TEST REPORT

Issued by: NWML Test Laboratory

NATIONAL WEIGHTS AND MEASURES LABORATORY

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Applicant:	Brulines Limited One Surtees Way Surtees Business Park Stockton-on-Tees TS18 3HR
Application number:	P00489
Reference number:	TS0502/0001
Date received:	05/08/2010
Procedures:	Tests were carried out on the equipment in accordance with the relevant parts of NWML Desk Instruction DI-09 [*Desk Instructions for type examination of measuring equipment used to dispense intoxicating liquor to be sold by retail*]and section 22 of TE-22 [*design assessment criteria for beer, cider or wine measuring*]. These two documents relate to beer metering instruments that are in use for trade [UK Weights and Measures Act 1985, section 7]. Although the submitted equipment is not prescribed by Regulation, it was deemed that certain tests contained within these documents would be suitable and therefore could be performed on the submitted equipment. However, as the equipment is not prescribed by Regulation, there is no pass or fail criteria that can be applied. A specific test plan was developed based on these documents, which included a series of delivery tests, using Beer, Lager, Cider, Ale, line cleaning solution and water (flushing), and tests to determine if the equipment was susceptible to Electomagnetic compatability conditions through the application of: RFI tests to BS EN 61000-4-3:2006 +A1 2008 Electrostatic discharge tests to BS EN 61000-4-2:2009 Fast transients/bursts to BS EN 61000-4-4:2004
Performed at:	Brulines Limited One Surtees Way Surtees Business Park Stockton-on-Tees TS18 3HR and National Measurement Office Stanton Avenue Teddington Middlesex TW11 0JZ

Revision 2 issued to remove reference to W&M legislation on Page 1.
This revision replaces the previous version issued on 23 December 2010.

GENERAL INFORMATION CONCERNING THE INSTRUMENT SUBMITTED

Application N°:	P00489
Applicant:	Brulines Limited
Instruments submitted:	DMS and I-DRAUGHT Flow Meter
Model No:	See below
Serial No:	See below
Date of report:	17 January 2011
Observer(s):	I James / G Stones / K Gilbert
Evaluation period:	23/08/10 to 10/11/10

Unit(s)	**Serial Number**	**Dispense point**
DMS 1 Standard Flowmeter	None	Font 1 & Font 5
DMS 2 Standard Flowmeter	None	Font 2
DMS 3 Standard Flowmeter	None	Font3
DMS 7 Standard Flowmeter	None	Font 10
DMS 8 Standard Flowmeter	None	Font 9
DMS 9 Standard Flowmeter	None	[EMC] Test Panel
I-DRAUGHT 1 Intelligent Flowmeter	s/n 10-18-002-407	Font 1
I-DRAUGHT 2 Intelligent Flowmeter	s/n not recorded	Font 2
I-DRAUGHT 3 Intelligent Flowmeter	s/n 10-18-004-697	Font 3
I-DRAUGHT 4 Intelligent Flowmeter	s/n 10-18-004-699	Font 5
I-DRAUGHT 5 Intelligent Flowmeter	s/n 10-18-004-713	Font 9
I-DRAUGHT 6 Intelligent Flowmeter	s/n 10-18-004-721	Font 10
I-DRAUGHT 7 Intelligent Flowmeter	s/n 10-24-006-649	[EMC] Test Panel

SUMMARY OF TESTS PERFORMED

Application No: P00489

Test number	Test description	Page Number	Remarks
1	Volume dispense accuracy and liquid type identification (Lager).	9	Font 1 I-Draught **s/n 10-18-002-407** DMS **No.1.**
2	Cleaning operation.	11	Font 1 I-Draught **s/n 10-18-002-407** DMS **No.1.**
3	Volume dispense accuracy and liquid type identification (Lager) Dual dispense.	13	Font 1 & 5 I-Draught **s/n 10-18-002-407** **s/n 10-18-004-699** DMS **No.1.**
4, 4a, 4b & 5	Volume dispense accuracy and liquid type identification (Lager).	14 - 21	Font 1 I-Draught **s/n 10-18-002-407** DMS **No.1.**
6 - 8	Volume dispense accuracy and liquid type identification (Cider).	22 - 27	Font 1 I-Draught **s/n 10-18-002-407** DMS **No.1.**
9	Volume dispense accuracy and liquid type identification (Cider) Dual dispense.	28	Font 1 & 5 I-Draught **s/n 10-18-002-407** **s/n 10-18-004-699** DMS **No.1.**
10	Volume dispense accuracy and liquid type identification (Cider) Dual dispense and Cleaning operation	30	Font 1 & 5 I-Draught **s/n 10-18-002-407** **s/n 10-18-004-699** DMS **No.1.**
11 & 11a	Volume dispense accuracy and liquid type identification (Ale) Hand pump	32 -35	Font 10 I-Draught **s/n 10-18-004-721** DMS **No.7.**
12 & 12a	Volume dispense accuracy and liquid type identification (Ale) Hand pump	36 - 39	Font 9 I-Draught **s/n 10-18-004-713** DMS **No.8.**
13	Cleaning operation	40	Font 10 I-Draught **s/n 10-18-004-721** DMS **No.7.**
14	Volume dispense accuracy and liquid type identification (Bitter).	42	Font 2 I-Draught **s/n 10-18-002-426** DMS **No.2.**
15	Cleaning operation	44	Font 2 I-Draught **s/n 10-18-002-426** DMS **No.2.**
16 & 17	Volume dispense accuracy and liquid type identification (Bitter).	46 - 49	Font 3 I-Draught **s/n 10-18-004-697** DMS **No.3.**
18	Volume dispense accuracy and liquid type identification (Stout).	50	Font 2 I-Draught **s/n 10-18-002-426** DMS **No.2.**
19	Cleaning operation	52	EMC panel I-Draught **s/n 10 24-006-649** DMS **NONE**
20 & 21	Electrostatic discharges at ± 6kV (Direct & Indirect)	54 - 56	EMC panel I-Draught **s/n 10 24-006-649** DMS **NONE**
22	Fast transients/burst ±1kV mains, ±0.5kV on comms lines	57	EMC panel I-Draught **s/n 10 24-006-649** DMS **NONE**
23 - 25	Immunity to radiated electromagnetic fields, 26 MHz to 2000MHz @ 3V/m on front faces	59 - 64	EMC panel I-Draught **s/n 10 24-006-649** DMS **NONE**

INFORMATION CONCERNING THE TEST EQUIPMENT USED

Type	Make	Model No.
The following test equipment was used for metrology testing:		
Mass comparator	Mettler Toledo	PC 4400
Electronic Thermometer	TME	2050
Hydrometers	GH Zeal Ltd	BS 178 M50 SP
The following test equipment was used for Electrostatic Discharge testing:		
Electrostatic discharge simulator	EM Test	Dito
The following equipment was used for Burst testing:		
Immunity Test System	EM Test	UCS 500
The following test equipment was used for Immunity to Radiated Electromagnetic Fields testing:		
BiLog Antenna	Chase	CBL6140A
Horn Antenna	Electro-Metrics	EM7020
Signal Generator	Rohde & Schwarz	SMT06
Amplifier	Amplifier Research	250W1000A
Amplifier	Amplifier Research	500A 100M1
Amplifier	Milmega	AS0104-55/55
Field Sensor	Dare Development	CTR1001A
RF Volt Meter	Hewlett Packard	EPM-441A
Automated Software	EMC Hire Ltd	Immunity S/W
Additional test equipment used for testing:		
Stopwatch	Oregon Scientific	

Where relevant the above equipment has been calibrated either in-house, by a UKAS accredited laboratory or by the National Physical Laboratory to ensure traceability of measurements to recognised national standards, and to the units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories.

Introduction

The DMS is a turbine flowmeter, model 300-010, manufactured by Titan Enterprises Ltd, Coldharbour Business Park, Sherborne, Dorset, DT9 4JW, England. As fluid flows it causes the turbine, which incorporates ceramic magnets, to rotate. This rotation is detected through the chamber wall by a Hall effect detector.

The I-Draught, is a development of the DMS, and additionally incorporates

- a thermistor, mounted through to the wet side, for measuring temperature, and
- a custom interface using two titanium pins, which are immersed in the liquid, to measure the electrical conductivity of the liquid

The 'raw' data that is collected by the sensors is transmitted via the GSM network to remote servers for processing.

The delivery tests were conducted at the Brulines R&D facility at their Stockton-on-Tees premises. This was due to availability of equipment to perform the range of tests, with access provided to software and data. Brulines provided the test set-up which emulated a typical setup that could be expected in a typical installation. The following results can only be construed as representing the test configuration and range of dispense scenarios devised and tested by NMO. The results are also only in relation to a comparison of the volumes determined by NMO and the results provided by the two systems.

The I-draught flowmeter is designed to recognise the difference between liquid types, and records Beer, Water and Cleaner (and combinations thereof). The DMS flowmeter only records liquid volumes passing through the meter. The scope of the testing did not include any validation of the manual processing of data by Brulines, such as the identification of line cleaning volumes when using the DMS system and I-draught systems

The I-Draught test data collected during testing was processed "live" with the data "pushed" to the servers every 15 minutes and the results were available almost instantaneously. The DMS test data is pulled to the servers and was available at the end of the testing day.

The EMC tests were conducted in the NMO test laboratories using water as the test liquid. The resulting I-Draught and DMS test data was not available 'live' when the system was installed in the NMO anechoic chamber, resulting in an overnight delay whilst the data was upload to the remote servers for processing before the results were supplied to NMO. During this time Brulines were not party to the testing conducted. The system is connected to the mains supply via a CE marked 14.7VDC/ 4A integral transformer (90V-230VAC), and backed up by a lead-acid battery. AC mains Voltage Variations and Short Time Power Reductions tests were not conducted as it was considered that the system (transformer & lead-acid battery) would negate the effects of these tests on the mains supply.

The delivery tests involved comparison of the volumes determined by NMO with those presented by Brulines. The NMO method incorporated a Gravimetric method, where the deliveries were weighed using an NMO test balance and then converting the weight using Temperature and Density (obtained using NMO traceable instruments) in an ISO polynomial equation to determine the volume.

The data for both systems included the date and time, and the I-Draught also included the temperature. The accuracy of the internal thermometer was not tested in this instance. The time of each dispense was logged during testing and compared satisfactorily during testing to enable correct identification of the compared volumes delivered with particular test events. To enable the comparison of individual pours, rather than have an hourly totalised volume as is normal on the DMS system, the communications panel was adapted to separately record each dispense action.

The DMS, and/or I-Draught, flowmeters were calibrated in-situ [by Brulines] before use with the type of liquids that were due to pass through them, as other liquids such as a different Beer, line cleaner or water could produce different results. The calibration involves using a measured volume (via a traceable measuring cylinder) and the number of pulses per litre produced during the delivery [BRULINES "calibration rules"].

During the accuracy tests the DMS was situated immediately (approx 300 mm) after the Froth on Beer (FoB) unit, and the I-Draught was situated immediately (approx 300 mm) before the dispense tap.

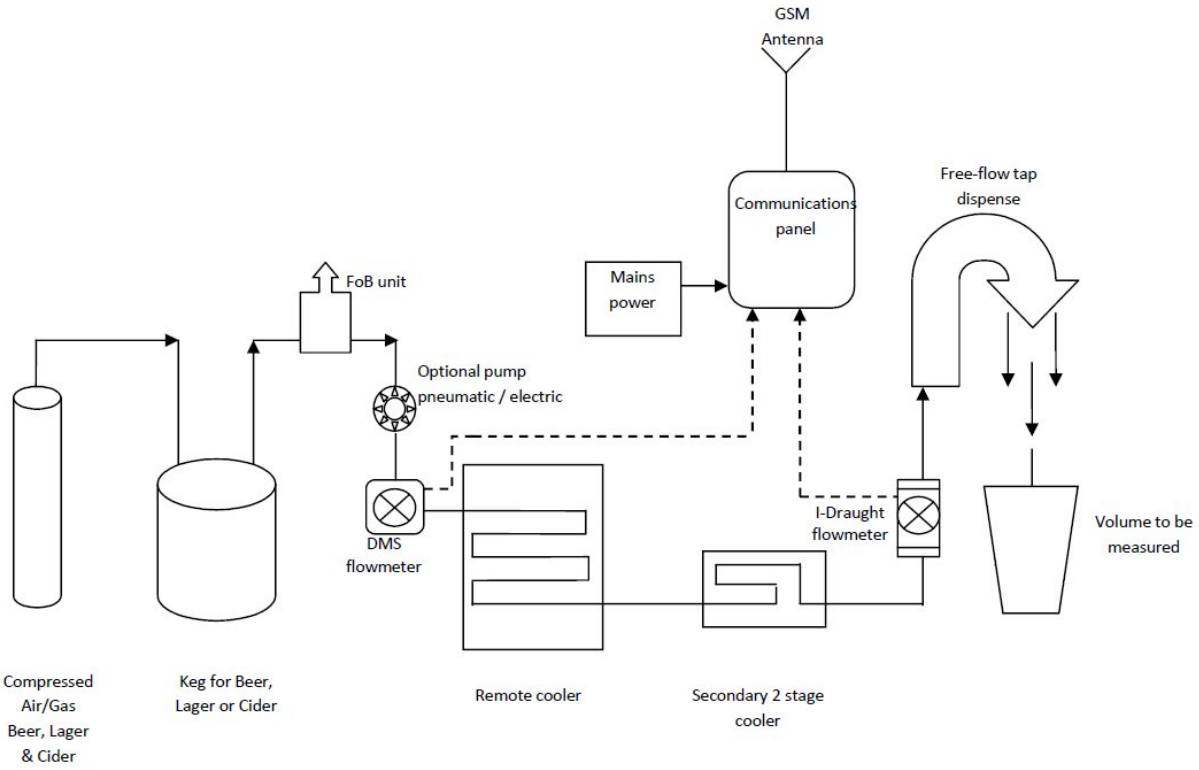
An event is described as: Tap open - liquid dispense - tap closed. Each event is logged in the volatile memory of the Communications Panel. Subsequently the data is uploaded by (or downloaded from) the GSM modem module, at pre-defined times, to servers for subsequent processing and analysis.

Following analysis of the results of tests 4, 11 and 12, additional tests were conducted at a later date. The original tests remain as originally recorded and the supplementary tests are included after the original test results.

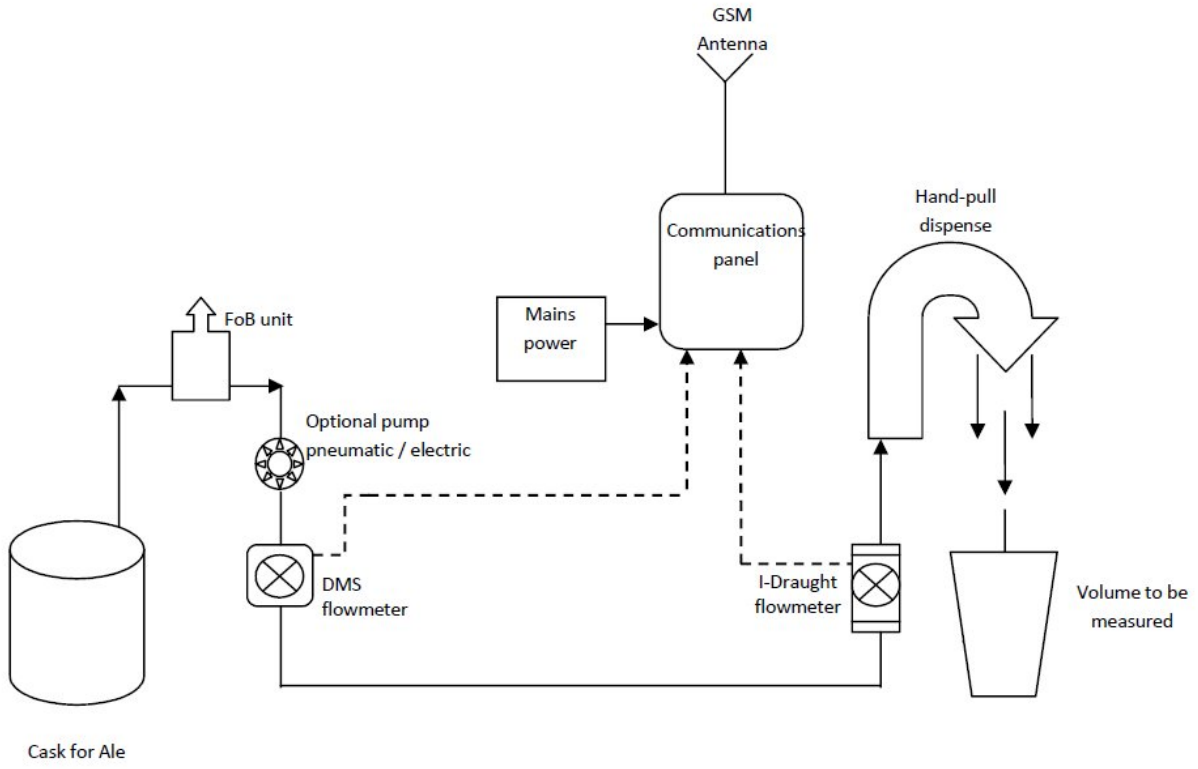
Volume accuracy and liquid identification tests:

Basic set-up diagrams:

1) Free flow tap dispenser.



2) Lever pull dispenser.



Volume accuracy and liquid identification results:

Tests were carried out to determine the volumes dispensed by the DMS / I-Draught, and whether the I-Draught could recognise the different liquid types.

The device was initially calibrated for Lager and the calibration factor determined. This was also performed for the tests using Bitter, Cider, Stout & Ale.

During the tests, liquid types are abbreviated as follows:

Liquid	Abbreviation	Liquid	Abbreviation
Lager	(Lgr)	Water	(Wtr)
Cider	(Cdr)	Clear line cleaner 100%	(SLC)
Ale	(Ale)	Clear line cleaner 50%	(WLC)

Transitions between products are shown as a combination, for example Lager to Water is shown as Lgr/Wtr. The transition events were determined by eye for a change of liquid colour exiting the tap dispenser.

The results for deliveries of actual product are highlighted for easy reference.

A line cleaning event procedure was also undertaken to simulate events for a typical installation. This would normally happen after an entire keg, or several kegs had passed through the system. For the purposes of testing by NMO a line clean was performed after a limited number of dispense events. The line clean process involved a flush though of water followed by the line cleaning solution and a final rinse through with water before dispensing product. The accuracy of these measurements on line cleaning solution and water volumes is based upon the calibration factor for beer.

Any noteworthy comments about each test are presented after each results table or chart.

Regarding measurements of all event deliveries, the length of pipe between the DMS meter, and the I-Draught meter, and the end of the dispense tap, and therefore volume of liquid contained within, could not be accurately determined (as not all pipework was visible].

The total length of [external] pipework was measured to be approximately 12 metres, however the length of pipework in the cooler(s) could not be measured. For the deliveries involving ale using the hand pump dispenser, the design of the pump is such that it also contained an unknown volume of liquid in the “pump” itself and the pipe connected to it.

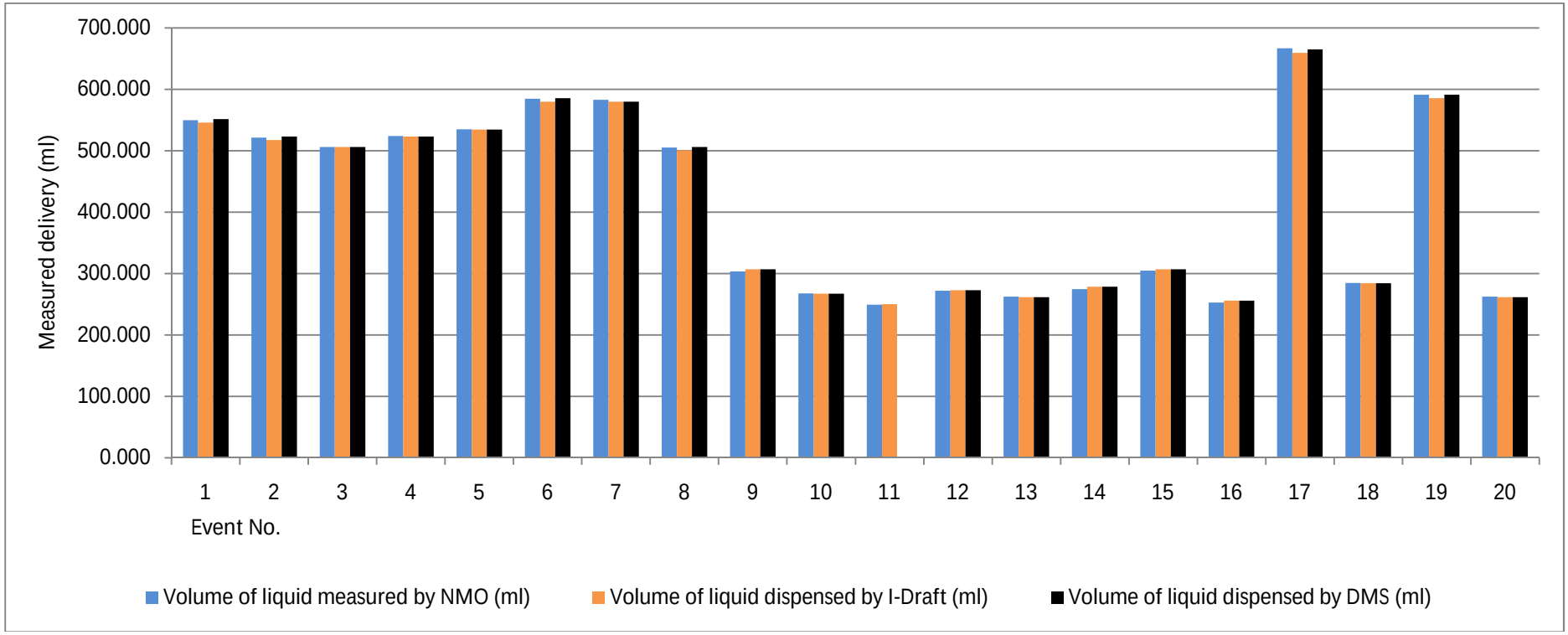
These “unknown volumes” would have already passed through the I-Draught [meter] but would not necessarily have been dispensed at the tap, therefore they could not be measured [by NMO] until during the next dispense event. As this was considered to be a small amount the deliveries calculated were not off-set to account for this.

What was generally measured was the displacement of liquid through the flow meter(s) at the same recorded time.

Test 1:Delivery **Font: 1 – Freeflow,** **I-Draught: s/n 10-18-002-407** **DMS: s/n –None (ID'd as No1)**

Keg head pressure: 20 psi (CO_2) (pneumatic pump assisted) **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO – DMS (ml)	Error (%)
1	Lager	Beer	549.689	545.531	-4.159	-0.757	551.213	1.524	0.28
2	Lager	Beer	521.046	517.118	-3.929	-0.754	522.800	1.754	0.34
3	Lager	Beer	505.893	505.753	-0.141	-0.028	505.753	-0.141	-0.03
4	Lager	Beer	523.807	522.800	-1.007	-0.192	522.800	-1.007	-0.19
5	Lager	Beer	534.601	534.166	-0.436	-0.082	534.166	-0.436	-0.08
6	Lager	Beer	584.417	579.626	-4.791	-0.820	585.309	0.892	0.15
7	Lager	Beer	582.833	579.626	-3.207	-0.550	579.626	-3.207	-0.55
8	Lager	Beer	504.890	500.070	-4.820	-0.955	505.753	0.862	0.17
9	Lager	Beer	303.301	306.861	3.560	1.174	306.861	3.560	1.17
10	Lager	Beer	267.499	267.083	-0.416	-0.156	267.083	-0.416	-0.16
11	Lager	Beer	249.385	250.035	0.650	0.260	0.000	-249.385	-100.00
12	Lager	Beer	271.827	272.765	0.939	0.345	272.765	0.939	0.35
13	Lager	Beer	262.250	261.400	-0.850	-0.324	261.400	-0.850	-0.32
14	Lager	Beer	274.629	278.448	3.819	1.390	278.448	3.819	1.39
15	Lager	Beer	304.717	306.861	2.144	0.704	306.861	2.144	0.70
16	Lager	Beer	252.822	255.718	2.895	1.145	255.718	2.895	1.15
17	Lager	Beer	666.417	659.183	-7.234	-1.086	664.866	-1.552	-0.23
18	Lager	Beer	284.542	284.131	-0.411	-0.145	284.131	-0.411	-0.14
19	Lager	Beer	590.850	585.309	-5.541	-0.938	590.992	0.141	0.02
20	Lager	Beer	262.101	261.400	-0.700	-0.267	261.400	-0.700	-0.27
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
Results for all tests			8297.519	8273.884	-23.635	-0.28	8057.945	-239.574	-2.89
Ignoring result of event 11			8048.133				8057.945	9.811	0.12[1]



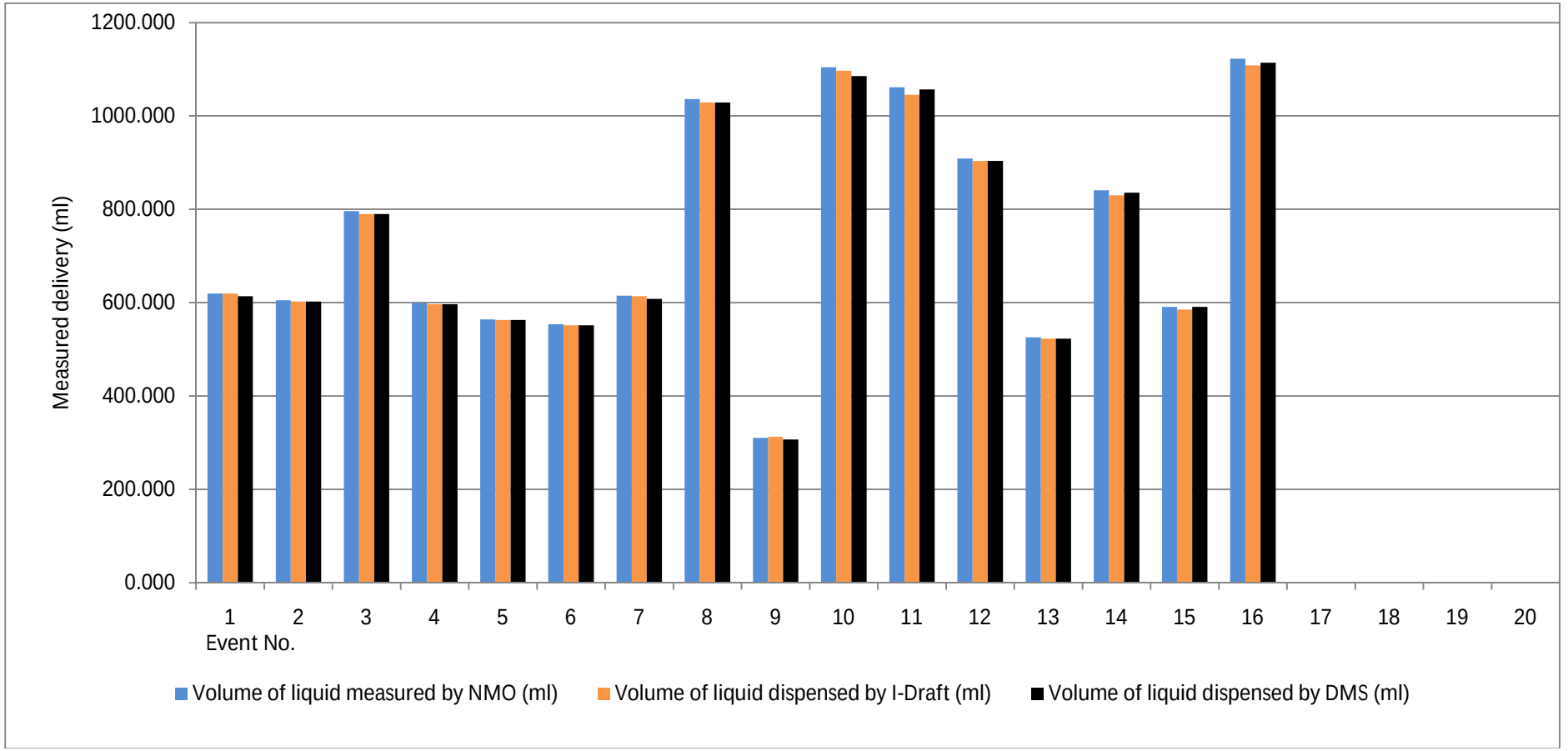
Comments:

[1] There was no dispensed volume recorded by the DMS during event 11. The explanation provided by the manufacturer of the communications panel was that the missed data was due to the panel being adapted to separately record [for NMO testing] each dispense action. NMO are unable to validate this information.

Test 2: Cleaning **Font: 1 – Freeflow,** **I-Draught: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 21 psi (CO_2) (pneumatic pump assisted) **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Lager	Beer	619.653	619.405	-0.248	-0.040	613.722	-5.931	-0.96
2	Lager	Beer	605.030	602.357	-2.673	-0.442	602.357	-2.673	-0.44
3	Lgr/Wtr	Beer/Water	796.372	789.883	-6.489	-0.815	789.883	-6.489	-0.81
4	Lgr/Wtr	Water	598.848	596.674	-2.174	-0.363	596.674	-2.174	-0.36
5	Wtr	Water	564.134	562.579	-1.556	-0.276	562.579	-1.556	-0.28
6	Wtr	Water	553.846	551.213	-2.632	-0.475	551.213	-2.632	-0.48
7	Wtr/Clnr	Beer/Cleaner	614.609	613.722	-0.887	-0.144	608.040	-6.569	-1.07
8	Clnr	Cleaner	1036.158	1028.553	-7.605	-0.734	1028.553	-7.605	-0.73
9	Clnr	Cleaner	310.268	312.544	2.276	0.733	306.861	-3.407	-1.10
10	Clnr/Wtr	Cleaner	1104.064	1096.744	-7.320	-0.663	1085.379	-18.685	-1.69
11	Clnr/Wtr	Beer/Water	1061.110	1045.601	-15.509	-1.462	1056.966	-4.144	-0.39
12	Wtr	Water	908.674	903.535	-5.139	-0.566	903.535	-5.139	-0.57
13	Wtr	Water	525.766	522.800	-2.966	-0.564	522.800	-2.966	-0.56
14	Wtr/Lgr	Water/Beer	840.759	829.661	-11.098	-1.320	835.344	-5.415	-0.64
15	Lager	Beer	590.851	585.309	-5.542	-0.938	590.992	0.140	0.02
16	Lager	Beer	1122.417	1108.109	-14.308	-1.275	1113.792	-8.625	-0.77
17									
18									
19									
20									
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
		Results for all tests	11852.56	11768.690	-83.869	-0.71	11768.690	-83.869	-0.71
		Results for Lager delivery only	2937.951	2915.180	-22.771	-0.775	2920.863	-17.088	-0.58[1]



Comments: The table includes the total measured by the DMS for all dispenses and for only those with Lager.

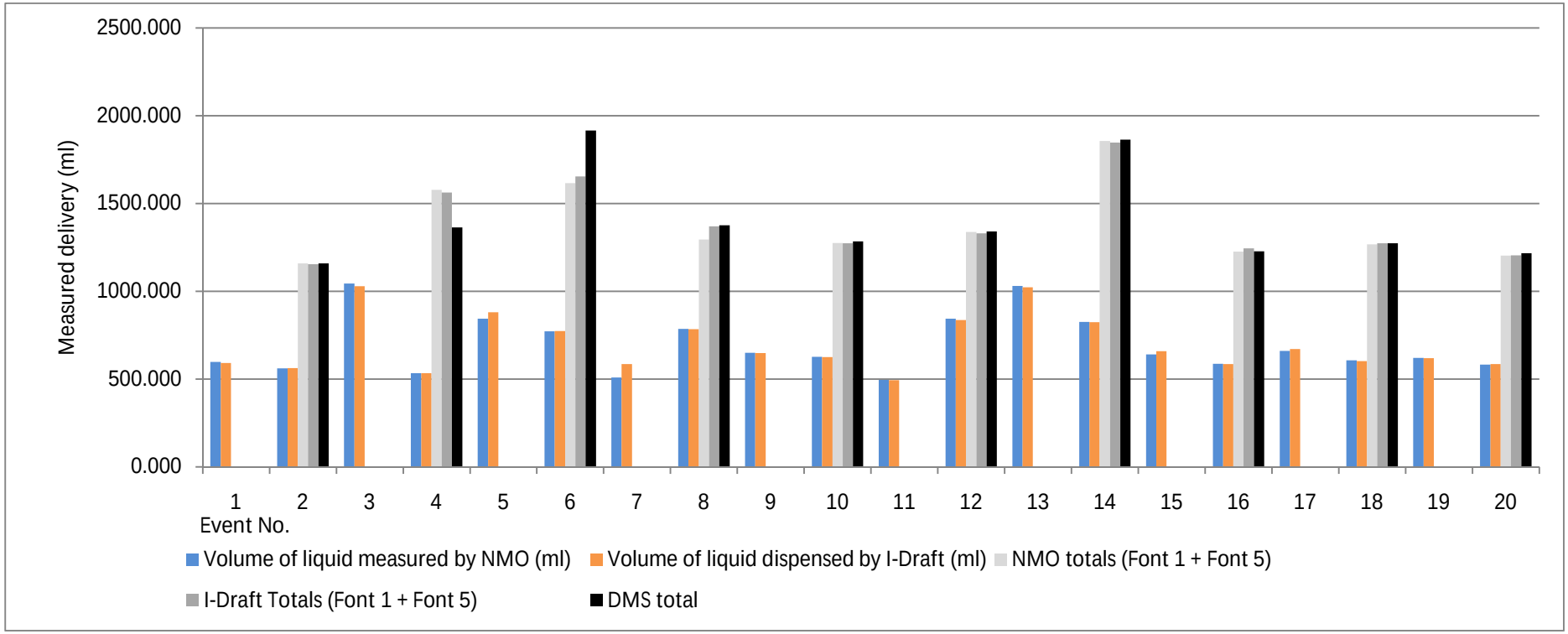
[1] These results depend upon the cleaning operation being correctly identified and the 'Total volume' being correctly adjusted. As the DMS cannot determine the difference between the liquid types, including a Beer dispense and a Cleaning operation, the system report would require interpretation of the results and the use of other "inputs" e.g. input from meter in cleaning line: notification of cleaning process etc., so that the results can be [manually] adjusted to account for the cleaning operation.

Test 3: Delivery **Font: 1 – Freeflow, pump assisted** **I-Draught: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Dual dispense **Font: 5 – Freeflow, pump assisted** **I-Draught: s/n 10-18-004-699** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 21 psi (CO_2) (pneumatic pump assisted) **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Lager	Beer	598.057	590.992	-7.065	-1.181	------		
2	Lager	Beer	560.907	562.579	1.672	0.298	1159.253	0.289	0.02
3	Lager	Beer	1043.767	1028.553	-15.215	-1.458	------		
4	Lager	Beer	533.741	534.166	0.425	0.080	1363.827	-213.681	-13.55
5	Lager	Beer/Water	843.166	880.805	37.639	4.464	------		
6	Lager	Beer	772.632	772.835	0.203	0.026	1915.040	299.242	18.52
7	Lager	Water/Beer	508.660	585.309	76.650	15.069	------		
8	Lager	Beer	785.823	784.201	-1.623	-0.206	1375.192	80.710	6.23
9	Lager	Beer	649.196	647.818	-1.378	-0.212	------		
10	Lager	Beer	625.961	625.087	-0.874	-0.140	1284.270	9.113	0.71
11	Lager	Beer	494.498	494.387	-0.111	-0.022	------		
12	Lager	Beer	843.562	835.344	-8.218	-0.974	1341.097	3.036	0.23
13	Lager	Beer	1029.988	1022.870	-7.117	-0.691	------		
14	Lager	Beer	825.756	823.979	-1.777	-0.215	1863.897	8.153	0.44
15	Lager	Beer	639.816	659.183	19.367	3.027	------		
16	Lager	Beer	586.734	585.309	-1.425	-0.243	1227.444	0.894	0.07
17	Lager	Beer	659.986	670.548	10.563	1.600	------		
18	Lager	Beer	607.239	602.357	-4.882	-0.804	1272.905	5.681	0.45
19	Lager	Beer	620.310	619.405	-0.905	-0.146	------		
20	Lager	Beer	582.663	585.309	2.646	0.454	1216.079	13.106	1.09
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
Results for all deliveries			13812.462	13911.0354	98.573	0.714	14019.005	206.543	1.50
Results if I-Draught events 5 & 7 are ignored (Beer/Water)			13812.462	12444.921	-1367.54	-9.90			



Comments: The pipe line had a "Y" connection immediately after the DMS meter, the DMS meter supplied Font 1 and Font 5. Therefore the DMS total is the sum of **Font: 1- I-Draught: s/n 10-18-002-407 & Font: 5 – I-Draught: s/n 10-18-004-699**

During events 5 -8, the Keg emptied and air entered the system, as the FoB was overridden. All of the air passed through and was included in the measurement made by the DMS, but due to the "Y" split the air was "shared in the measurement made by **Font: 1- I-Draught: s/n 10-18-002-407** & **Font: 5 – I-Draught: s/n 10-18-004-699.**

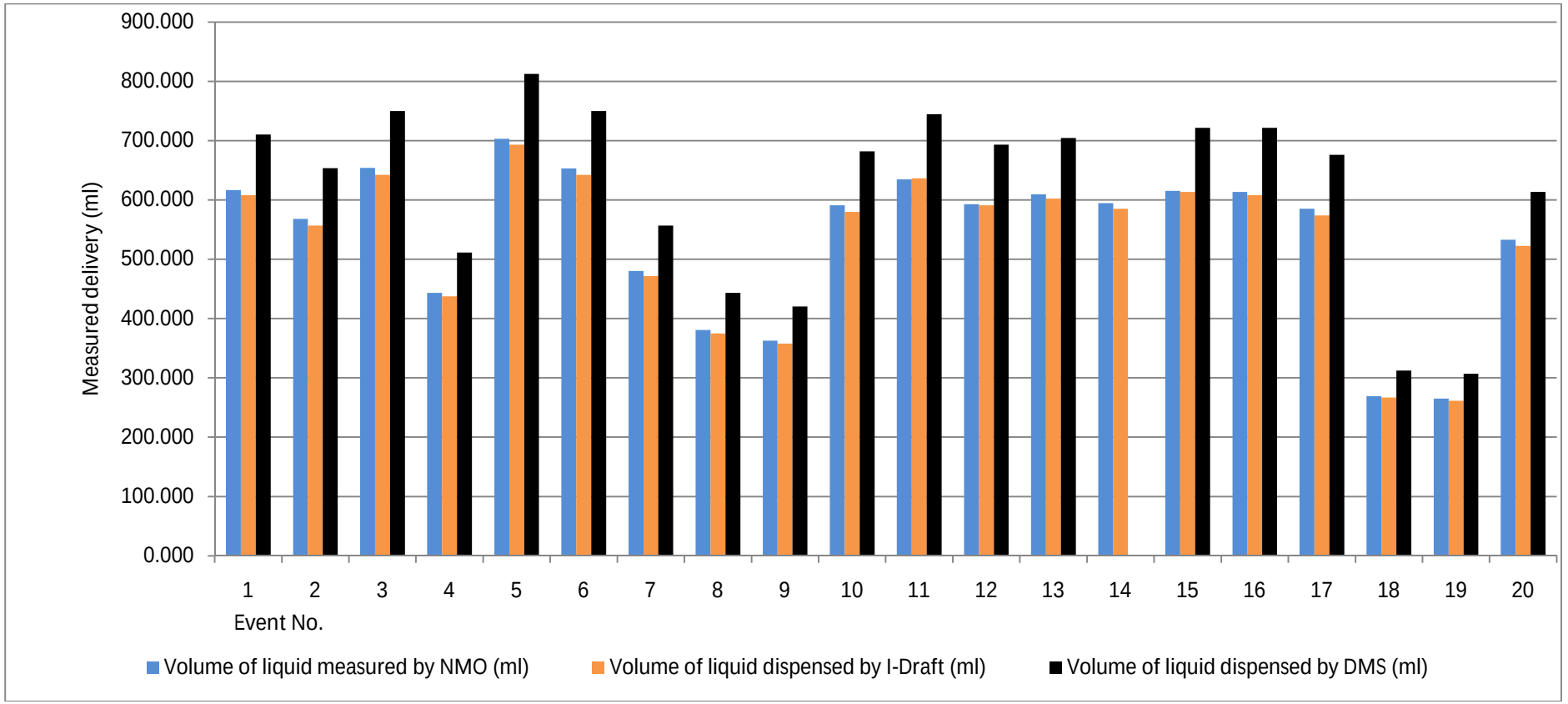
In Events 5 & 7 the I-Draught (**s/n 10-18-002-40)7** identified the dispenses as a mixture of Beer & Water, therefore the errors are also calculated to take account if the results of the I-Draught dispenses are excluded (ignored) from the total in the reporting system. However although the I-Draught (**s/n 10-18-002-40)7** identified the dispenses as a mixture of Beer & Water the mixture was observed to be Beer/Air, when the Keg emptied and air entered the system as the as FoB was overridden.

Event 15 included "fast" top ups

Event 17 included "slow" top ups

Test 4: Delivery Font: 1 – Freeflow, not pump assisted I-Draught: s/n 10-18-002-407 DMS: s/n None (ID'd as No1)
Keg head pressure: 26 psi (CO_2) Delivery pipe length: Approx 12 m

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Lager	Beer	616.739	608.040	-8.699	-1.411	710.327	93.588	15.17
2	Lager	Beer	567.884	556.896	-10.988	-1.935	653.500	85.616	15.08
3	Lager	Beer	653.840	642.135	-11.704	-1.790	750.105	96.265	14.72
4	Lager	Beer	443.290	437.561	-5.729	-1.292	511.435	68.145	15.37
5	Lager	Beer	703.061	693.279	-9.782	-1.391	812.614	109.553	15.58
6	Lager	Beer	653.048	642.135	-10.913	-1.671	750.105	97.057	14.86
7	Lager	Beer	480.129	471.657	-8.473	-1.765	556.896	76.767	15.99
8	Lager	Beer	380.697	375.052	-5.645	-1.483	443.244	62.547	16.43
9	Lager	Beer	362.614	358.005	-4.609	-1.271	420.513	57.899	15.97
10	Lager	Beer	590.952	579.626	-11.326	-1.916	681.914	90.962	15.39
11	Lager	Beer	634.629	636.453	1.824	0.287	744.422	109.793	17.30
12	Lager	Beer	592.639	590.992	-1.647	-0.278	693.279	100.640	16.98
13	Lager	Beer	609.476	602.357	-7.120	-1.168	704.644	95.168	15.61
14	Lager	Beer	594.516	585.309	-9.207	-1.549	0.000	-594.516	-100.00
15	Lager	Beer	615.513	613.722	-1.791	-0.291	721.692	106.179	17.25
16	Lager	Beer	613.534	608.040	-5.494	-0.896	721.692	108.158	17.63
17	Lager	Beer	585.210	573.944	-11.266	-1.925	676.231	91.021	15.55
18	Lager	Beer	268.966	267.083	-1.884	-0.700	312.544	43.577	16.20
19	Lager	Beer	264.860	261.400	-3.460	-1.306	306.861	42.001	15.86
20	Lager	Beer	532.920	522.800	-10.119	-1.899	613.722	80.803	15.16
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
Results for all tests			10764.517	10626.485	-138.032	-1.283	11785.738	1021.221	9.49
Ignoring result of event 14			10170.002				11785.738[1]	1615.737	15.89[1]



Comments: Individual dispense % error, and total dispense error, of the DMS are greater than those of the I-Draught, which may be due to an incorrect calibration setting [by Brulines].

[1] There was no dispensed volume recorded by the DMS during event 14. The explanation provided by the manufacturer of the communications panel was that the missed data was due to the panel being adapted to separately record [for NMO testing] each dispense action. NMO are unable to validate this information.

Events 11 & 12 included 2 “slow” top-ups

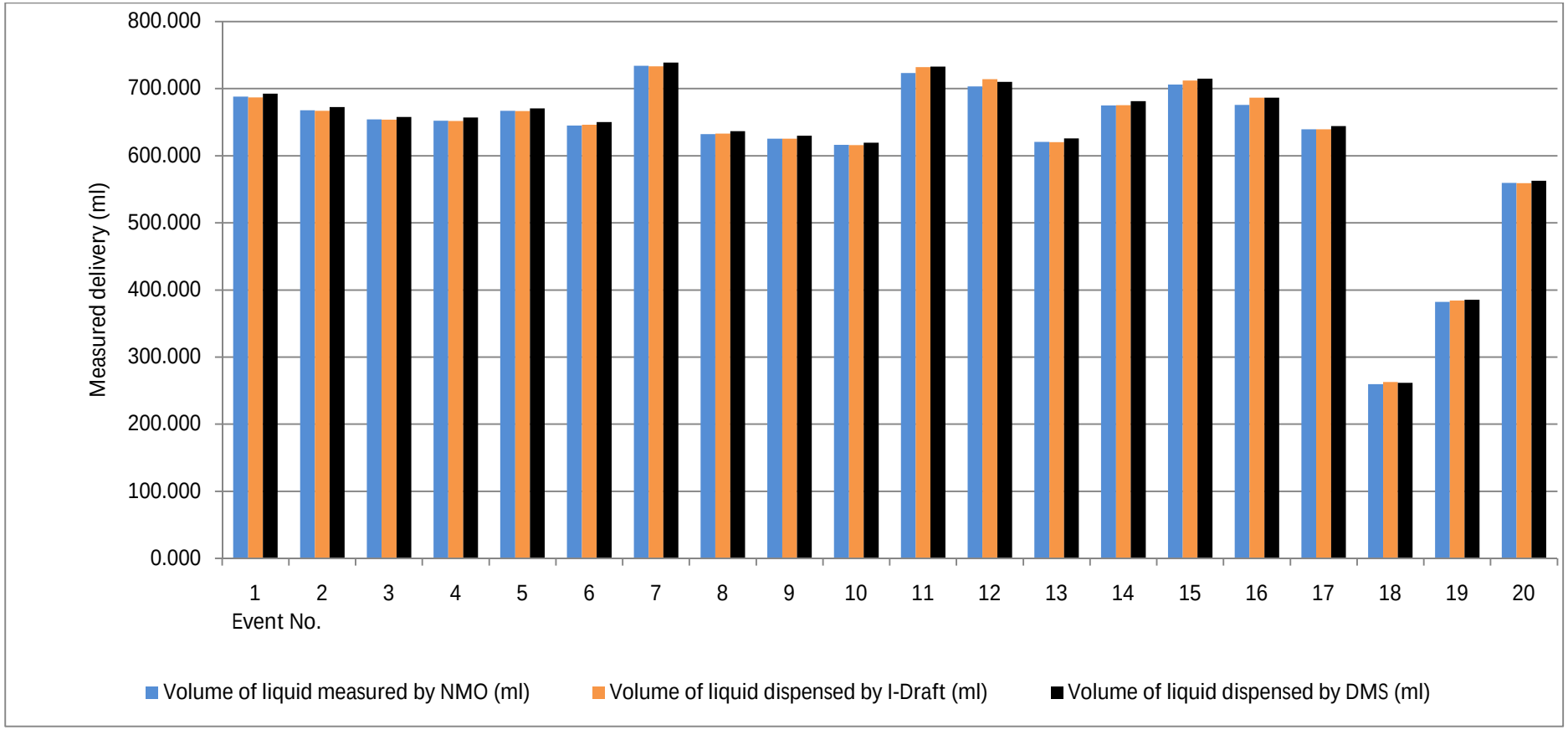
Events 15 &16 included 2 “fast” top-ups

Test 4a

Supplemental to Test 4: Delivery **Font: 1 – Freeflow, pump assisted** **I-Draught: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 26 psi (CO_2) **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draft flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draft (ml)	Difference of measured volumes [NMO - I-Draft] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Lager	Beer	688.148	687.170	-0.978	-0.142	692.570	4.422	0.64
2	Lager	Beer	667.894	667.120	-0.774	-0.116	672.760	4.866	0.73
3	Lager	Beer	654.400	653.980	-0.420	-0.064	657.740	3.340	0.51
4	Lager	Beer	652.222	651.910	-0.312	-0.048	657.050	4.828	0.74
5	Lager	Beer	667.000	666.430	-0.570	-0.086	670.710	3.710	0.56
6	Lager	Beer	645.170	646.380	1.210	0.188	650.220	5.050	0.78
7	Lager	Beer	734.192	733.490	-0.702	-0.096	739.010	4.818	0.66
8	Lager	Beer	632.173	633.250	1.077	0.170	636.560	4.387	0.69
9	Lager	Beer	625.520	625.640	0.120	0.019	629.730	4.210	0.67
10	Lager	Beer	616.194	615.960	-0.234	-0.038	619.490	3.296	0.53
11	Lager	Beer	723.479	732.100	8.621	1.192	732.860	9.381	1.30
12	Lager	Beer	703.425	714.130	10.705	1.522	710.330	6.905	0.98
13	Lager	Beer	620.855	620.110	-0.745	-0.120	625.770	4.915	0.79
14	Lager	Beer	674.943	675.420	0.477	0.071	681.230	6.287	0.93
15	Lager	Beer	706.206	712.060	5.854	0.829	714.780	8.574	1.21
16	Lager	Beer	675.937	686.480	10.543	1.560	686.710	10.773	1.59
17	Lager	Beer	639.417	639.470	0.053	0.008	644.260	4.843	0.76
18	Lager	Beer	259.654	262.700	3.046	1.173	261.540	1.886	0.73
19	Lager	Beer	382.233	384.370	2.137	0.559	385.460	3.227	0.84
20	Lager	Beer	559.623	559.270	-0.353	-0.063	562.780	3.157	0.56
			Total volume (NMO)	Total volume (I-Draft)	Total Difference	Total % error	Total volume (DMS)	Total Difference	Total % error
			12528.683	12567.44	38.757	0.309	12631.560	102.877	0.82



Comments: The above tests are supplemental to those conducted at Test 4, where a large (consistent) error was noted.

These tests included the use of an assist pump, and were conducted at a later date.

Events 11 & 12 included 2 “slow” top-ups Comments: Events 11 & 12 included 2 “slow” top-ups

Events 15 &16 included 2 “fast” top-ups

The keg emptied during test 16. The meters stopped and the FoB unit prevented any gas entering the system.

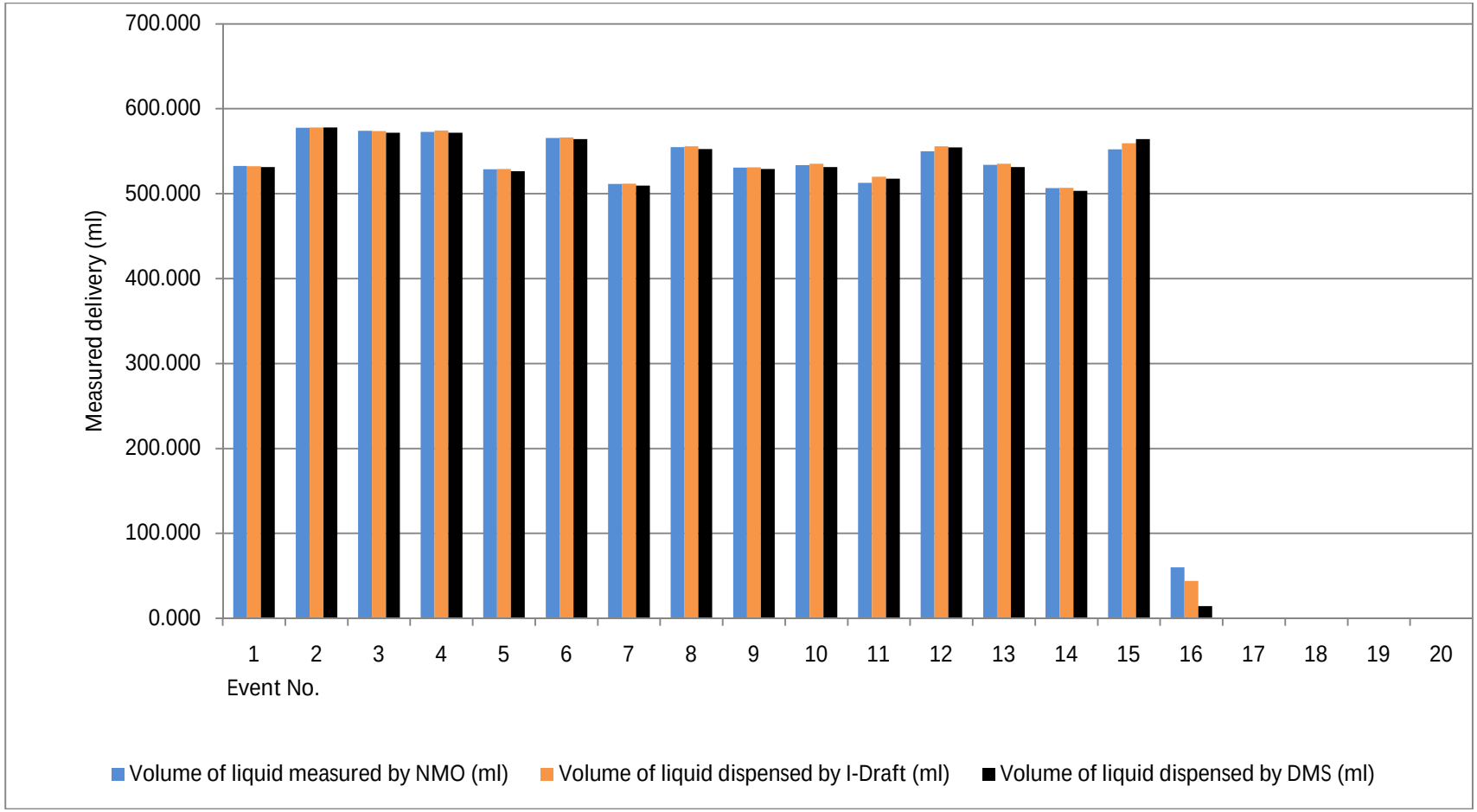
Events 15 &16 included 2 “fast” top-ups

Test 4b

Supplemental to Test 4: Delivery **Font: 1 – Freeflow, NOT pump assisted** **I-Draught: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 26 psi (CO_2) **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draft flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draft (ml)	Difference of measured volumes [NMO - I-Draft] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Lager	Beer	532.753	532.400	-0.353	-0.066	531.290	-1.463	-0.27
2	Lager	Beer	577.588	577.920	0.332	0.057	577.850	0.262	0.05
3	Lager	Beer	574.111	573.780	-0.331	-0.058	571.680	-2.431	-0.42
4	Lager	Beer	572.921	574.470	1.549	0.270	571.680	-1.241	-0.22
5	Lager	Beer	528.660	528.950	0.290	0.055	526.500	-2.160	-0.41
6	Lager	Beer	565.478	566.190	0.712	0.126	564.150	-1.328	-0.23
7	Lager	Beer	511.392	511.710	0.318	0.062	509.380	-2.012	-0.39
8	Lager	Beer	554.859	555.850	0.991	0.179	552.510	-2.349	-0.42
9	Lager	Beer	530.644	531.020	0.376	0.071	529.240	-1.404	-0.26
10	Lager	Beer	533.721	535.160	1.439	0.270	531.290	-2.431	-0.46
11	Lager	Beer	512.880	519.990	7.110	1.386	517.600	4.720	0.92
12	Lager	Beer	550.096	555.850	5.754	1.046	554.570	4.474	0.81
13	Lager	Beer	533.820	535.160	1.340	0.251	531.290	-2.530	-0.47
14	Lager	Beer	506.627	506.880	0.253	0.050	503.220	-3.407	-0.67
15	Lager	Beer	552.278	559.300	7.022	1.272	564.150	11.872	2.15
16	Lager	Beer	60.081	44.140	-15.941	-26.532	14.380	-45.701	-76.07
			Total volume (NMO)	Total volume (I-Draft)	Total Difference	Total % error	Total volume (DMS)	Total Difference	Total % error
			8197.908	8208.77	10.862	0.132	8150.780	-47.128	-0.57



Comments: The above tests are supplemental to those conducted at Test 4, where a large (consistent) error was noted, and were conducted at a later date.

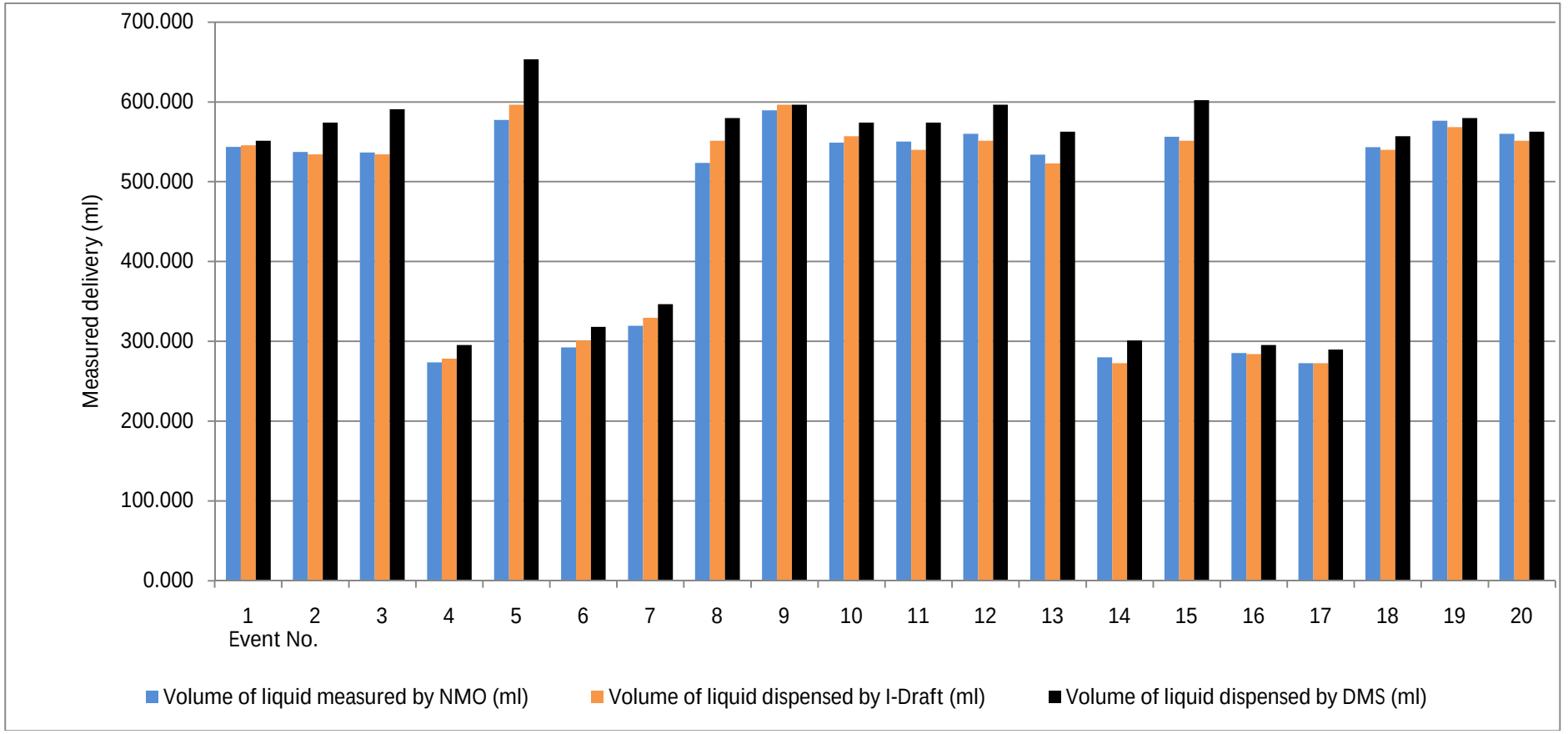
Events 11 & 12 included 2 “slow” top-ups

Events 15 &16 included 2 “fast” top-ups

The keg emptied during test 16. The meters stopped and the FoB unit prevented any gas entering the system.

Test 5: Delivery **Font: 1 – Freeflow, I-Draught: s/n 10-18-002-407 DMS: s/n None (ID'd as No1)**
Keg head pressure: 35 psi (CO_2) events 1- 10 (not pump assisted) , 24 psi (CO_2) events 11-20 (pneumatic pump assisted
Delivery pipe length: Approx 112 m [100 m coiled]

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Lager	Beer	543.540	545.531	1.991	0.366	551.213	7.674	1.41
2	Lager	Beer	537.290	534.166	-3.125	-0.582	573.944	36.653	6.82
3	Lager	Beer	536.483	534.166	-2.318	-0.432	590.992	54.509	10.16
4	Lager	Beer	273.601	278.448	4.847	1.772	295.496	21.895	8.00
5	Lager	Beer	577.386	596.674	19.288	3.341	653.500	76.114	13.18
6	Lager	Beer	292.459	301.178	8.720	2.982	318.226	25.768	8.81
7	Lager	Beer	319.434	329.592	10.158	3.180	346.639	27.206	8.52
8	Lager	Beer	523.711	551.213	27.502	5.251	579.626	55.915	10.68
9	Lager	Beer	589.466	596.674	7.208	1.223	596.674	7.208	1.22
10	Lager	Beer	549.061	556.896	7.835	1.427	573.944	24.883	4.53
11	Lager	Beer	550.475	539.848	-10.626	-1.930	573.944	23.469	4.26
12	Lager	Beer	560.051	551.213	-8.838	-1.578	596.674	36.623	6.54
13	Lager	Beer	533.808	522.800	-11.007	-2.062	562.579	28.771	5.39
14	Lager	Beer	280.168	272.765	-7.403	-2.642	301.178	21.010	7.50
15	Lager	Beer	556.391	551.213	-5.178	-0.931	602.357	45.966	8.26
16	Lager	Beer	285.218	284.131	-1.088	-0.381	295.496	10.277	3.60
17	Lager	Beer	272.624	272.765	0.141	0.052	289.813	17.189	6.31
18	Lager	Beer	543.413	539.848	-3.565	-0.656	556.896	13.483	2.48
19	Lager	Beer	576.394	568.261	-8.132	-1.411	579.626	3.233	0.56
20	Lager	Beer	560.053	551.213	-8.839	-1.578	562.579	2.526	0.45
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			9461.027	9478.598	17.571	0.186	10001.398	540.371	5.71



Comments: An additional 100 m of piping, which was coiled and un-insulated, was placed between the DMS flowmeter and the remote cooler. [This was to determine if there was an effect due to a longer pipe run.]

Events 5 &15 included 2 "slow" top-ups

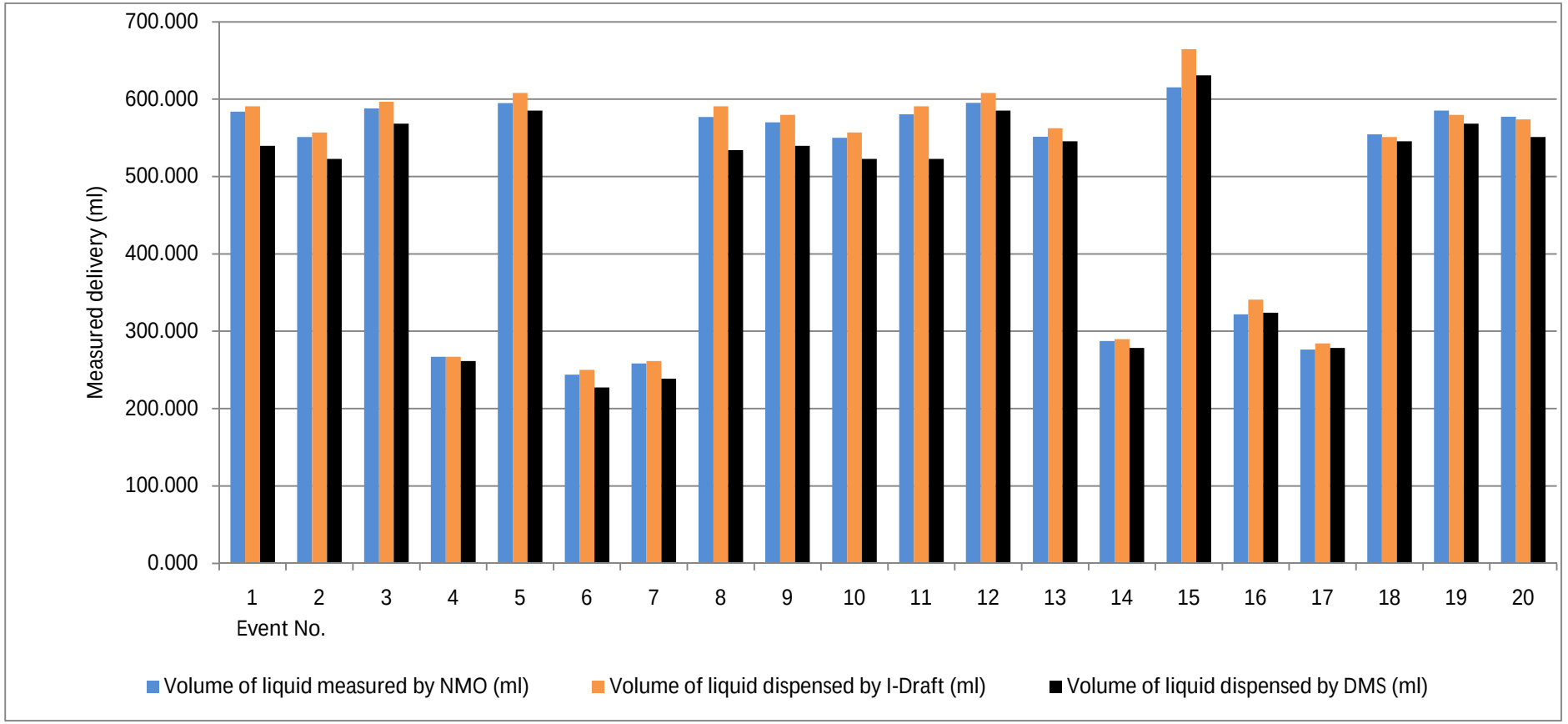
Events 8 & 18 included 2 "fast" top-ups

Test 6: Delivery **Font: 1 – Freeflow,** **I-Draugh: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 35 psi (CO_2) events 1- 10 (not pump assisted) , 24 psi (CO_2) events 11-20 (pneumatic pump assisted

Delivery pipe length: Approx 112 m [100 m coiled]

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Cider	Beer	583.920	590.992	7.072	1.211	539.848	-44.072	-7.55
2	Cider	Beer	551.115	556.896	5.781	1.049	522.800	-28.315	-5.14
3	Cider	Beer	588.137	596.674	8.537	1.452	568.261	-19.876	-3.38
4	Cider	Beer	266.967	267.083	0.116	0.043	261.400	-5.567	-2.09
5	Cider	Beer	595.000	608.040	13.039	2.191	585.309	-9.691	-1.63
6	Cider	Beer	243.747	250.035	6.288	2.580	227.305	-16.443	-6.75
7	Cider	Beer	258.270	261.400	3.130	1.212	238.670	-19.600	-7.59
8	Cider	Beer	577.085	590.992	13.907	2.410	534.166	-42.919	-7.44
9	Cider	Beer	570.118	579.626	9.508	1.668	539.848	-30.270	-5.31
10	Cider	Beer	550.012	556.896	6.884	1.252	522.800	-27.211	-4.95
11	Cider	Beer	580.483	590.992	10.508	1.810	522.800	-57.683	-9.94
12	Cider	Beer	595.199	608.040	12.841	2.157	585.309	-9.890	-1.66
13	Cider	Beer	551.406	562.579	11.172	2.026	545.531	-5.875	-1.07
14	Cider	Beer	287.310	289.813	2.503	0.871	278.448	-8.862	-3.08
15	Cider	Beer/Water	615.305	664.866	49.561	8.055	630.770	15.465	2.51
16	Cider	Beer	321.971	340.957	18.985	5.897	323.909	1.937	0.60
17	Cider	Beer	276.185	284.131	7.945	2.877	278.448	2.263	0.82
18	Cider	Beer	554.492	551.213	-3.279	-0.591	545.531	-8.961	-1.62
19	Cider	Beer	585.347	579.626	-5.721	-0.977	568.261	-17.086	-2.92
20	Cider	Beer	577.285	573.944	-3.341	-0.579	551.213	-26.072	-4.52
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
Results if I-Draught event 15 is recorded as Beer (in reporting system)			9729.356	9904.794	175.438	1.8038	9370.628	-358.728	-3.69
Results if I-Draught event 15 is ignored (in reporting sys)			9729.356	9239.928	-489.428	-5.030			



Comments: An additional 100 m of piping, which was coiled and un-insulated, was placed between the DMS flowmeter and the remote cooler. [This was to determine if there was an effect due to a longer pipe run.]

In Event 15 the I-Draught (**s/n 10-18-002-40)7** identified the dispense as a mixture of Beer & Water, therefore the errors are also calculated to take account if the results of the I-Draught dispenses are excluded (ignored) from the total in the reporting system.

Events 5 &15 included 2 "slow" top-ups

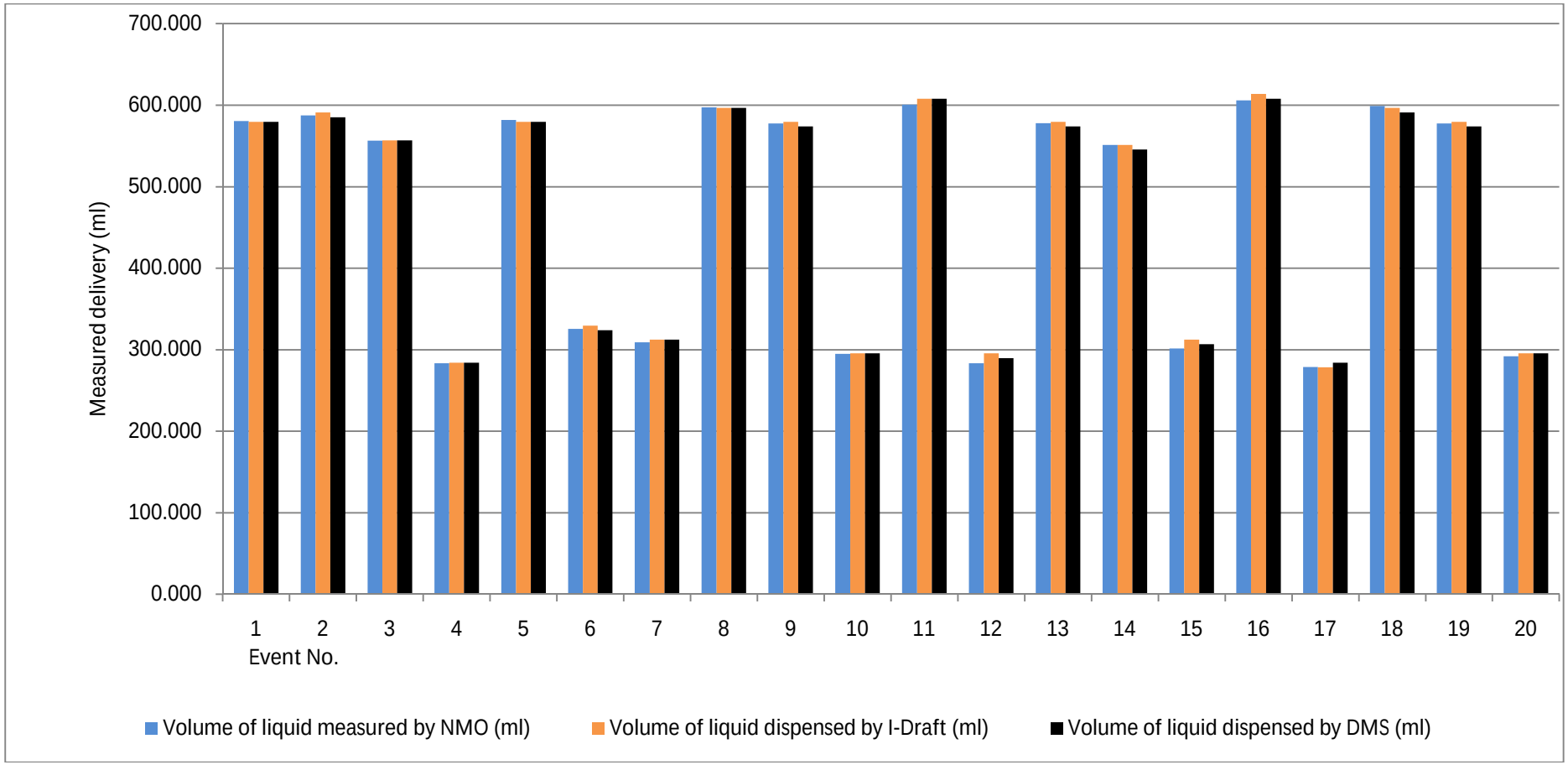
Events 8 & 18 included 2 "fast" top-ups

Test 7: Delivery **Font 1 - Freeflow,** **I-Draught: s/n 10-18-002-407** **DMS: s/n - None (ID'd as No1)**

Keg head pressure: 21 psi (CO_2) pneumatic pump assisted

Delivery pipe length: Approx 12 m

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Cider	Beer	580.553	579.626	-0.927	-0.160	579.626	-0.927	-0.16
2	Cider	Beer	587.552	590.992	3.440	0.585	585.309	-2.243	-0.38
3	Cider	Beer	556.489	556.896	0.407	0.073	556.896	0.407	0.07
4	Cider	Beer	283.381	284.131	0.750	0.265	284.131	0.750	0.26
5	Cider	Beer	581.866	579.626	-2.239	-0.385	579.626	-2.239	-0.38
6	Cider	Beer	325.493	329.592	4.099	1.259	323.909	-1.584	-0.49
7	Cider	Beer	309.178	312.544	3.366	1.089	312.544	3.366	1.09
8	Cider	Beer	597.191	596.674	-0.517	-0.087	596.674	-0.517	-0.09
9	Cider	Beer	577.586	579.626	2.041	0.353	573.944	-3.642	-0.63
10	Cider	Beer	294.885	295.496	0.611	0.207	295.496	0.611	0.21
11	Cider	Beer	600.478	608.040	7.561	1.259	608.040	7.561	1.26
12	Cider	Beer	283.272	295.496	12.224	4.315	289.813	6.541	2.31
13	Cider	Beer	577.983	579.626	1.643	0.284	573.944	-4.039	-0.70
14	Cider	Beer	551.114	551.213	0.099	0.018	545.531	-5.583	-1.01
15	Cider	Beer	301.506	312.544	11.038	3.661	306.861	5.355	1.78
16	Cider	Beer	605.953	613.722	7.769	1.282	608.040	2.086	0.34
17	Cider	Beer	278.702	278.448	-0.254	-0.091	284.131	5.428	1.95
18	Cider	Beer	598.985	596.674	-2.311	-0.386	590.992	-7.994	-1.33
19	Cider	Beer	577.487	579.626	2.139	0.370	573.944	-3.543	-0.61
20	Cider	Beer	292.078	295.496	3.417	1.170	295.496	3.417	1.17
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			9361.733	9416.089	54.356	0.581	9364.945	3.213	0.03



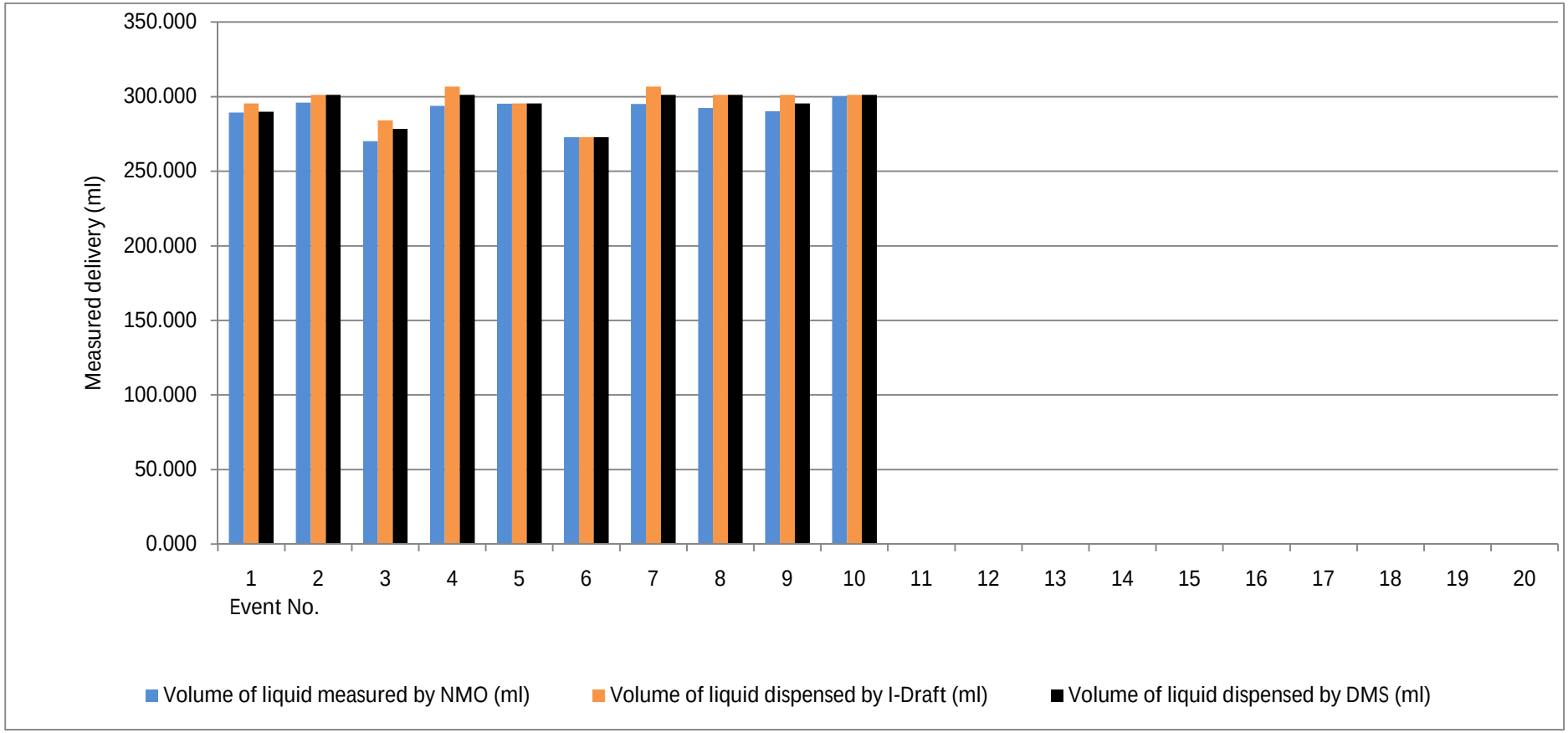
Comments: Events 11 &12 included 2 "slow" top-ups
Events 15 & 16 included 2 "fast" top-ups

Test 8: Delivery **Font 1 - Freeflow,** **I-Draught: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 21 psi (CO_2) (pneumatic pump assisted

Delivery pipe length: Approx 12 m

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Cider	Beer	289.391	295.496	6.105	2.110	289.813	0.423	0.15
2	Cider	Beer	295.979	301.178	5.199	1.757	301.178	5.199	1.76
3	Cider	Beer	270.118	284.131	14.012	5.188	278.448	8.330	3.08
4	Cider	Beer	293.864	306.861	12.997	4.423	301.178	7.315	2.49
5	Cider	Beer	295.359	295.496	0.137	0.046	295.496	0.137	0.05
6	Cider	Beer	272.791	272.765	-0.025	-0.009	272.765	-0.025	-0.01
7	Cider	Beer	295.048	306.861	11.813	4.004	301.178	6.130	2.08
8	Cider	Beer	292.378	301.178	8.800	3.010	301.178	8.800	3.01
9	Cider	Beer	290.198	301.178	10.981	3.784	295.496	5.298	1.83
10	Cider	Beer	300.093	301.178	1.085	0.362	301.178	1.085	0.36
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			2895.218	2966.324	71.106	2.456	2937.911	42.692	1.47



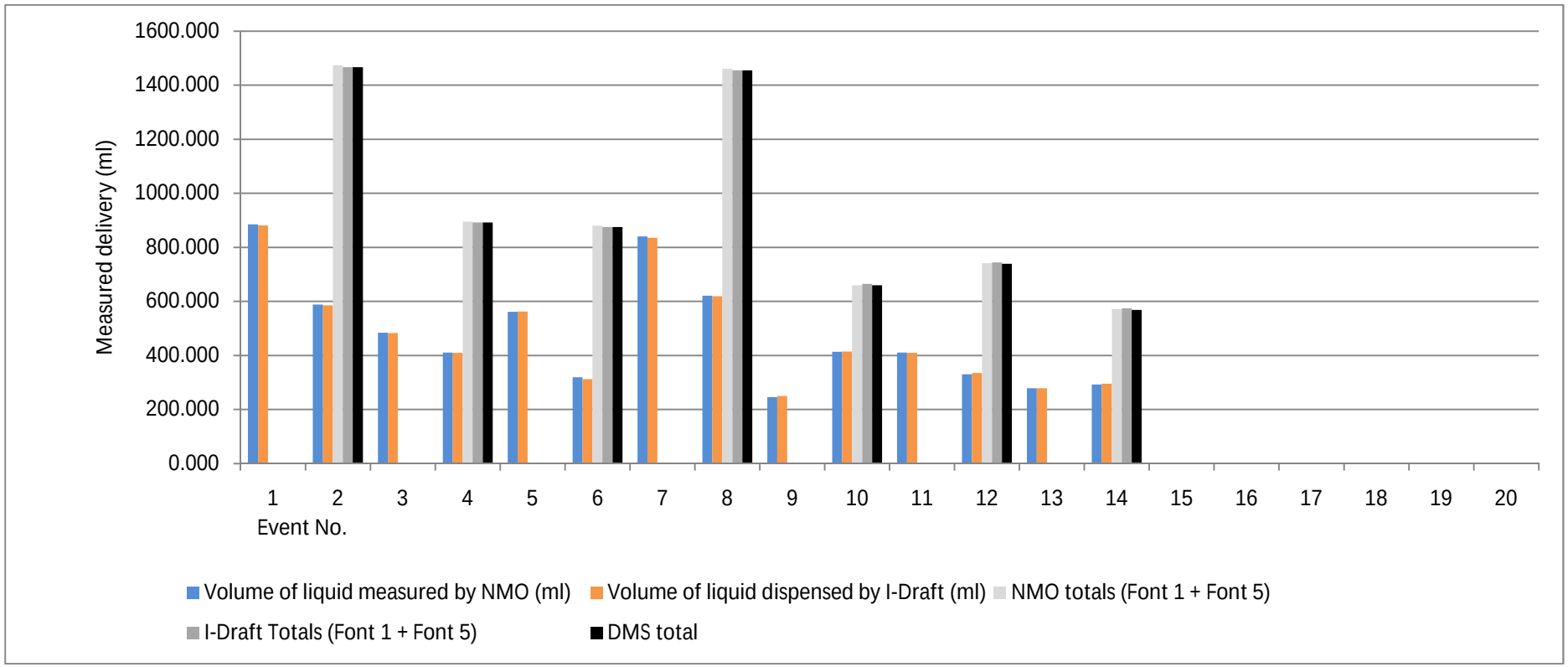
Comments: Events 2, 3 & 4 included 2 “slow” top-ups”
Events. 7, 8 & 9 included 2 “fast” top-ups”

Test 9: Delivery **Font: 1 – Freeflow, pump assisted** **I-Draught: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Dual dispense **Font: 5 – Freeflow, pump assisted** **I-Draught: s/n 10-18-004-699** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 21 psi (CO_2) (pneumatic pump assisted) **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Cider	Beer	884.657	880.805	-3.852	-0.435	0.000		
2	Cider	Beer	588.469	585.309	-3.160	-0.537	1466.114	-7.012	-0.48
3	Cider	Beer	484.127	483.022	-1.105	-0.228	0.000		
4	Cider	Beer	410.409	409.148	-1.261	-0.307	892.170	-2.367	-0.26
5	Cider	Beer	560.964	562.579	1.615	0.288	0.000		
6	Cider	Beer	318.784	312.544	-6.241	-1.958	875.122	-4.626	-0.53
7	Cider	Beer	839.853	835.344	-4.509	-0.537	0.000		
8	Cider	Beer	621.193	619.405	-1.788	-0.288	1454.749	-6.297	-0.43
9	Cider	Beer	246.155	250.035	3.880	1.576	0.000		
10	Cider	Beer	413.796	414.831	1.035	0.250	659.183	-0.768	-0.12
11	Cider	Beer	410.574	409.148	-1.426	-0.347	0.000		
12	Cider	Beer	330.541	335.274	4.733	1.432	738.740	-2.375	-0.32
13	Cider	Beer	278.400	278.448	0.048	0.017	0.000		
14	Cider	Beer	292.773	295.496	2.722	0.930	568.261	-2.912	-0.51
15									
16									
17									
18									
19									
20									
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			6680.696	6671.387	-9.309	-0.14	6654.339	-26.357	-0.39



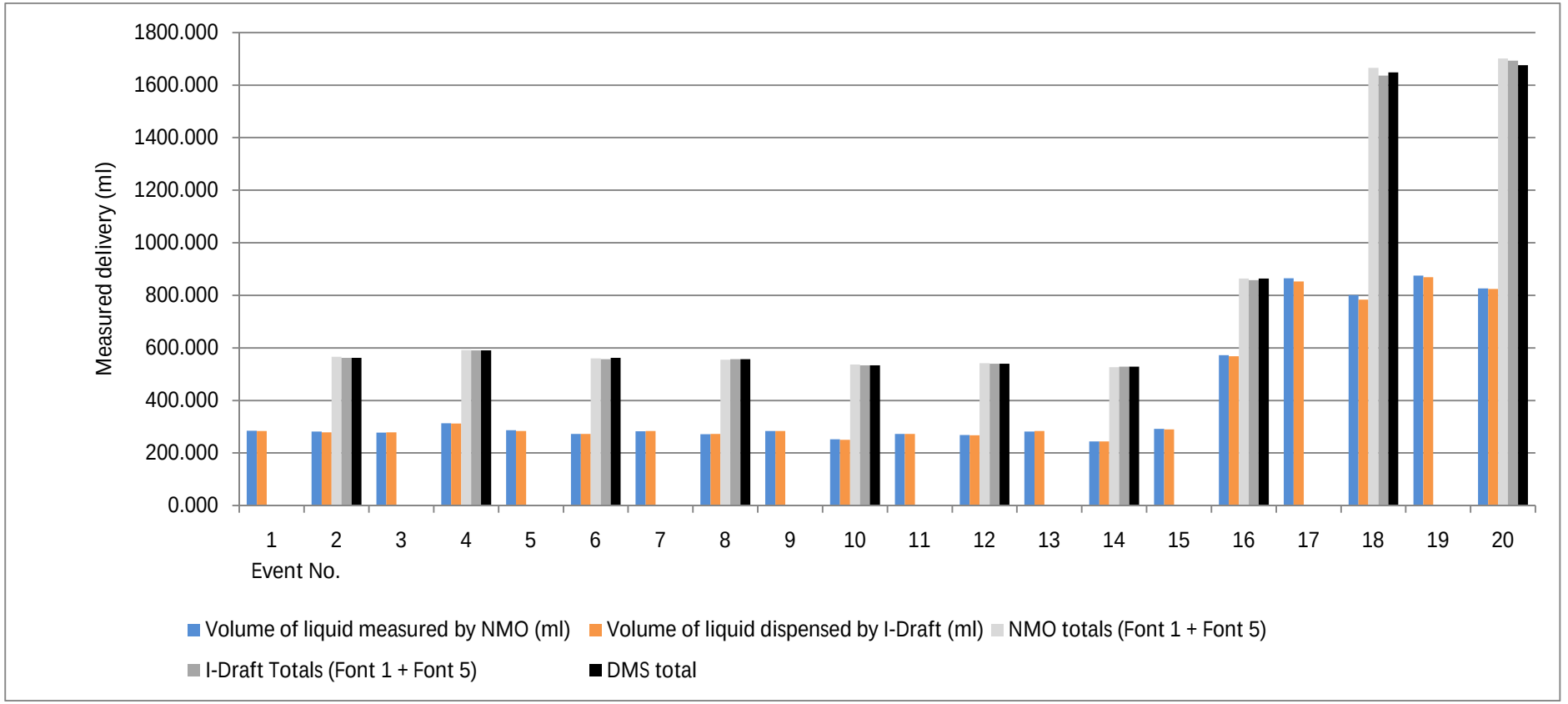
Comments: The pipe line had a "Y" connection immediately after the DMS meter, the DMS meter supplied Font 1 and Font 5. Therefore the DMS total is the sum of **Font: 1- I-Draught: s/n 10-18-002-407 & Font: 5 – I-Draught: s/n 10-18-004-699**
This test was a "Dual dispense" involving the use of Fonts 1 & 5. Odd numbered Events are Font 1 dispenses, even numbered Events are Font 5 dispenses.
Font 1 dispenses were cooled in the 1st & 2nd stage in the Secondary cooler ,Font 5 dispenses were cooled in the 1st stage in the Secondary cooler.

Test 10: Delivery **Font: 1 – Freeflow,** **I-Draught: s/n 10-18-002-407** **DMS: s/n None (ID'd as No1)**

Dual dispense **Font: 5 – Freeflow,** **I-Draught: s/n 10-18-004-699** **DMS: s/n None (ID'd as No1)**

Keg head pressure: 21 psi (CO_2) (not pump assisted) **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Cider	Beer	284.376	284.131	-0.245	-0.086	----		
2	Cider	Beer	281.802	278.448	-3.354	-1.190	562.579	-3.599	-1.28
3	Cider	Beer	278.201	278.448	0.247	0.089	----		
4	Cider	Beer	313.579	312.544	-1.035	-0.330	590.992	-0.788	-0.25
5	Cider	Beer/Water	287.055	284.131	-2.924	-1.019	----		
6	Cider	Beer	273.059	272.765	-0.293	-0.107	562.579	2.465	0.90
7	Cider	Water	283.174	284.131	0.957	0.338	----		
8	Cider	Beer	271.607	272.765	1.159	0.427	556.896	2.115	0.78
9	Cider	Beer	284.172	284.131	-0.041	-0.014	----		
10	Cider	Beer	252.198	250.035	-2.163	-0.858	534.166	-2.204	-0.87
11	Cider	Beer	273.121	272.765	-0.356	-0.130	----		
12	Cider	Beer	268.649	267.083	-1.567	-0.583	539.848	-1.922	-0.72
13	Cider	Beer	282.178	284.131	1.953	0.692	----		
14	Cider	Beer	244.554	244.352	-0.201	-0.082	528.483	1.752	0.72
15	Cider	Beer	291.831	289.813	-2.018	-0.692	----		
16	Cider	Beer	572.109	568.261	-3.848	-0.673	863.757	-0.183	-0.03
17	Cider	Beer	864.938	852.392	-12.546	-1.451	----		
18	Cider/water	Beer	800.757	784.201	-16.556	-2.068	1647.958	-17.738	-2.22
19	Cider/water	Beer/Water	874.790	869.440	-5.351	-0.612	----		
20	Water	Water	826.066	823.979	-2.088	-0.253	1676.371	-24.486	-2.96
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
		Total volumes	8108.216	8057.945	-50.272	-0.620	8063.627	-44.589	-0.55
For Cider only, if I-Draught results for events 5 & 7 are excluded, and result for event 18 is included			5606.602	5796.265	189.662	3.383			



Comments: The pipe line had a "Y" connection immediately after the DMS meter, the DMS meter supplied Font 1 and Font 5. Therefore the DMS total is the sum of **Font: 1 I-Draught: s/n 10-18-002-407 & Font: 5 – I-Draught: s/n 10-18-004-699**

This test was a "Dual dispense" involving the use of Fonts 1 & 5. Odd numbered Events are Font 1 dispenses, even numbered Events are Font 5 dispenses. Font 1 dispenses were cooled in the 1st & 2nd stage in the Secondary cooler ,Font 5 were cooled in the 1st stage in the Secondary cooler.

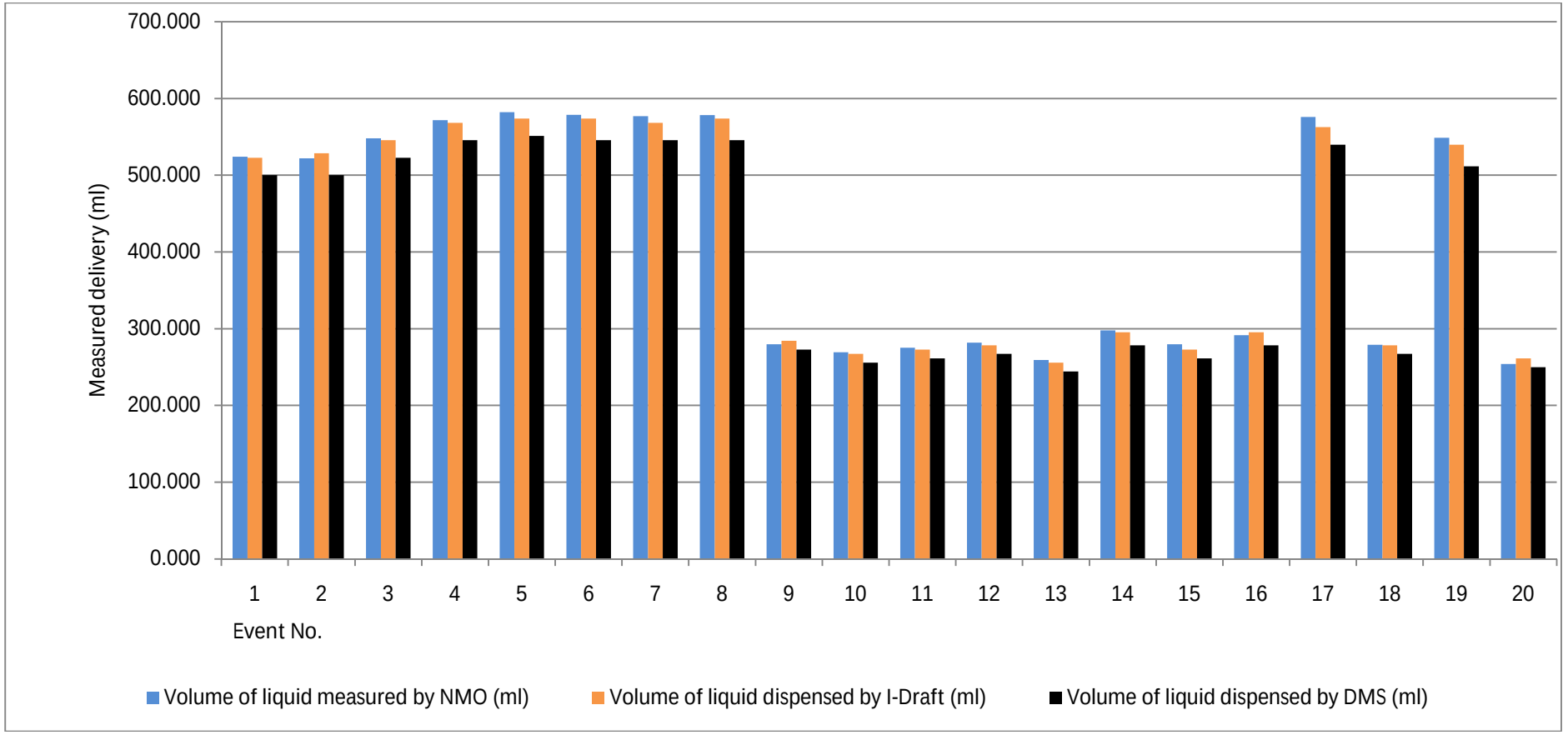
In events 5 & 7 [Font 1] and 18 [Font 5], the I-Draught(s) identified the liquids differently to those dispensed by NMO, therefore the errors are also calculated to take account of the Cider only dispenses if the results of the I-Draught dispenses are excluded (Events 5 & 7) or included (Event 18) in the totals of the reporting system

At the conclusion of Event 16, the Keg connection was replaced by the water connection (prior to "flushing" Events 18 -20).

Test 11: Delivery **Font 10- Handpull,** **I-Draught: s/n 10-18-004-721** **DMS: s/n ----- (ID'd as No.7)**

Delivery pipe length: Approx 8.5 m

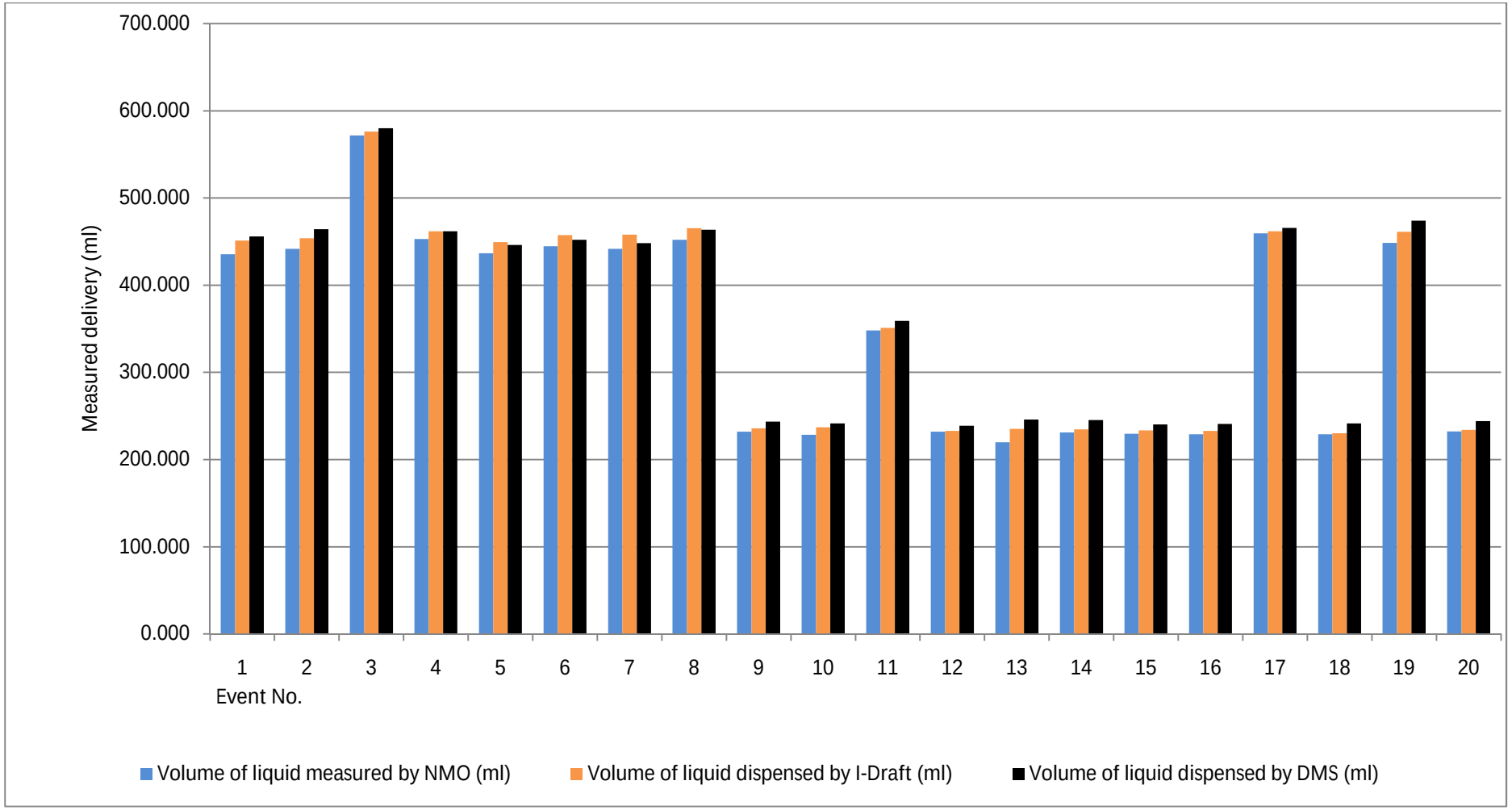
Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Ale	Beer	524.037	522.800	-1.236	-0.236	500.070	-23.967	-4.57
2	Ale	Beer	521.943	528.483	6.540	1.253	500.070	-21.874	-4.19
3	Ale	Beer	547.968	545.531	-2.437	-0.445	522.800	-25.168	-4.59
4	Ale	Beer	571.599	568.261	-3.338	-0.584	545.531	-26.068	-4.56
5	Ale	Beer	582.149	573.944	-8.205	-1.409	551.213	-30.935	-5.31
6	Ale	Beer	578.668	573.944	-4.724	-0.816	545.531	-33.137	-5.73
7	Ale	Beer	576.874	568.261	-8.612	-1.493	545.531	-31.343	-5.43
8	Ale	Beer	578.361	573.944	-4.417	-0.764	545.531	-32.830	-5.68
9	Ale	Beer	279.855	284.131	4.276	1.528	272.765	-7.089	-2.53
10	Ale	Beer	269.449	267.083	-2.366	-0.878	255.718	-13.731	-5.10
11	Ale	Beer	275.085	272.765	-2.319	-0.843	261.400	-13.685	-4.97
12	Ale	Beer	281.937	278.448	-3.489	-1.237	267.083	-14.854	-5.27
13	Ale	Beer	259.331	255.718	-3.614	-1.393	244.352	-14.979	-5.78
14	Ale	Beer	297.717	295.496	-2.221	-0.746	278.448	-19.269	-6.47
15	Ale	Beer	279.890	272.765	-7.124	-2.545	261.400	-18.489	-6.61
16	Ale	Beer	291.485	295.496	4.011	1.376	278.448	-13.037	-4.47
17	Ale	Beer	575.870	562.579	-13.292	-2.308	539.848	-36.022	-6.26
18	Ale	Beer	279.116	278.448	-0.668	-0.239	267.083	-12.034	-4.31
19	Ale	Beer	548.622	539.848	-8.774	-1.599	511.435	-37.187	-6.78
20	Ale	Beer	253.877	261.400	7.523	2.963	250.035	-3.842	-1.51
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			8373.832	8319.345	-54.488	-0.651	7944.292	-429.540	-5.13



Comments:. Beer hand pump manufactured by:England Worthside Ltd.

Test 11a
Supplemental to Test 11: Delivery **Font 10- Handpull,** **I-Draught: s/n 10-18-004-721** **DMS: s/n ----- (ID'd as No.7)**
Delivery pipe length: Approx 8.5 m

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draft flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draft (ml)	Difference of measured volumes [NMO - I-Draft] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Cask Ale	Beer	435.430	451.270	15.840	3.638	455.900	20.470	4.70
2	Cask Ale	Beer	441.775	453.740	11.965	2.708	464.300	22.525	5.10
3	Cask Ale	Beer	571.628	576.310	4.682	0.819	579.890	8.262	1.45
4	Cask Ale	Beer	453.093	461.790	8.697	1.920	461.710	8.617	1.90
5	Cask Ale	Beer	436.720	449.410	12.690	2.906	446.210	9.490	2.17
6	Cask Ale	Beer	444.555	457.460	12.905	2.903	452.030	7.475	1.68
7	Cask Ale	Beer	441.684	458.080	16.396	3.712	448.150	6.466	1.46
8	Cask Ale	Beer	452.208	465.500	13.292	2.939	463.650	11.442	2.53
9	Cask Ale	Beer	231.977	235.850	3.873	1.670	243.450	11.473	4.95
10	Cask Ale	Beer	228.486	237.090	8.604	3.765	241.510	13.024	5.70
11	Cask Ale	Beer	348.066	350.990	2.924	0.840	359.040	10.974	3.15
12	Cask Ale	Beer	232.070	232.750	0.680	0.293	238.930	6.860	2.96
13	Cask Ale	Beer	219.780	235.230	15.450	7.030	246.030	26.250	11.94
14	Cask Ale	Beer	231.187	234.610	3.423	1.481	245.390	14.203	6.14
15	Cask Ale	Beer	229.708	233.370	3.662	1.594	240.220	10.512	4.58
16	Cask Ale	Beer	228.953	232.760	3.807	1.663	240.870	11.917	5.20
17	Cask Ale	Beer	459.455	461.790	2.335	0.508	465.590	6.135	1.34
18	Cask Ale	Beer	229.013	230.280	1.267	0.553	241.510	12.497	5.46
19	Cask Ale	Beer	448.625	461.170	12.545	2.796	473.980	25.355	5.65
20	Cask Ale	Beer	232.442	233.990	1.548	0.666	244.090	11.648	5.01
			Total volume (NMO)	Total volume (I-Draft)	Total Difference	Total % error	Total volume (DMS)	Total Difference	Total % error
			6996.854	7153.44	156.586	2.238	7252.450	255.596	3.65

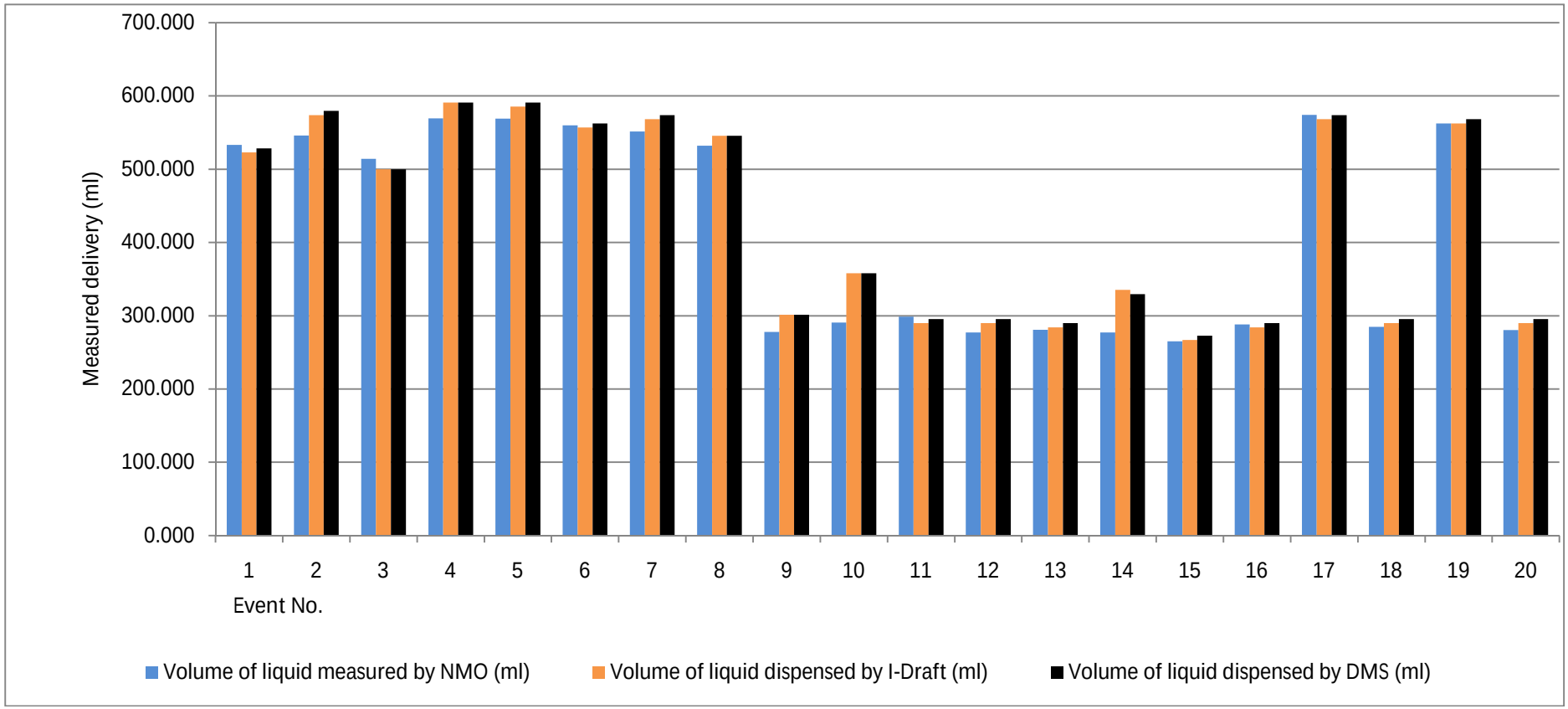


Comment: The above tests are supplemental to those conducted at Test 11, and were conducted at a later date.

Test 12: Delivery **Font 9- Handpull, pump assisted** **I-Draught: s/n 10-18-004-713** **DMS: s/n None (ID'd as No 8)**

Delivery pipe length: Approx 16.5 m [3.3m (½") + 12m (⅜") + 1.2m (½")]

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Ale	Beer	533.210	522.800	-10.410	-1.952	528.483	-4.727	-0.89
2	Ale	Beer	545.921	573.944	28.022	5.133	579.626	33.705	6.17
3	Ale	Beer	514.053	500.070	-13.983	-2.720	500.070	-13.983	-2.72
4	Ale	Beer	569.546	590.992	21.446	3.765	590.992	21.446	3.77
5	Ale	Beer	569.174	585.309	16.135	2.835	590.992	21.817	3.83
6	Ale	Beer	559.757	556.896	-2.861	-0.511	562.579	2.821	0.50
7	Ale	Beer	551.332	568.261	16.929	3.071	573.944	22.612	4.10
8	Ale	Beer	532.193	545.531	13.338	2.506	545.531	13.338	2.51
9	Ale	Beer	278.005	301.178	23.173	8.336	301.178	23.173	8.34
10	Ale	Beer	290.845	358.005	67.159	23.091	358.005	67.159	23.09
11	Ale	Beer	298.684	289.813	-8.871	-2.970	295.496	-3.188	-1.07
12	Ale	Beer	277.317	289.813	12.496	4.506	295.496	18.179	6.56
13	Ale	Beer	280.881	284.131	3.250	1.157	289.813	8.932	3.18
14	Ale	Beer	277.275	335.274	57.999	20.917	329.592	52.316	18.87
15	Ale	Beer	265.056	267.083	2.027	0.765	272.765	7.709	2.91
16	Ale	Beer	288.064	284.131	-3.933	-1.365	289.813	1.750	0.61
17	Ale	Beer	574.072	568.261	-5.811	-1.012	573.944	-0.128	-0.02
18	Ale	Beer	284.967	289.813	4.846	1.701	295.496	10.529	3.69
19	Ale	Beer	562.318	562.579	0.261	0.046	568.261	5.943	1.06
20	Ale	Beer	280.305	289.813	9.508	3.392	295.496	15.191	5.42
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			8332.977	8518.236	185.259	2.223	8637.571	304.594	3.66



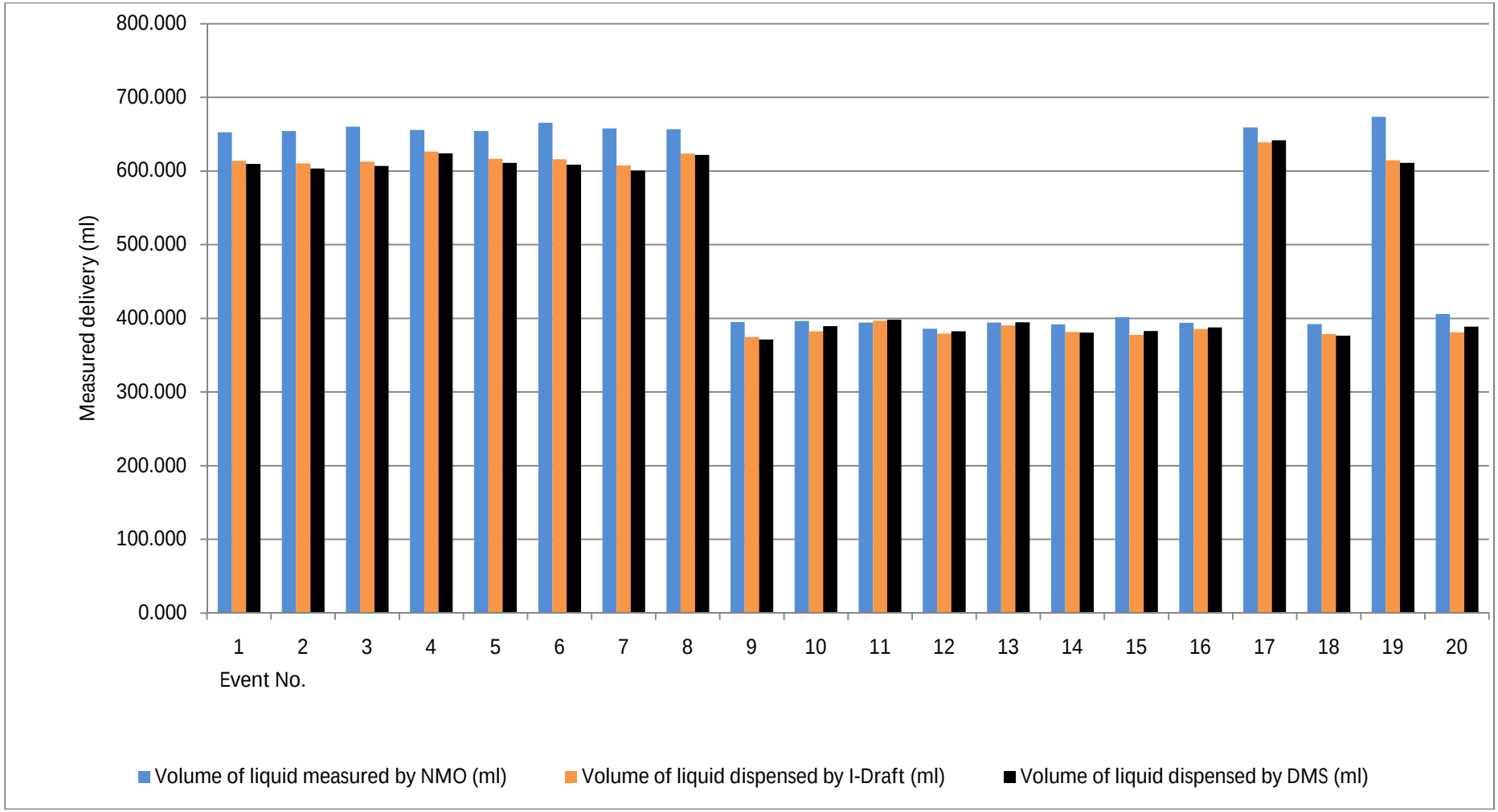
Comments: Beer hand pump manufactured by: Angram Ltd. Boroughbridge N Yorks (incorporates non-return valve)
Irregular/inconsistent "pulls" required for dispense

Some air visible in lines between the line / meter connections – possibly due to air being in line (between when connected and not “purged” during priming. The majority of the ½” pipe was nylon re-enforced and offered poor visibility

Test 12a

Supplemental to Test 12: Delivery **Font 9- Handpull, pump assisted** **I-Draught: s/n 10-18-004-713** **DMS: s/n None (ID'd as No 8)**
Delivery pipe length: Approx 16.5 m [3.3m (½") + 12m (⅜") + 1.2m (½")]

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draft flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draft (ml)	Difference of measured volumes [NMO - I-Draft] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Cask Ale	Beer	652.523	613.810	-38.713	-5.933	609.770	-42.753	-6.55
2	Cask Ale	Beer	654.400	610.400	-44.000	-6.724	603.340	-51.060	-7.80
3	Cask Ale	Beer	660.393	612.670	-47.723	-7.226	606.850	-53.543	-8.11
4	Cask Ale	Beer	655.830	626.340	-29.490	-4.497	623.800	-32.030	-4.88
5	Cask Ale	Beer	654.317	616.660	-37.657	-5.755	610.940	-43.377	-6.63
6	Cask Ale	Beer	665.626	616.090	-49.536	-7.442	608.600	-57.026	-8.57
7	Cask Ale	Beer	657.682	607.550	-50.132	-7.622	600.420	-57.262	-8.71
8	Cask Ale	Beer	656.690	623.490	-33.200	-5.056	622.050	-34.640	-5.27
9	Cask Ale	Beer	394.972	374.670	-20.302	-5.140	371.240	-23.732	-6.01
10	Cask Ale	Beer	396.323	382.640	-13.683	-3.452	389.360	-6.963	-1.76
11	Cask Ale	Beer	394.486	396.870	2.384	0.604	398.130	3.644	0.92
12	Cask Ale	Beer	386.008	379.220	-6.788	-1.759	382.570	-3.438	-0.89
13	Cask Ale	Beer	394.505	390.610	-3.895	-0.987	394.630	0.125	0.03
14	Cask Ale	Beer	391.901	381.500	-10.401	-2.654	380.590	-11.311	-2.89
15	Cask Ale	Beer	401.614	377.510	-24.104	-6.002	382.930	-18.684	-4.65
16	Cask Ale	Beer	394.094	385.480	-8.614	-2.186	387.610	-6.484	-1.65
17	Cask Ale	Beer	659.153	638.870	-20.283	-3.077	641.930	-17.223	-2.61
18	Cask Ale	Beer	392.248	378.650	-13.598	-3.467	376.500	-15.748	-4.01
19	Cask Ale	Beer	673.636	614.380	-59.256	-8.796	610.940	-62.696	-9.31
20	Cask Ale	Beer	405.745	380.930	-24.815	-6.116	388.780	-16.965	-4.18
			Total volume (NMO)	Total volume (I-Draft)	Total Difference	Total % error	Total volume (DMS)	Total Difference	Total % error
			10542.145	10008.34	-533.805	-5.064	9990.980	-551.165	-5.23



Comments Insulated line with cold water recirculation only.
The above tests are supplemental to those conducted at Test 12, and were conducted at a later date.

Test 13: Cleaning **Font 10- Handpull, pump assisted** **I-Draught: s/n 10-18-004-713** **DMS: s/n –None (ID'd as No. 7)**
Delivery pipe length: 8.5m

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Ale	Beer	278.075	272.765	-5.309	-1.909	284.131	6.056	2.18
2	Ale/water	Beer/Water	817.581	846.709	29.128	3.563	852.392	34.811	4.26
3	Water	Water	592.759	602.357	9.598	1.619	568.261	-24.498	-4.13
4	Water/cleaner	Water/Cleaner	1143.669	1176.301	32.631	2.853	1181.983	38.314	3.35
5	Cleaner	Cleaner	745.677	755.787	10.110	1.356	721.692	-23.985	-3.22
6	Cleaner/water	Cleaner/Water	1023.706	1039.918	16.212	1.584	1017.188	-6.519	-0.64
7	Water	Water	740.319	750.105	9.786	1.322	681.914	-58.406	-7.89
8	Water/ale	Water/Beer	1054.918	1068.331	13.413	1.272	1028.553	-26.365	-2.50
9	Ale	Beer	450.509	465.974	15.466	3.433	465.974	15.466	3.43
10	Ale	Beer	490.940	522.800	31.860	6.490	500.070	9.130	1.86
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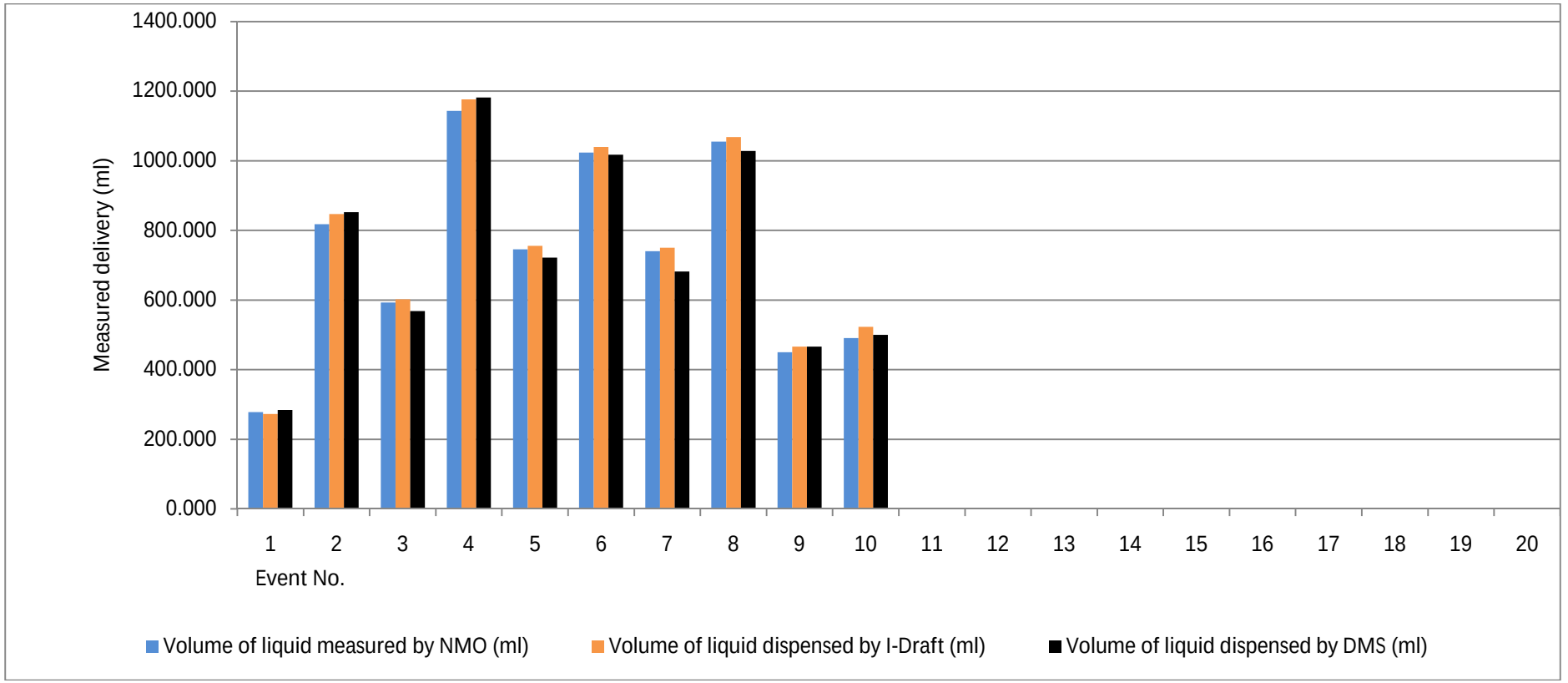
17									
18									
19									
20									
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
Results for all dispenses			7338.153	7501.0485	162.896	2.22	7302.157	-35.996	-0.49
Results for Ale dispenses[1] only			1219.523	1261.540	42.017	3.446	1250.175	30.562	2.51[1]



Comments: Beer hand pump manufactured by: Angram Ltd. Boroughbridge N Yorks (incorporates non-return valve)

Irregular/inconsistent "pulls" required for dispense

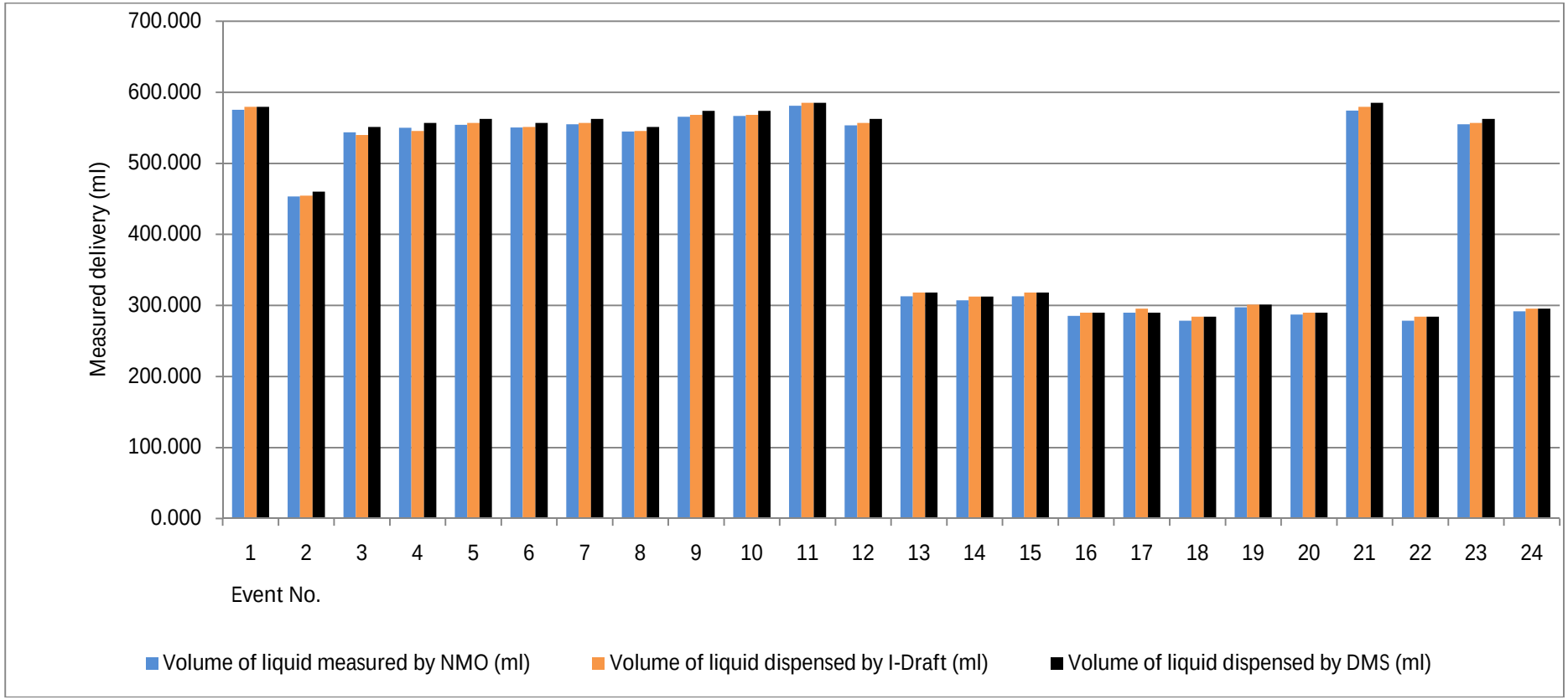
The table includes the total measured by the DMS for all dispenses and for only those with Ale.

[1] As the DMS cannot determine the difference between the liquid types, including a Beer dispense and a Cleaning operation, the system report would require interpretation of the results and the use of other “inputs” e.g. input from meter in cleaning line: notification of cleaning process etc., so that the results can be [manually] adjusted to account for the cleaning operation.

Test 14: Delivery **Font 2 - Freeflow,** **I-Draught: s/n 10-18-002-426** **DMS: s/n –None (ID'd as No. 2)**
Keg head pressure: 34 psi (Mixed gas 70/30) electric pump assisted (10 second delivery) – pint **Delivery pipe length: Approx 12 m**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Bitter	Beer	575.240	579.626	4.386	0.762	579.626	4.386	0.76
2	Bitter	Beer	453.221	454.609	1.388	0.306	460.292	7.071	1.56
3	Bitter	Beer	543.497	539.848	-3.649	-0.671	551.213	7.716	1.42
4	Bitter	Beer	549.952	545.531	-4.421	-0.804	556.896	6.944	1.26
5	Bitter	Beer	554.098	556.896	2.798	0.505	562.579	8.480	1.53
6	Bitter	Beer	550.453	551.213	0.761	0.138	556.896	6.443	1.17
7	Bitter	Beer	554.829	556.896	2.067	0.372	562.579	7.749	1.40
8	Bitter	Beer	544.707	545.531	0.824	0.151	551.213	6.506	1.19
9	Bitter	Beer	565.448	568.261	2.814	0.498	573.944	8.496	1.50
10	Bitter	Beer	566.740	568.261	1.521	0.268	573.944	7.203	1.27
11	Bitter	Beer	581.124	585.309	4.185	0.720	585.309	4.185	0.72
12	Bitter	Beer	553.551	556.896	3.345	0.604	562.579	9.028	1.63
13	Bitter	Beer	313.058	318.226	5.168	1.651	318.226	5.168	1.65
14	Bitter	Beer	307.303	312.544	5.241	1.705	312.544	5.241	1.71
15	Bitter	Beer	312.892	318.226	5.334	1.705	318.226	5.334	1.70
16	Bitter	Beer	285.249	289.813	4.564	1.600	289.813	4.564	1.60
17	Bitter	Beer	289.975	295.496	5.521	1.904	289.813	-0.161	-0.06
18	Bitter	Beer	278.551	284.131	5.580	2.003	284.131	5.580	2.00
19	Bitter	Beer	297.246	301.178	3.932	1.323	301.178	3.932	1.32
20	Bitter	Beer	287.094	289.813	2.719	0.947	289.813	2.719	0.95
21	Bitter	Beer	574.240	579.626	5.387	0.938	585.309	11.069	1.93
22	Bitter	Beer	278.585	284.131	5.546	1.991	284.131	5.546	1.99
23	Bitter	Beer	555.104	556.896	1.792	0.323	562.579	7.475	1.35
24	Bitter	Beer	291.737	295.496	3.759	1.288	295.496	3.759	1.29

			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			10663.895	10734.455	70.560	0.662	10808.329	144.434	1.35



Comments: Events 3 & 4, pump did not operate, delivered under gas pressure only

Events 5 & 6, pump did not operate immediately, initial part of delivery made under gas pressure only

Test 15: Cleaning **Font 2 - Freeflow,** **I-Draught: s/n 10-18-002-426** **DMS: s/n –None (ID'd as No. 2)**

Keg head pressure: 34 psi (Mixed gas 70/30) electric pump assisted (10 second delivery - pint)

Delivery pipe length: Approx 12 m

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Bitter	Beer	842.889	841.027	-1.862	-0.221	846.709	3.820	0.45
2	Bitter/Wtr	Beer/Water	735.010	738.740	3.729	0.507	733.057	-1.953	-0.27
3	Wtr	Water	569.049	573.944	4.894	0.860	568.261	-0.788	-0.14
4	Wtr	Water	579.741	585.309	5.568	0.960	579.626	-0.114	-0.02
5	Wtr	Water	863.403	863.757	0.354	0.041	875.122	11.719	1.36
6	Wtr/Bitter	Water/Beer	552.026	551.213	-0.813	-0.147	562.579	10.553	1.91
7	Bitter	Beer	534.674	534.166	-0.509	-0.095	545.531	10.856	2.03
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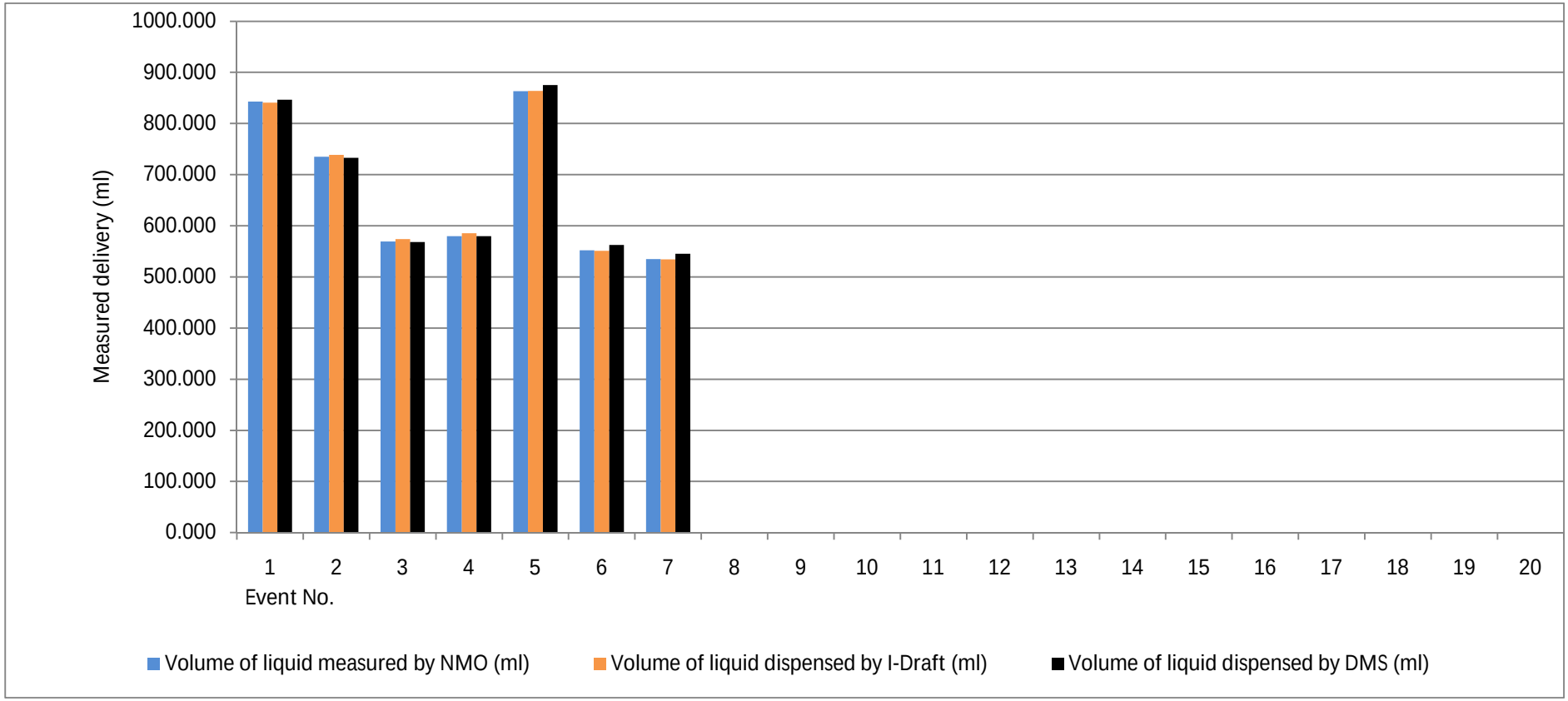
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
Results for all tests			4676.793	4688.155	11.362	0.243	4710.886	34.092	0.73
Results for Bitter (only) - I-Draught, and DMS[1]			1377.564	1375.192	-2.371	-0.172	1392.240	14.676	1.07[1]

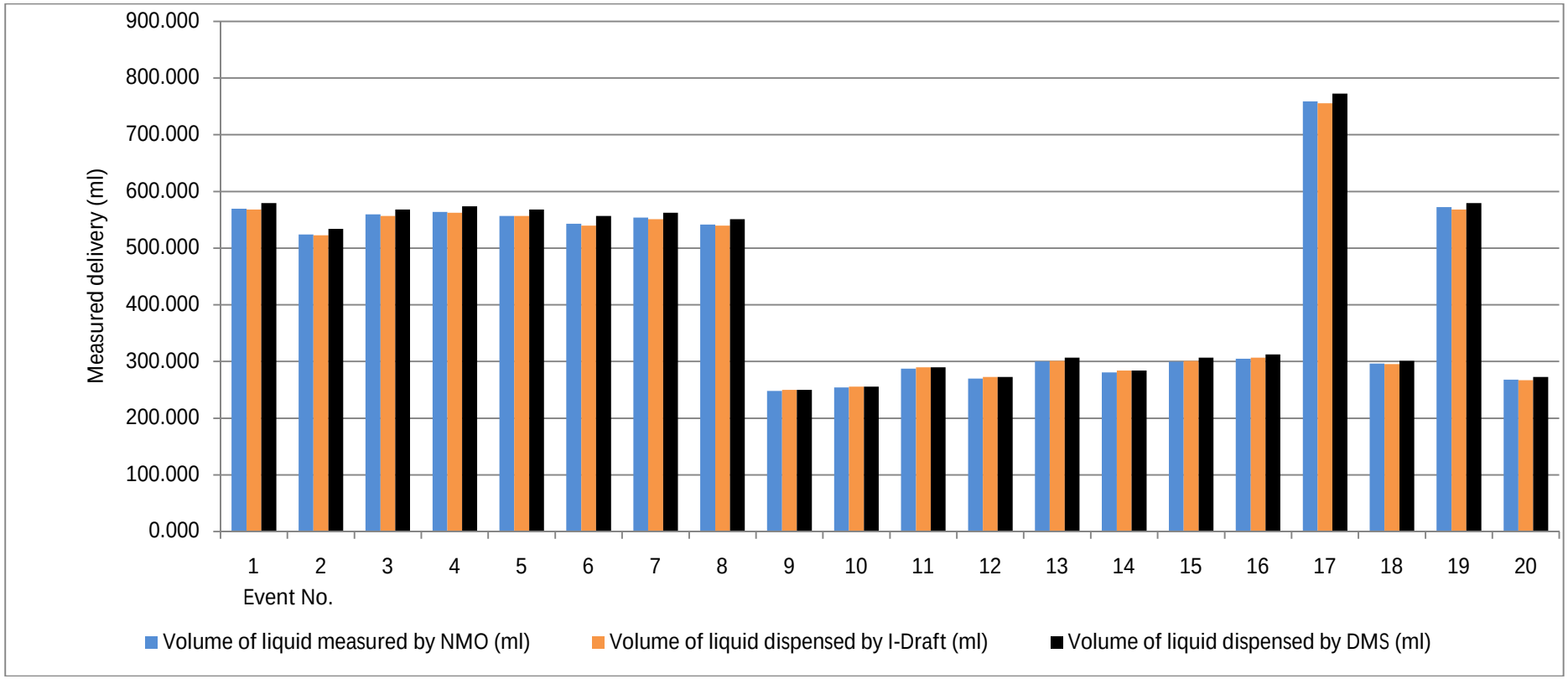


Comments: The table includes the total measured by the DMS for all dispenses and for only those with Bitter.

[1] As the DMS cannot determine the difference between the liquid types, including a Beer dispense and a Cleaning operation, the system report would require interpretation of the results and the use of other “inputs” e.g. input from meter in cleaning line: notification of cleaning process etc., so that the results can be [manually] modified to account for the cleaning operation.

Test 16: Delivery **Font 2 - Freeflow,** **I-Draught: s/n 10-18-002-426** **DMS: s/n –None (ID'd as No. 2)**
Keg head pressure: 34 psi (Mixed gas 70/30) not pump assisted (16 second delivery - pint)
Delivery pipe length: Approx 12 m

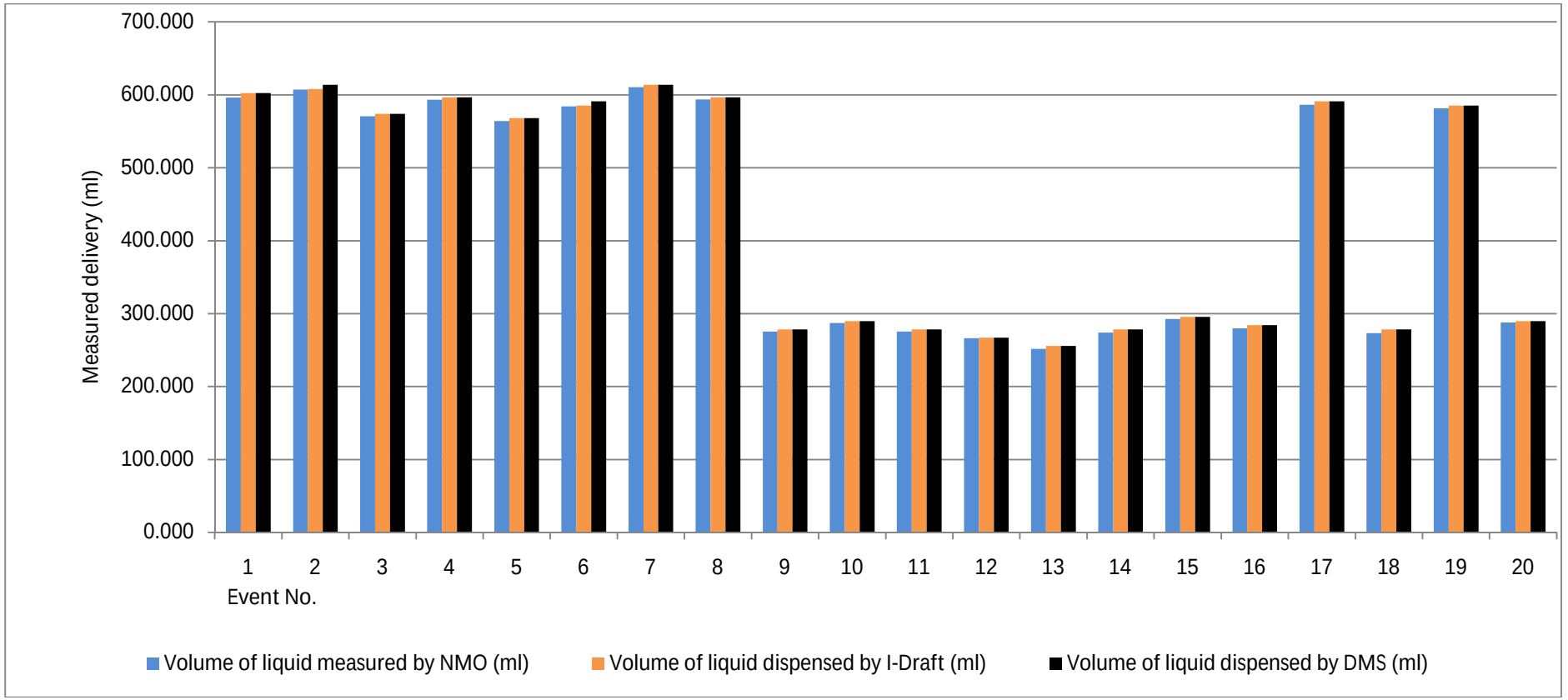
Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Bitter	Beer	569.586	568.261	-1.325	-0.233	579.626	10.041	1.76
2	Bitter	Beer	524.048	522.800	-1.248	-0.238	534.166	10.118	1.93
3	Bitter	Beer	559.483	556.896	-2.587	-0.462	568.261	8.778	1.57
4	Bitter	Beer	564.039	562.579	-1.460	-0.259	573.944	9.905	1.76
5	Bitter	Beer	556.903	556.896	-0.007	-0.001	568.261	11.358	2.04
6	Bitter	Beer	542.911	539.848	-3.063	-0.564	556.896	13.985	2.58
7	Bitter	Beer	553.814	551.213	-2.600	-0.470	562.579	8.765	1.58
8	Bitter	Beer	541.621	539.848	-1.773	-0.327	551.213	9.593	1.77
9	Bitter	Beer	248.289	250.035	1.746	0.703	250.035	1.746	0.70
10	Bitter	Beer	254.179	255.718	1.539	0.605	255.718	1.539	0.61
11	Bitter	Beer	287.341	289.813	2.472	0.860	289.813	2.472	0.86
12	Bitter	Beer	269.805	272.765	2.961	1.097	272.765	2.961	1.10
13	Bitter	Beer	300.416	301.178	0.763	0.254	306.861	6.445	2.15
14	Bitter	Beer	280.828	284.131	3.303	1.176	284.131	3.303	1.18
15	Bitter	Beer	299.662	301.178	1.517	0.506	306.861	7.199	2.40
16	Bitter	Beer	304.981	306.861	1.880	0.616	312.544	7.563	2.48
17	Bitter	Beer	759.109	755.787	-3.321	-0.438	772.835	13.727	1.81
18	Bitter	Beer	296.435	295.496	-0.939	-0.317	301.178	4.743	1.60
19	Bitter	Beer	572.260	568.261	-3.999	-0.699	579.626	7.366	1.29
20	Bitter	Beer	268.139	267.083	-1.056	-0.394	272.765	4.627	1.73
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			8553.846	8546.6492	-7.197	-0.084	8700.080	146.233	1.71



Comments: None

Test 17: Delivery **Font 2 - Freeflow,** **I-Draught: s/n 10-18-002-426** **DMS: s/n –None (ID'd as No. 2)**
Keg head pressure: 34 psi (Mixed gas 70/30) not pump assisted (21 second delivery) - pint
Delivery pipe length: Approx 12 m

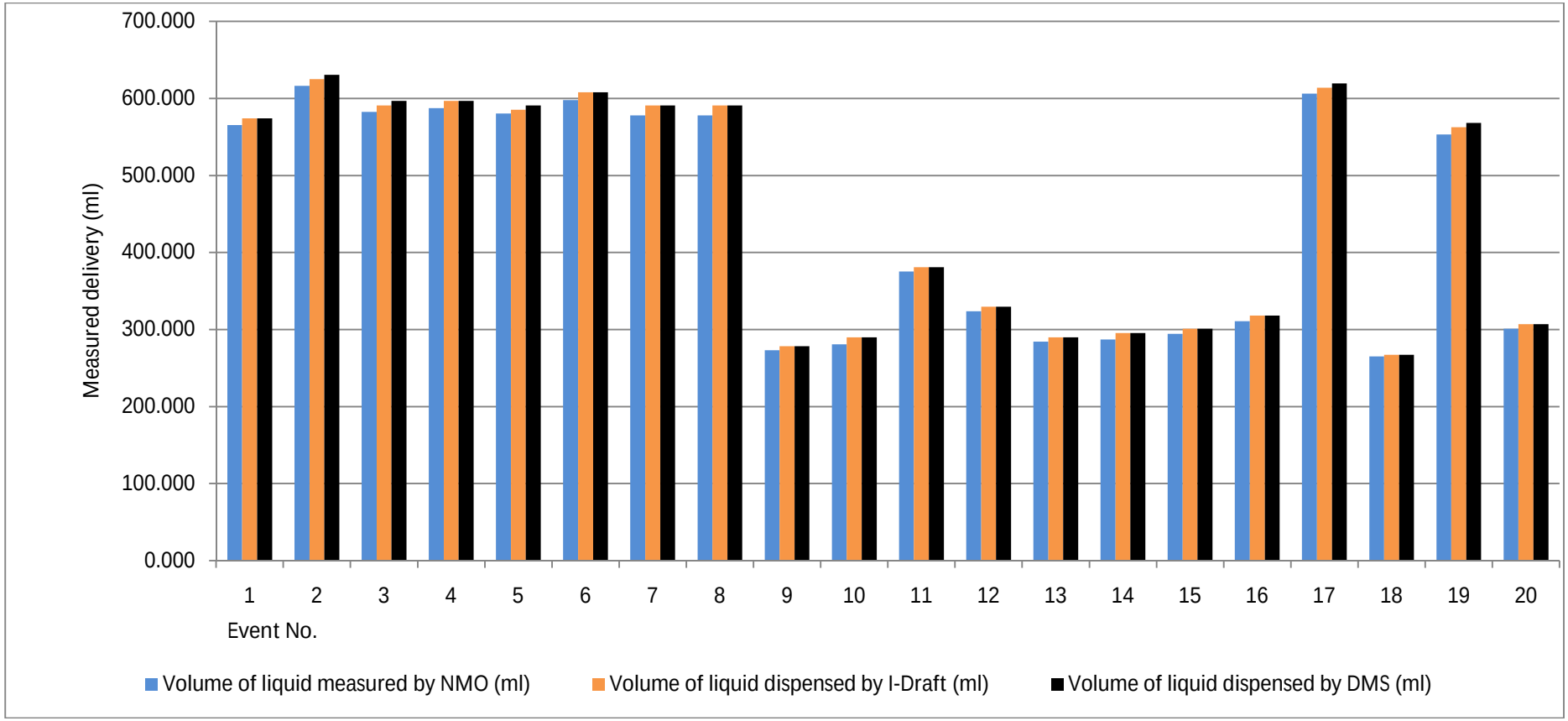
Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Bitter	Beer	596.378	602.357	5.979	1.002	602.357	5.979	1.00
2	Bitter	Beer	607.203	608.040	0.837	0.138	613.722	6.520	1.07
3	Bitter	Beer	570.590	573.944	3.354	0.588	573.944	3.354	0.59
4	Bitter	Beer	593.412	596.674	3.263	0.550	596.674	3.263	0.55
5	Bitter	Beer	563.944	568.261	4.317	0.766	568.261	4.317	0.77
6	Bitter	Beer	584.282	585.309	1.027	0.176	590.992	6.710	1.15
7	Bitter	Beer	610.676	613.722	3.046	0.499	613.722	3.046	0.50
8	Bitter	Beer	593.818	596.674	2.856	0.481	596.674	2.856	0.48
9	Bitter	Beer	275.331	278.448	3.117	1.132	278.448	3.117	1.13
10	Bitter	Beer	287.022	289.813	2.791	0.973	289.813	2.791	0.97
11	Bitter	Beer	275.316	278.448	3.132	1.138	278.448	3.132	1.14
12	Bitter	Beer	266.460	267.083	0.623	0.234	267.083	0.623	0.23
13	Bitter	Beer	251.754	255.718	3.963	1.574	255.718	3.963	1.57
14	Bitter	Beer	274.081	278.448	4.367	1.593	278.448	4.367	1.59
15	Bitter	Beer	292.725	295.496	2.771	0.947	295.496	2.771	0.95
16	Bitter	Beer	279.726	284.131	4.404	1.575	284.131	4.404	1.57
17	Bitter	Beer	586.343	590.992	4.648	0.793	590.992	4.648	0.79
18	Bitter	Beer	273.257	278.448	5.191	1.900	278.448	5.191	1.90
19	Bitter	Beer	581.485	585.309	3.825	0.658	585.309	3.825	0.66
20	Bitter	Beer	287.779	289.813	2.034	0.707	289.813	2.034	0.71
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			8651.582	8717.128	65.546	0.758	8728.493	76.911	0.89



Comments: None

Test 18: Delivery **Font 3 - Freeflow,** **I-Draught: s/n 10-18-004-697** **DMS: s/n –None (ID'd as No. 3)**
Keg head pressure: 34 psi (Mixed gas 70/30) not pump assisted (21 second delivery) - pint
Delivery pipe length: Approx 12 m

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Stout	Beer	565.262	573.944	8.681	1.536	573.944	8.681	1.54
2	Stout	Beer	616.324	625.087	8.763	1.422	630.770	14.446	2.34
3	Stout	Beer	582.563	590.992	8.429	1.447	596.674	14.112	2.42
4	Stout	Beer	587.226	596.674	9.448	1.609	596.674	9.448	1.61
5	Stout	Beer	580.467	585.309	4.842	0.834	590.992	10.524	1.81
6	Stout	Beer	597.753	608.040	10.287	1.721	608.040	10.287	1.72
7	Stout	Beer	577.991	590.992	13.001	2.249	590.992	13.001	2.25
8	Stout	Beer	577.889	590.992	13.102	2.267	590.992	13.102	2.27
9	Stout	Beer	273.060	278.448	5.388	1.973	278.448	5.388	1.97
10	Stout	Beer	280.728	289.813	9.085	3.236	289.813	9.085	3.24
11	Stout	Beer	375.231	380.735	5.504	1.467	380.735	5.504	1.47
12	Stout	Beer	323.748	329.592	5.843	1.805	329.592	5.843	1.80
13	Stout	Beer	284.160	289.813	5.653	1.989	289.813	5.653	1.99
14	Stout	Beer	286.931	295.496	8.565	2.985	295.496	8.565	2.98
15	Stout	Beer	294.251	301.178	6.927	2.354	301.178	6.927	2.35
16	Stout	Beer	310.967	318.226	7.259	2.334	318.226	7.259	2.33
17	Stout	Beer	606.368	613.722	7.354	1.213	619.405	13.037	2.15
18	Stout	Beer	264.974	267.083	2.109	0.796	267.083	2.109	0.80
19	Stout	Beer	553.143	562.579	9.436	1.706	568.261	15.118	2.73
20	Stout	Beer	301.076	306.861	5.785	1.921	306.861	5.785	1.92
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
			8840.113	8995.576	155.463	1.759	9023.989	183.876	2.08



Comments: Each delivery consisted of an initial dispense (approx 80%) and then “topped-up” to 100% (after gas settlement)

Test 19: Cleaning **Font 3 - Freeflow,**
Keg head pressure: n/a
Delivery pipe length: Approx 12 m

I-Draught: s/n 10-18-004-697 **DMS: s/n –None (ID'd as No. 3)**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught flowmeter	Volume of liquid measured by NMO (ml)	Volume of liquid dispensed by I-Draught (ml)	Difference of measured volumes [NMO - I-Draught] (ml)	Error (%)	Volume of liquid dispensed by DMS (ml)	Difference of measured volumes [NMO - DMS (ml)	Error (%)
1	Stout/Water	Beer/Water	806.688	812.614	5.926	0.735	812.614	5.926	0.73
2	Water	Water	798.162	818.296	20.135	2.523	818.296	20.135	2.52
3	Water/Stout	Water/Beer	481.377	488.705	7.328	1.522	488.705	7.328	1.52
4	Stout	Beer	549.787	556.896	7.109	1.293	556.896	7.109	1.29
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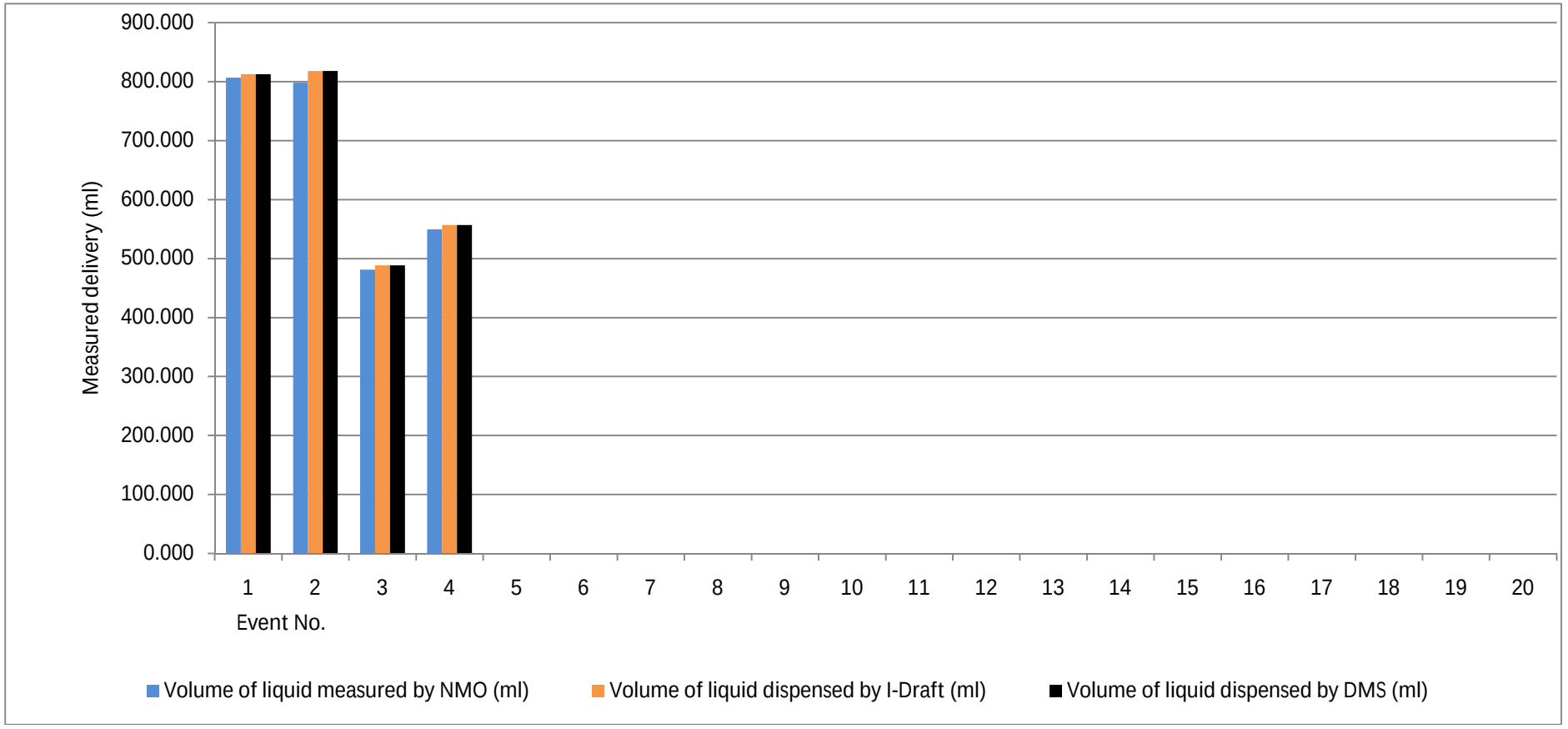
20									
			Total volume (NMO)	Total volume (I-Draught)	Total volume Difference	Total volume % error	Total volume (DMS)	Total volume Difference	Total volume % error
		Results for all tests	2636.013	2676.510	40.497	1.536	2676.510	40.497	1.54
Results for Stout only – I-Draught, and DMS results[1]			549.787	556.896	7.109	1.293	556.896	7.109	1.29[1]



Comments: The table includes the total measured by the DMS for all dispenses compared to only those with Lager (NMO & i-Draught).

[1] As the DMS cannot determine the difference between the liquid types, including a Beer dispense and a Cleaning operation, the system report would require interpretation of the results and the use of other “inputs” e.g. input from meter in cleaning line: notification of cleaning process etc., so that the results can be [manually] modified to account for the cleaning operation.

Test 20:
Electrostatic discharge tests:

This test consists of exposing the devices to direct and indirect electrostatic charges.

For all tests below the type of liquid dispensed was ordinary tap water, as the test was not concerning the accuracy of dispense but the susceptibility of the instrument and subsequent corruption of data. A calibration was performed before testing.

For the following results, types of tests are abbreviated as follows:

VCP	Vertical coupling plane
HCP	Horizontal coupling plane
AIR	ESD gun direct to device
Control	No ESD test
VV	Voltage variation

Test panel I-Draught ser. No. 10 24-006-649 **DMS: s/n –None (ID'd as [EMC] Test Panel]**

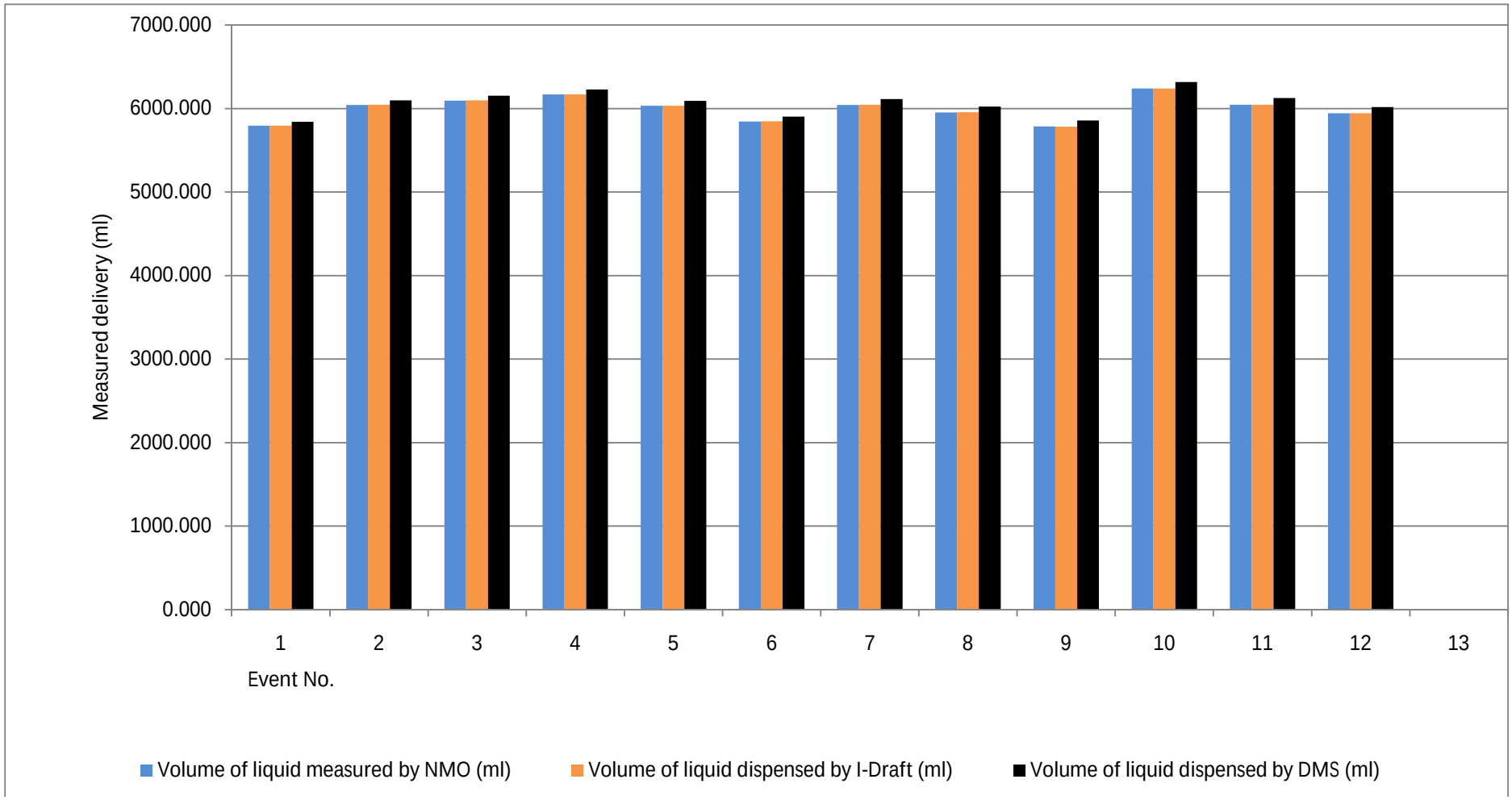
Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Type of ESD test	Details of test Direct contact discharges to instrument	Value & Polarity of charge +/-(kV)	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – [DMS] (%)**
1	Wtr	Wtr	Air	10 discharges	+ 6	5797	5796	-1	-0.017	5842	44	0.767
2	Wtr	Wtr	Air	10 discharges	+ 6	6044	6046	2	0.041	6097	54	0.887
3	Wtr	Wtr	Air	10 discharges	+ 6	6097	6097	1	0.009	6154	57	0.941
4	Wtr	Wtr	Air	10 discharges	- 6	6169	6171	2	0.037	6228	59	0.958
5	Wtr	Wtr	Air	10 discharges	- 6	6033	6035	2	0.036	6092	59	0.977
6	Wtr	Wtr	Air	10 discharges	- 6	5844	5847	3	0.051	5904	60	1.023

Comments: Events 1 & 4 applied to screws on lower LHS of communications panel
Events 2 & 5 applied to screws on centre LHS of communications panel
Events 3 & 6 applied to screws on centre RHS of communications panel

Test 21:

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Type of ESD test	Details of test Indirect contact discharges to instrument via Vertical Coup[ling Plane (VCP)	Value & Polarity of charge +/-(kV)	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – [DMS] (%)**
1	Wtr	Wtr	Air	10 discharges onto VCP	+ 6	6043	6046	4	0.062	6114	72	1.191
2	Wtr	Wtr	Air		+ 6	5953	5955	2	0.034	6024	70	1.179
3	Wtr	Wtr	Air		+ 6	5785	5785	0	-0.001	5859	74	1.276
4	Wtr	Wtr	Air		- 6	6241	6240	-1	-0.022	6319	78	1.253
5	Wtr	Wtr	Air		- 6	6047	6046	0	-0.004	6126	79	1.312
6	Wtr	Wtr	Air		- 6	5943	5944	1	0.013	6018	75	1.256

Comments: Events 1 & 4 applied adjacent to communications panel
Events 2 & 5 applied adjacent to I-Draught flowmeter
Events 3 & 6 applied adjacent to DMS flowmeter



Comments **1 -6** are **Direct contact discharges** Events 1-6
7 -12 are **Indirect contact discharges** Events 1-6

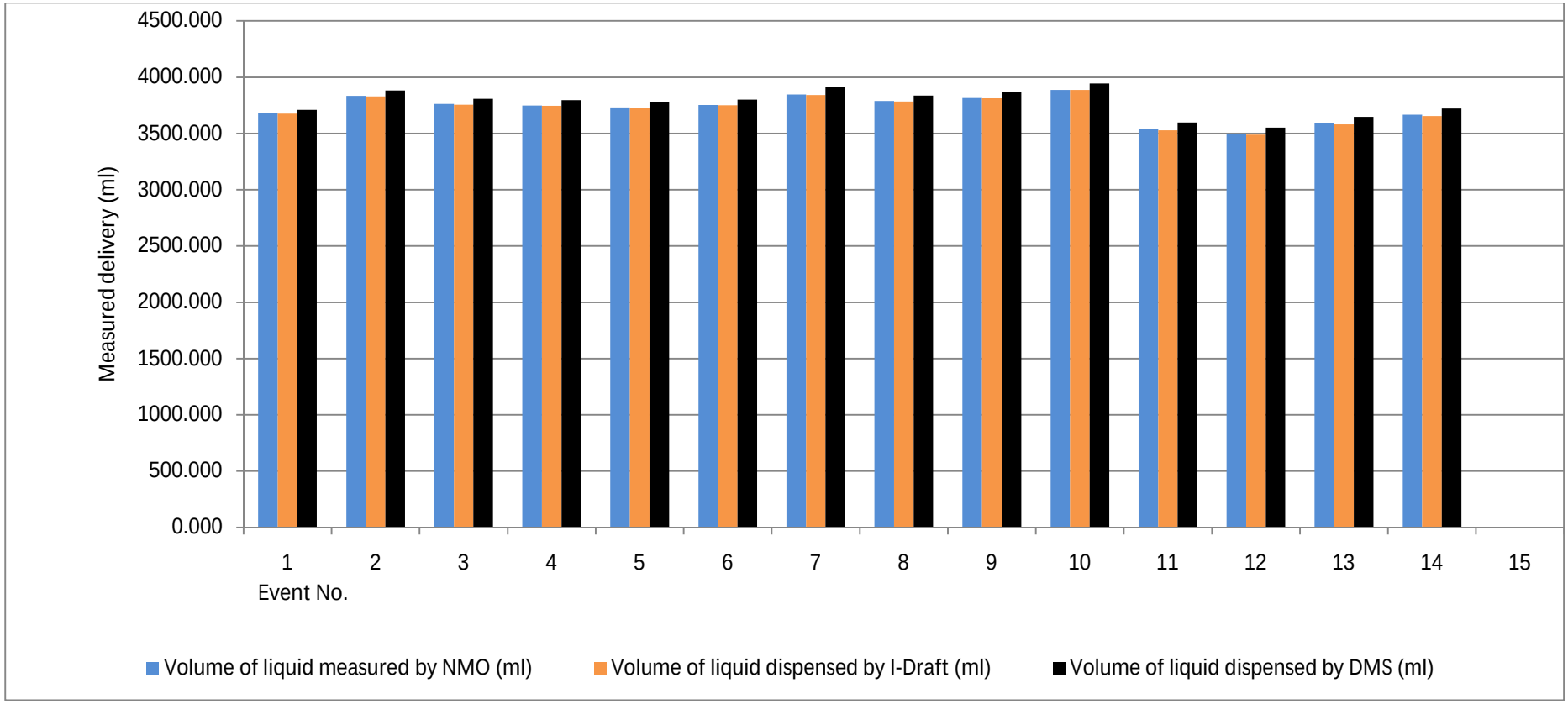
Test 22:

Fast transients/burst test

Test panel I-Draught ser. No. 10 24-006-649 **DMS: s/n –None**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Details of test	Value & of charge +/-(kV)	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – DMS] (%)**
1	Wtr	Wtr	Common mode Applied to mains cable	+1.0	3681	3677	-4	-0.121	3711	30	0.806
2	Wtr	Wtr		-1.0	3833	3830	-3	-0.085	3881	48	1.249
3	Wtr	Wtr	I-D meter cable, Jct box-Ctrl panel box, at jct box end	+0.5	3761	3756	-5	-0.133	3807	46	1.226
4	Wtr	Wtr		-0.5	3747	3745	-2	-0.063	3796	49	1.302
5	Wtr	Wtr	I-D meter cable, Jct box-Ctrl panel box, at panel box end	+0.5	3731	3728	-3	-0.091	3779	48	1.280
6	Wtr	Wtr		-0.5	3752	3751	-2	-0.045	3802	49	1.318
7	Wtr	Wtr	I-D meter comms cable, at meter end	+0.5	3845	3841	-4	-0.102	3915	70	1.819
8	Wtr	Wtr		-0.5	3789	3785	-5	-0.123	3836	46	1.227
9	Wtr	Wtr	DMS meter comms cable, at Jct box end	+0.5	3815	3813	-2	-0.060	3870	55	1.430
10	Wtr	Wtr		-0.5	3886	3887	0	0.012	3944	57	1.474
11	Wtr	Wtr	DMS meter comms cable, at panel box end	+0.5	3542	3529	-13	-0.357	3597	56	1.568
12	Wtr	Wtr		-0.5	3499	3489	-10	-0.296	3552	52	1.490
13	Wtr	Wtr	DMS meter comms cable at meter end	+0.5	3592	3580	-12	-0.323	3648	57	1.576
14	Wtr	Wtr		-0.5	3667	3654	-13	-0.350	3722	55	1.510

Comments: This test involved exposing the Communications panel to specified bursts of voltage spikes, through the mains plug.



Comments: None

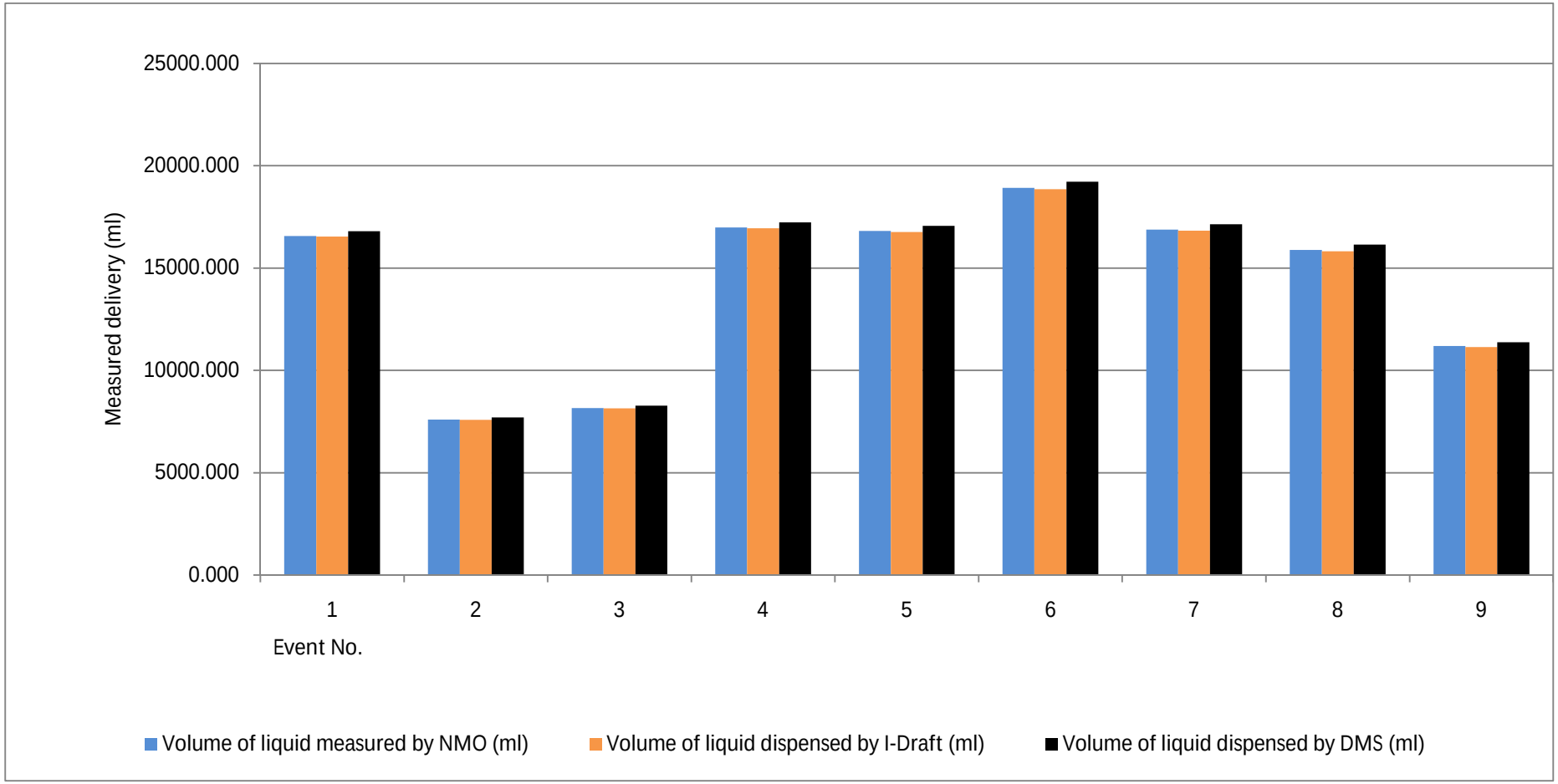
Test 23:

Immunity to radiated electromagnetic fields tests.

Test panel I-Draught ser. No. 10 24-006-649 **DMS: s/n –None**

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Details of test (MHz frequencies) in Horizontal Orientation of antenna	Power output V/m	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – DMS] (%)**
1	Wtr	Wtr	26 – 53.225	3	16571.200	16536.402	-34.797	-0.210	16797.803	226.603	1.37
2	Wtr	Wtr	53.225 – 80	3	7594.632	7580.605	-14.027	-0.185	7699.940	105.307	1.39
3	Wtr	Wtr	80 -99.577	3	8156.419	8143.184	-13.235	-0.162	8273.884	117.465	1.44
4	Wtr	Wtr	99.577 – 149.740	3	16988.784	16939.868	-48.916	-0.288	17235.364	246.579	1.45
5	Wtr	Wtr	149.740 – 218.549	3	16817.545	16763.707	-53.838	-0.320	17064.885	247.341	1.47
6	Wtr	Wtr	218.549 – 370.324	3	18912.477	18854.908	-57.569	-0.304	19212.913	300.435	1.59
7	Wtr	Wtr	370.324 – 562.444	3	16874.624	16831.898	-42.726	-0.253	17144.442	269.817	1.60
8	Wtr	Wtr	562.444 – 812.77	3	15889.245	15826.076	-63.169	-0.398	16149.985	260.740	1.64
9	Wtr	Wtr	812.775 – 1000	3	11191.668	11143.603	-48.065	-0.429	11376.590	184.922	1.65

Comments: This test involved exposing the devices to electromagnetic fields.
Modulation was 80% @ 1 kHz stepped 1%

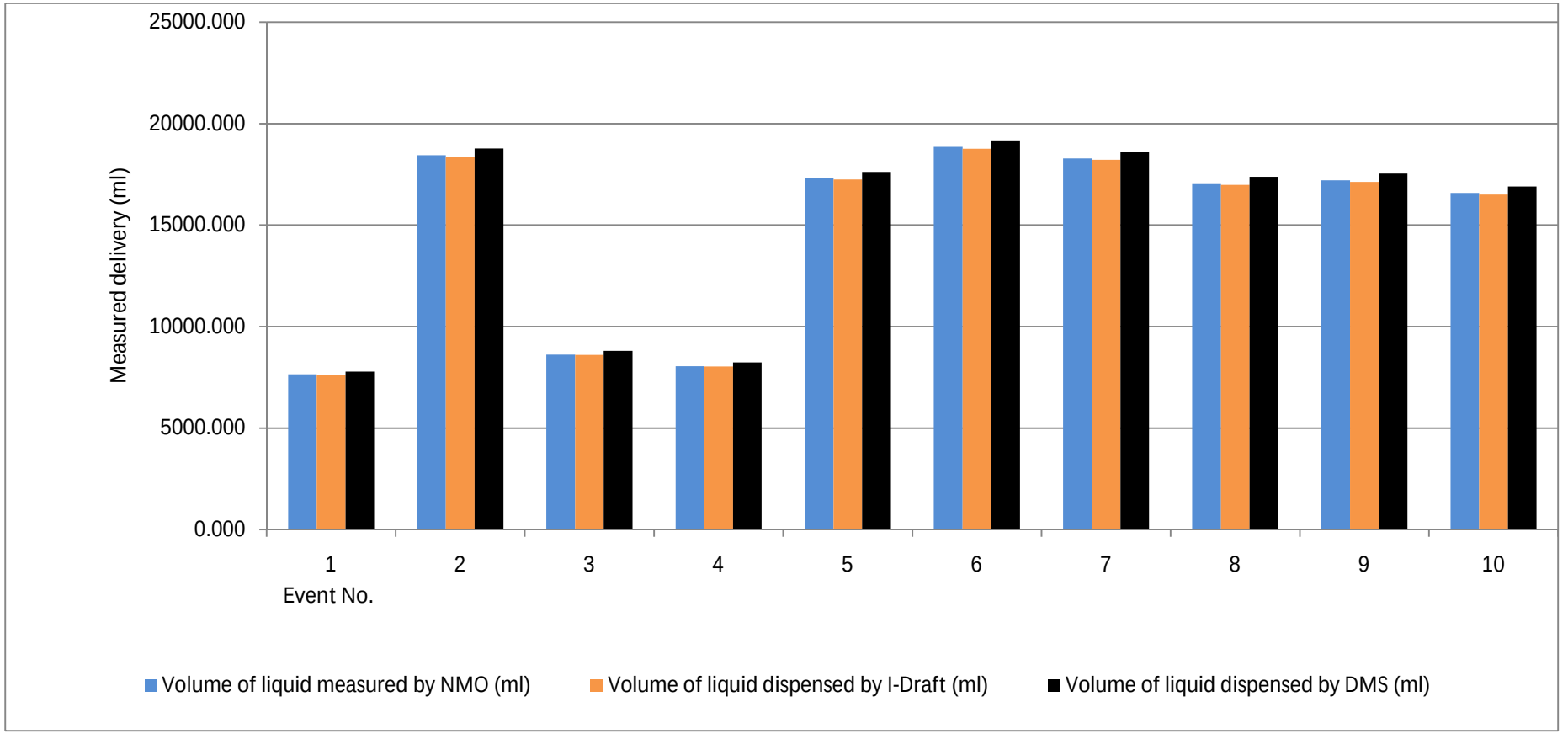


Comments: None

Test 24:

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Details of test (MHz frequencies) in Vertical Orientation of antenna	Power output V/m	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – DMS] (%)**
1	Wtr	Wtr	26 – 30.487	3	7655.718	7626.066	-29.652	-0.387	7785.179	129.461	1.69
2	Wtr	Wtr	30.487 – 61.180	3	18447.827	18383.251	-64.576	-0.350	18775.352	327.525	1.78
3	Wtr	Wtr	61.180 - 80	3	8619.067	8609.158	-9.909	-0.115	8808.049	188.983	2.19
4	Wtr	Wtr	80 – 94.744	3	8048.268	8040.897	-7.371	-0.092	8234.106	185.838	2.31
5	Wtr	Wtr	90.744 – 152.749	3	17331.264	17246.729	-84.535	-0.488	17621.781	290.518	1.68
6	Wtr	Wtr	152.749 – 214.243	3	18851.783	18758.304	-93.479	-0.496	19173.135	321.352	1.70
7	Wtr	Wtr	214.243 – 309.597	3	18284.978	18224.138	-60.839	-0.333	18621.921	336.944	1.84
8	Wtr	Wtr	309.957 – 484.461	3	17060.238	16979.646	-80.591	-0.472	17383.112	322.874	1.89
9	Wtr	Wtr	484.961 – 686.289	3	17210.451	17127.394	-83.057	-0.483	17542.225	331.774	1.93
10	Wtr	Wtr	686.289 – 1000	3	16579.555	16502.307	-77.248	-0.466	16905.772	326.218	1.97

Comments: This test involved exposing the devices to electromagnetic fields.
Modulation was 80% @ 1 kHz stepped 1%



Comments: None

Test 25:

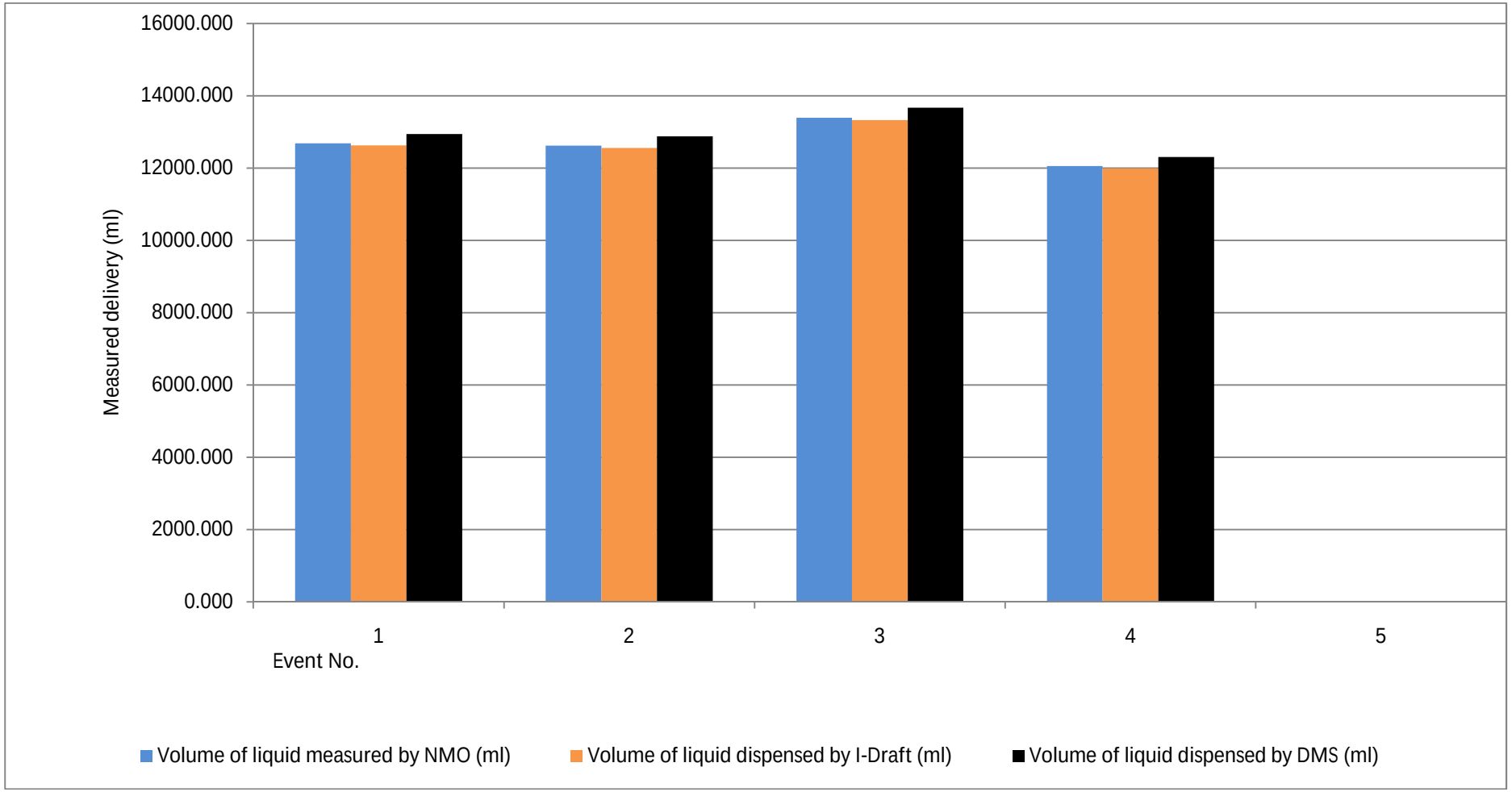
Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Details of test (MHz frequencies) in Horizontal Orientation of antenna	Power output V/m	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – DMS] (%)**
1	Wtr	Wtr	1000 - 2000	3	12688.712	12626.765	-61.947	-0.488	12944.991	256.279	2.02

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Details of test (MHz frequencies) in Vertical Orientation of antenna	Power output V/m	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – DMS] (%)**
2	Wtr	Wtr	1000 - 2000	3	12622.620	12558.574	-64.046	-0.507	12882.483	259.863	2.06

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Details of test (MHz frequencies) in Horizontal Orientation of antenna	Power output V/m	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – DMS] (%)**
3	Wtr	Wtr	1000 - 2000	3	13393.696	13325.726	-67.970	-0.507	13672.366	278.670	2.08

Event Number	Type of liquid used by NMO	Type of liquid identified by I-Draught	Details of test (MHz frequencies) in Vertical Orientation of antenna	Power output V/m	Volume of liquid measured by NMO (ml)	Volume of liquid measured by I-Draught (ml)	Difference of measured volume (ml)	**Error [NMO – I-Draught] (%)**	Volume of liquid measured by DMS (ml)	Difference of measured volume (ml)	**Error [NMO – DMS] (%)**
4	Wtr	Wtr	1000 - 2000	3	12055.828	11995.995	-59.833	-0.496	12308.539	252.710	2.10

Comments: **Tests 1 & 2** conducted with Communication panel & Junction box in the RFI field
Tests 3 & 4 conducted with I-Draught and DMS flowmeters in the RFI field



Comments: None