

Evaluation of the Dräger DrugTest® 5000 Test System

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Summary

The Dräger DrugTest 5000 system is an immunochemical *in vitro* diagnostic medical device for the qualitative detection of drugs, including amphetamines, benzodiazepines, cannabinoides, cocaine metabolites, metamphetamines and opiates in saliva. The system consists of a test kit for sample collection and an electronic Analyzer. This Analyzer provides measurements based on an optical evaluation of the immunochemical test strips contained in the test kit and the assays are based on the principle of competitive inhibition; which means that drugs present in the saliva compete with drugs on the test diaphragm for binding with micro-particles covered with antibodies. The immunoassays are designed for the cut-off concentrations in oral fluid samples below (Table 1).

The saliva sample of approximately 0.4 ml is collected with the oral fluid collector, which has a coloured indicator to show correct sample volume collection. If necessary, two sample collecting kits can be combined to carry out a simultaneous double sample collection for laboratory validation if required. The oral fluid is collected by direct absorption into the porous collector, which forms an integral part of the test cassette. After sampling is completed, the analysis is started by placing both the test cassette and a buffer cartridge into the analyzer. The specimen is then transferred into the test cassette, which starts the test process. There is a digital readout after about five minutes.

Table 1. Concentration limits (cut-off)

Drug		Calibrator	ng/ml
COC	Cocaine	Cocaine	20
OPI	Opiates	Morphine	20
BENZO	Benzodiazepine	Diazepam	15
THC	Delta-9-tetrahydrocannabinol	Delta-9-THC	25
AMP	Amphetamine	D-Amphetamine	50
MAMP	Methamphetamines	D-Methamphetamine	35

During the sample processing the antibodies on the reagent diaphragm bind with the antigens on the micropraticles and thereby generate a control signal, which is used by the instrument to refute the test procedure.

A positive result merely indicates that the drug concentration is above the preset limit value. A negative result can indicate that either the sample is free from drugs or that the concentration of a drug is below the limit value. Due to the properties of immuno-assays cross-reactive substances or non-specific interactions can interfere with the test and cause incorrect results. This is detailed in Appendix 1.

This system is regarded as a screening procedure and it is recommended that confirmatory analysis should be carried out on a random sample, including negative samples, using techniques such as GCMS or LCMS.

A study (1*) was carried out to evaluate the Dräger system, with samples taken from patients in a number of drug treatment centers. These were analysed at the point-of-care (POC) and compared with parallel samples later analysis in the laboratory. One sample was collected using the system described above and a second sample was collected using the DCD5000. This collector is the same, but does not have the immunoassay component. At the laboratory, samples were analysed by means of GC/MS using deuterated drug-analogues as internal standards. Verification of benzodiazepines* results were obtained using a commercially-available Benzo-ELISA-kit (target compound: Oxazepam).

The POC assay sensitivity, specificity and accuracy were defined by analysing and evaluating oral fluid specimens collected from up to 503 individual patients. The results (Table 2) show that a high percentage of samples contained benzodiazepines (30%), cannabinoides (20%) and opiates (13%), but no samples contained the amphetamine group of drugs. The system performed reasonably well, with sensitivity (true positives) varying from 90% to 74% for Benzos and 76% for cannabinoides. This was explained because Benzos have a wide range of structures, but the cannabinoides value was somewhat disappointing. Specificity (true negatives) were all excellent, above 98%. Accuracy (analytical precision) was also good ranging from 93% to 99% (see Appendix 2).

Table 2. Results from parallel analysis involving the Dräger system and laboratory analysis.

Number screened	POCT - IA	Prevalence [%]	Cut-off [ng/mL]	Sensitivity [%]	Specificity ¹ [%]	Accuracy ² [%]
503	COC	4.5	20	86	99	98
441	OPI	13	40	90	98	97
341	Δ9THC	20	25	76	99	93
155	AMP	0	50	n/a	99	99
155	METAMP	0	25	n/a	99	99
194	*BENZO	30	15	74	98	97

1 Specificity is explained and detailed in Appendix 1.

2 Accuracy is explained and detailed in Appendix 2.

*The low sensitivity of the BENZO result is due to the wide range of compounds encountered in this group and AMP and METAMP were not encountered in this group of subjects.

References

1. Manns A, Björn L, Kaneblei1 I, et al Analytical Evaluation of a New Oral Fluid Sample Drugs of Abuse Diagnostic System. Proc T2007 (International Council on Alcohol, Drugs, and Traffic Safety, The International Association of Forensic Analysts) 2007. (* carried out by employees of Dräger. Therefore not impartial).

APPENDIX 1

Specificity: Substances which are structurally similar to drugs detectable with the unit were examined in Dräger 5000 analyses for cross reactivity. The amounts specified in the table are limit concentrations for the respective substance with a positive test result being generated once they are exceeded.

Cocaine related compounds	[ng/ml]
Benzoylecgonine	200
Cocaethylene	500
Ecgonine methyl ester	≤10000

Opiates related compounds	
6-Monoacetylmorphine	20
Codeine	10
Dihydrocodeine	10
Morphine-3β-D-glucuronide	35
Hydromorphone	20
Hydrocodone	10
Oxycodone	2500

Benzodiazepine related compounds	
7-Aminoflunitrazepam	250
Alprazolam	15
Bromazepam	150
Chlordiazepoxide	25000
Clonazepam	90
Desalkylflurazepam	45
Flunitrazepam	20
Flurazepam	30000
Lorazepam	200
Midazolam	100
Nordia	30
Nitrazepam	45
Oxazepam	50
Prazepam	100000
Temazepam	15

THC related compounds	
11-Nor-9-Carboxy-d9-THC	7.5
Cannabinol	75
Cannabidiol	35000

Amphetamine related compounds	
MDA	100
MDEA	>10000
MDMA	>10000
MBDB	>10000
Phentermine	500
S(+)-Methamphetamine	30000
Tyramine	5000

Methamphetamine related compounds	
MDEA	1000
MDA	>10000
MDMA	75
MBDB	35
S(+)-Amphetamine	30000
Procain	5000
Pseudoephedrine	100000

APPENDIX 2

Accuracy: A total of 100 oral fluid samples were analysed for the six substances to be detected with the Dräger 5000. A second sample was taken at the same time and analysed by GC/MS. The clinical performance of the system has been summarised below.

Cocaine

Cocaine-Equivalents

Dräger system	GC/MS [ng/ml]		
	<8 ng	8 – 20 ng	> 20 ng
positive	0	1	20
negative	95	5	2

Overall agreement between Dräger DrugTest® 5000 and GC/MS: **98 %** (Cut-off GC-MS: 20 ng/ml)

Opiates

Morphin-Equivalents

Dräger system	GC/MS [ng/ml]		
	<8 ng	8 – 20 ng	> 20 ng
positive	0	7	27
negative	86	5	1

Overall agreement between Dräger DrugTest® 5000 and GC/MS: **94 %** (Cut-off GC-MS: 10 ng/ml)

Benzodiazepine

Diazepam-Equivalents

Dräger system	GC/MS [ng/ml]		
	<4 ng	4 – 15 ng	> 15 ng
positive	0	3	17
negative	84	3	2

Overall agreement between Dräger DrugTest® 5000 and LC-MS/MS: **97 %** (Cut-off LC-MS/MS: 7.5 ng/ml)

Tetrahydrocannabinol

Delta-9-Tetrahydrocannabinol

Dräger system	GC/MS [ng/ml]		
	<10 ng	10 – 25 ng	> 25 ng
positive	0	0	19
negative	88	4	12

Overall agreement between Dräger DrugTest® 5000 and GC/MS: **90 %** (Cut-off GC-MS: 25 ng/ml)

Amphetamine

Amphetamine-Equivalents

Dräger system	GC/MS [ng/ml]		
	<20 ng	20 – 50 ng	> 50 ng
positive	1	1	19
negative	94	4	0

Overall agreement between Dräger DrugTest® 5000 and GC/MS: **98 %** (Cut-off GC-MS: 50 ng/ml)

Methamphetamine

Methamphetamine-Equivalents

Dräger system	GC/MS [ng/ml]		
	<14 ng	10 – 35 ng	> 35 ng
Positive	0	8	23
negative	89	3	0

Overall agreement between Dräger DrugTest® 5000 and GC/MS: **93 %** (Cut-off GC-MS: 35 ng/ml)