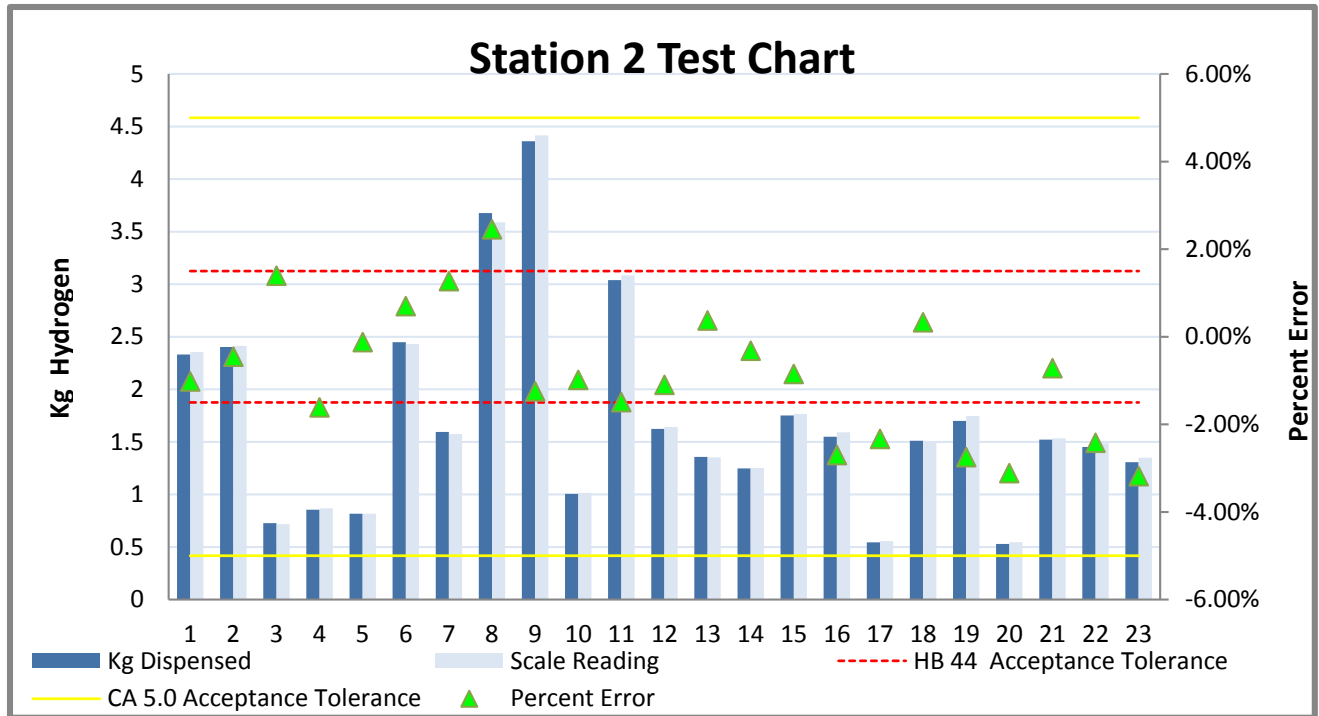
# Hydrogen Station Dispenser Test Data



Tolerances apply to both under-registrations and over-registrations

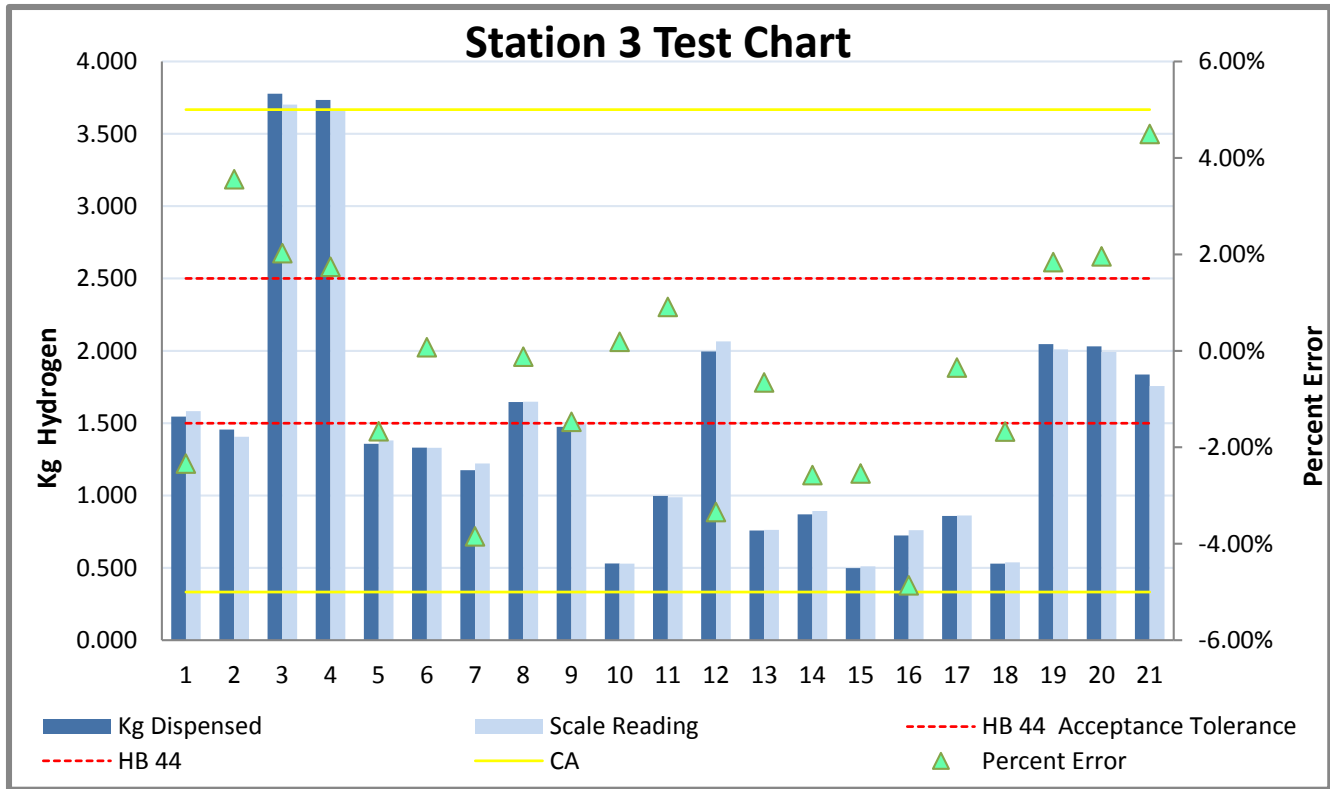
Fill #	Kg Dispensed	Reference Scale	Percent Error	HB 44 Acceptance Tolerance	CA 5.0 Acceptance Tolerance
1	3.763	3.678	2.311%	1.50%	5.00%
2	3.855	3.750	2.800%	1.50%	5.00%
3	1.423	1.388	2.522%	1.50%	5.00%
4	1.376	1.323	4.006%	1.50%	5.00%
5	1.201	1.178	1.952%	1.50%	5.00%
6	0.902	0.934	-3.426%	1.50%	5.00%
7	1.798	1.857	-3.177%	1.50%	5.00%
8*	1.077	1.047	2.865%	1.50%	5.00%
9	0.872	0.887	-1.691%	1.50%	5.00%
10	0.513	0.503	1.988%	1.50%	5.00%
11	0.512	0.515	-0.583%	1.50%	5.00%
12	1.680	1.661	1.144%	1.50%	5.00%
13	0.441	0.463	-4.752%	1.50%	5.00%
14	2.223	2.242	-0.847%	1.50%	5.00%
15	1.413	1.417	-0.282%	1.50%	5.00%

# Hydrogen Station Dispenser Test Data



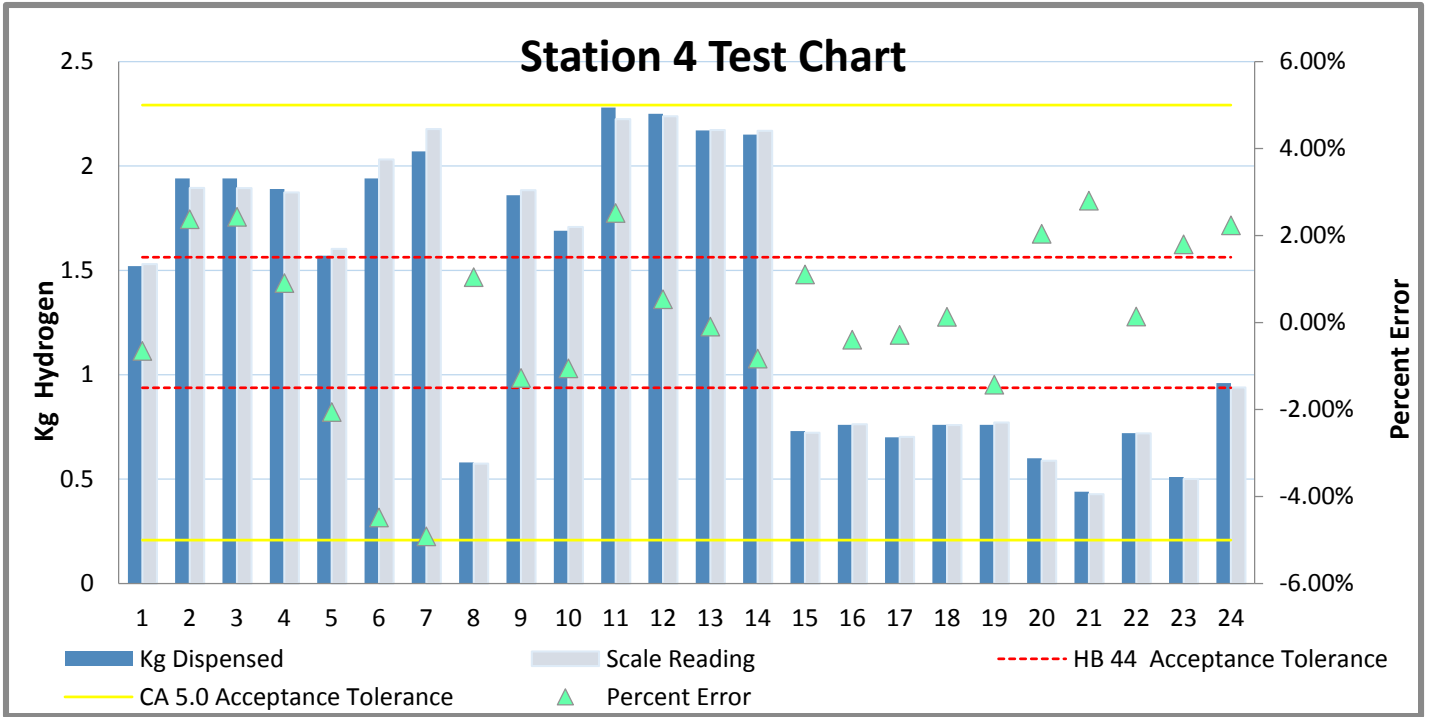
Fill #	Kg Dispensed	Reference Scale	Percent Error	HB 44 Acceptance Tolerance	CA 5.0 Acceptance Tolerance
1	2.331	2.355	-1.019%	1.50%	5.00%
2	2.402	2.413	-0.456%	1.50%	5.00%
3	0.727	0.717	1.395%	1.50%	5.00%
4	0.855	0.869	-1.611%	1.50%	5.00%
5	0.816	0.817	-0.122%	1.50%	5.00%
6	2.448	2.431	0.699%	1.50%	5.00%
7	1.595	1.575	1.270%	1.50%	5.00%
8	3.677	3.589	2.452%	1.50%	5.00%
9	4.361	4.416	-1.245%	1.50%	5.00%
10	1.005	1.015	-0.985%	1.50%	5.00%
11	3.039	3.085	-1.491%	1.50%	5.00%
12	1.624	1.642	-1.096%	1.50%	5.00%
13	1.357	1.352	0.370%	1.50%	5.00%
14	1.248	1.252	-0.319%	1.50%	5.00%
15	1.752	1.767	-0.849%	1.50%	5.00%
16	1.549	1.592	-2.701%	1.50%	5.00%
17	0.544	0.557	-2.334%	1.50%	5.00%
18	1.51	1.505	0.332%	1.50%	5.00%
19	1.699	1.747	-2.748%	1.50%	5.00%
20	0.529	0.546	-3.114%	1.50%	5.00%
21	1.522	1.533	-0.718%	1.50%	5.00%
22	1.452	1.488	-2.419%	1.50%	5.00%
23	1.307	1.35	-3.185%	1.50%	5.00%

# Hydrogen Station Dispenser Test Data



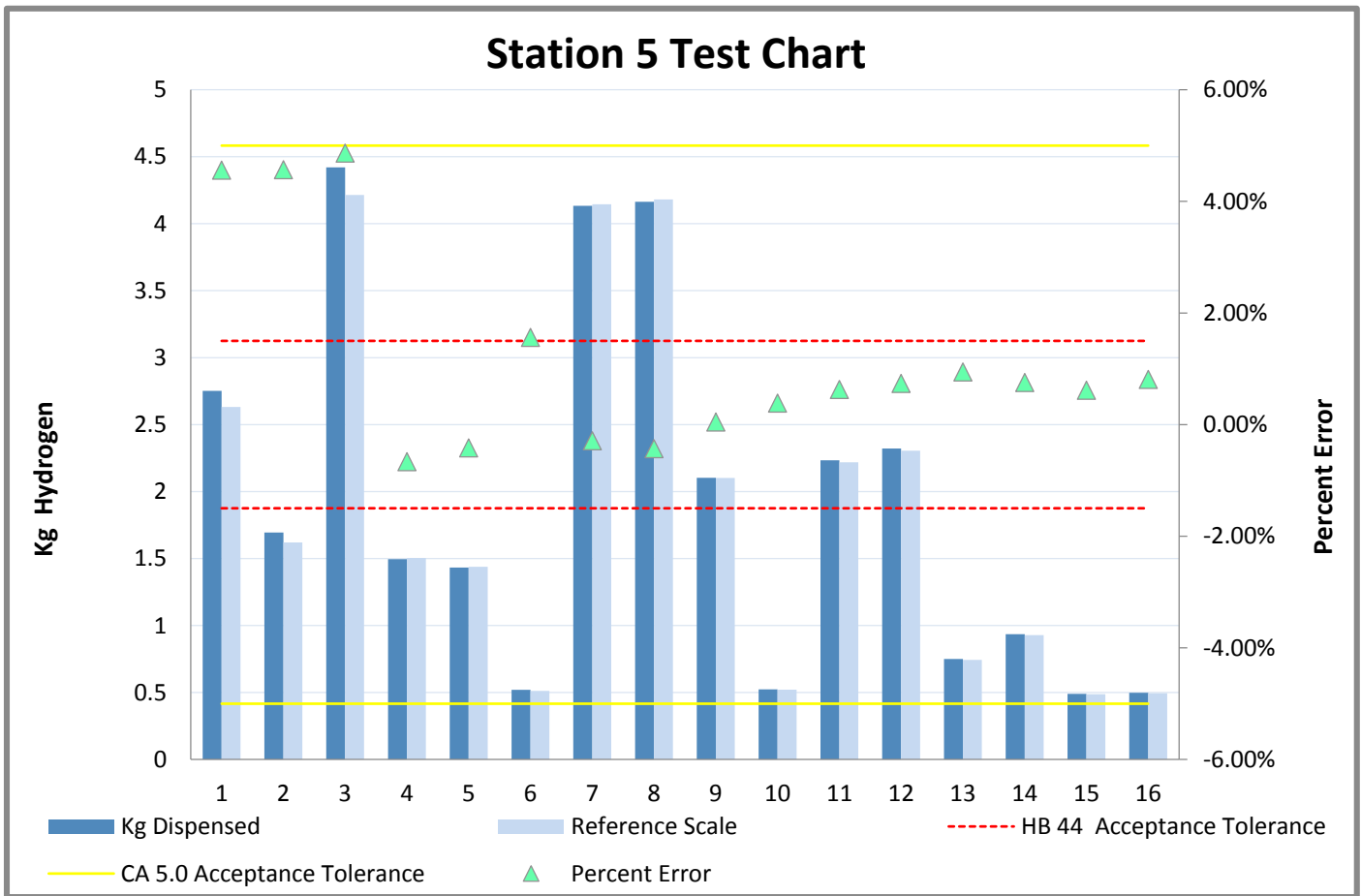
Fill #	Kg Dispensed	Reference Scale	Percent Error	HB 44 Acceptance Tolerance	CA 5.0 Acceptance Tolerance
1	1.546	1.583	-2.337%	1.50%	5.00%
2	1.456	1.406	3.556%	1.50%	5.00%
3	3.777	3.702	2.026%	1.50%	5.00%
4	3.734	3.67	1.744%	1.50%	5.00%
5	1.358	1.381	-1.665%	1.50%	5.00%
6	1.331	1.33	0.075%	1.50%	5.00%
7	1.175	1.222	-3.846%	1.50%	5.00%
8	1.646	1.648	-0.121%	1.50%	5.00%
9	1.475	1.497	-1.470%	1.50%	5.00%
10	0.531	0.53	0.189%	1.50%	5.00%
11	0.997	0.988	0.911%	1.50%	5.00%
12	1.996	2.065	-3.341%	1.50%	5.00%
13	0.758	0.763	-0.655%	1.50%	5.00%
14	0.870	0.893	-2.576%	1.50%	5.00%
15	0.498	0.511	-2.544%	1.50%	5.00%
16	0.724	0.761	-4.862%	1.50%	5.00%
17	0.859	0.862	-0.348%	1.50%	5.00%
18	0.529	0.538	-1.673%	1.50%	5.00%
19	2.047	2.01	1.841%	1.50%	5.00%
20	2.031	1.992	1.958%	1.50%	5.00%
21	1.836	1.757	4.496%	1.50%	5.00%

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Fill #	Kg Dispensed	Reference Scale	Percent Error	HB 44 Acceptance Tolerance	CA 5.0 Acceptance Tolerance
1	1.520	1.530	-0.654%	1.50%	5.00%
2	1.940	1.895	2.375%	1.50%	5.00%
3	1.940	1.894	2.429%	1.50%	5.00%
4	1.890	1.873	0.908%	1.50%	5.00%
5	1.570	1.603	-2.059%	1.50%	5.00%
6	1.94	2.031	-4.481%	1.50%	5.00%
7	2.070	2.177	-4.915%	1.50%	5.00%
8	0.580	0.574	1.045%	1.50%	5.00%
9	1.860	1.884	-1.274%	1.50%	5.00%
10	1.690	1.708	-1.054%	1.50%	5.00%
11	2.280	2.224	2.518%	1.50%	5.00%
12	2.250	2.238	0.536%	1.50%	5.00%
13	2.17	2.172	-0.092%	1.50%	5.00%
14	2.150	2.168	-0.830%	1.50%	5.00%
15	0.730	0.722	1.108%	1.50%	5.00%
16	0.760	0.763	-0.393%	1.50%	5.00%
17	0.700	0.702	-0.285%	1.50%	5.00%
18	0.760	0.759	0.132%	1.50%	5.00%
19	0.760	0.771	-1.427%	1.50%	5.00%
20	0.600	0.588	2.041%	1.50%	5.00%
21	0.440	0.428	2.804%	1.50%	5.00%
22	0.720	0.719	0.139%	1.50%	5.00%
23	0.510	0.501	1.796%	1.50%	5.00%
24	0.960	0.939	2.236%	1.50%	5.00%

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Fill #	Kg Dispensed	Reference Scale	Percent Error	HB 44 Acceptance Tolerance	CA 5.0 Acceptance Tolerance
1	2.752	2.632	4.559%	1.50%	5.00%
2	1.694	1.620	4.568%	1.50%	5.00%
3	4.42	4.215	4.864%	1.50%	5.00%
4	1.495	1.505	-0.664%	1.50%	5.00%
5	1.433	1.439	-0.417%	1.50%	5.00%
6	0.52	0.512	1.563%	1.50%	5.00%
7	4.133	4.145	-0.290%	1.50%	5.00%
8	4.163	4.181	-0.431%	1.50%	5.00%
9	2.103	2.102	0.048%	1.50%	5.00%
10	0.523	0.521	0.384%	1.50%	5.00%
11	2.233	2.219	0.631%	1.50%	5.00%
12	2.322	2.305	0.738%	1.50%	5.00%
13	0.75	0.743	0.942%	1.50%	5.00%
14	0.935	0.928	0.754%	1.50%	5.00%
15	0.49	0.487	0.616%	1.50%	5.00%
16	0.498	0.494	0.810%	1.50%	5.00%