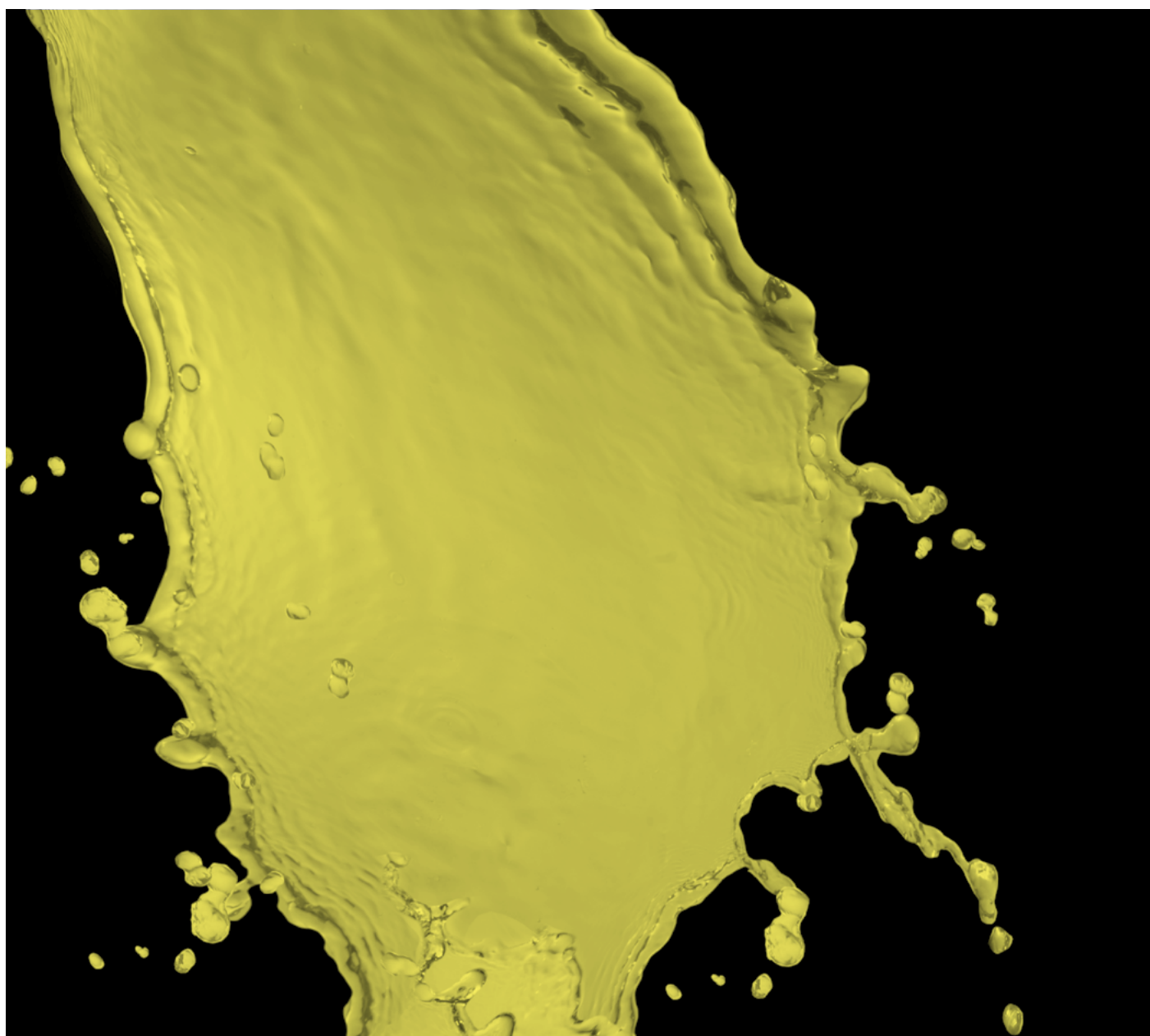




Degradation reference materials 2017

S-oxides



Welcome to LGCs degradation reference standards with focus on S-oxides.

Active pharmaceutical ingredients (APIs) containing sulfur as a thioether are prone to degrade to S-Oxides readily and quickly under oxidative stress.

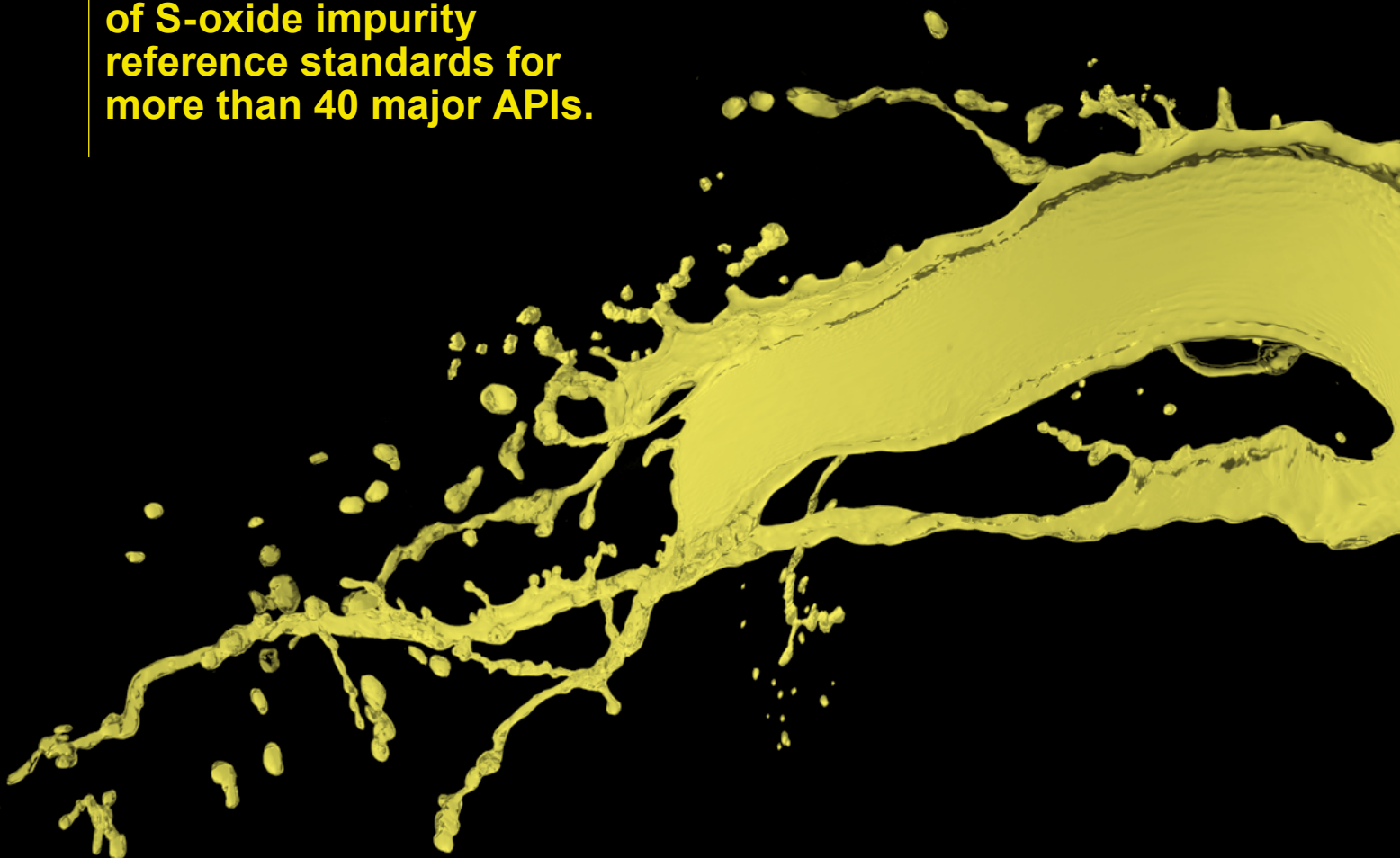
LGC's impurity reference standards are designed to be used at all relevant stages of the testing chain. The use of our S-Oxide impurities facilitate an assessment of the oxidative stress a particular product has been subjected to, the purity of the originating API, and help determine the shelf life of the product.

Each impurity is accompanied by a detailed certificate of analysis, providing all the information you need to best use the reference material. Our products can be used with confidence during analytical research and development and validation studies as well as for stability monitoring and routine quality control purposes.

Visit our webshop [lgcstandards.com](https://www.lgcstandards.com)

To find out more contact your local **LGC office**.

LGC provides a range of S-oxide impurity reference standards for more than 40 major APIs.

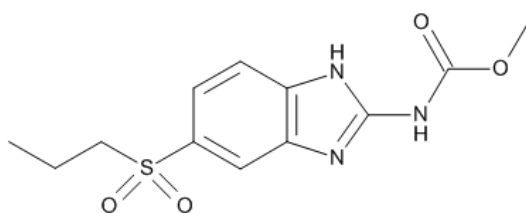




Certificate of Analysis

Reference Standard

Methyl [5-Propylsulphonyl]-1H-benzimidazol-2-yl]carbamate



Molecular Formula: $C_{12}H_{15}N_3O_4S$
Molecular Weight: 297.33
CAS Number: 75184-71-3

Catalogue Number: MM0382.03
Lot Number: 144676
Long-term Storage: 2 to 8 °C, dark
Appearance: off-white solid
Melting Point: 272 °C
Assay 'as is': 98.7 %

Date of shipment: **2017-July-19**

This certificate is valid for two years from the date of shipment provided the substance is stored under the recommended conditions unopened in the original container.

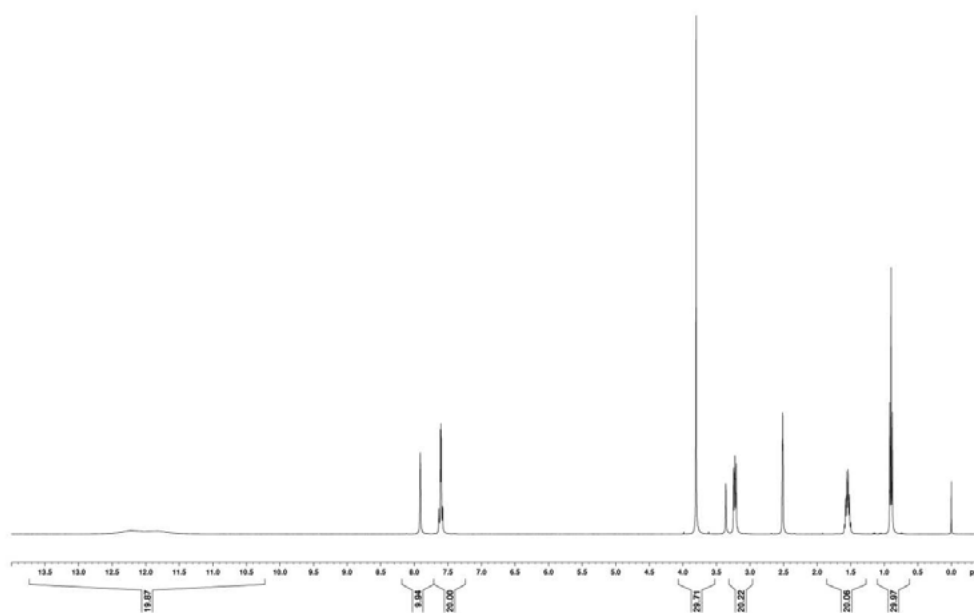


I. Identity

The identity of the reference substance was established by following analyses.

Ia. ^1H -NMR Spectrum

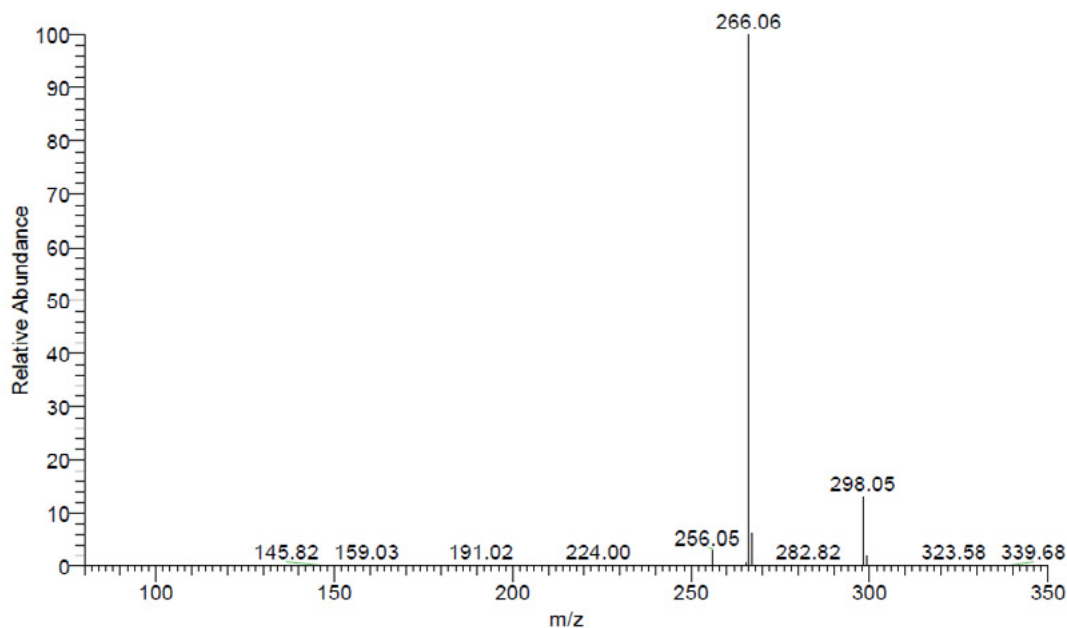
Conditions: 400 MHz, DMSO- d_6



The structure is confirmed by the signals of the spectrum and their interpretation.

**Ib. Mass Spectrum**

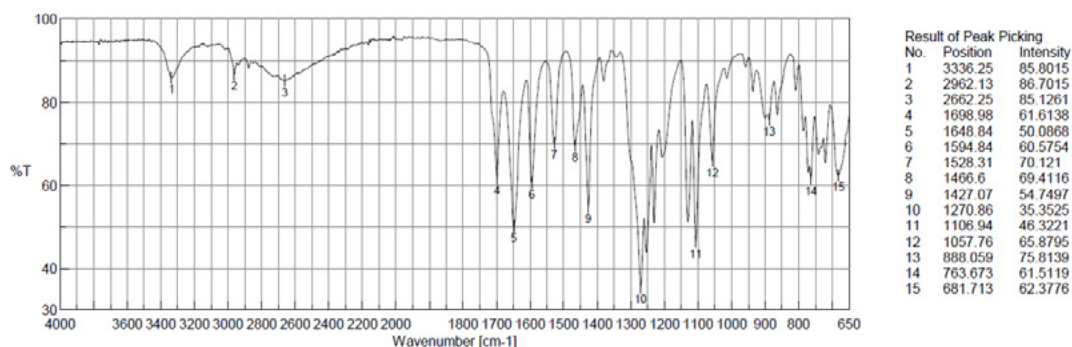
Method: 4.5 kV ESI+; vaporization temperature: 200 °C



The signals of the mass spectrum and their interpretation are consistent with the structural formula.

Ic. IR Spectrum

Method: Attenuated Total Reflection Fourier Transform Infrared (ATR-FTIR) Spectroscopy



The signals of the IR spectrum and their interpretation are consistent with the structural formula.



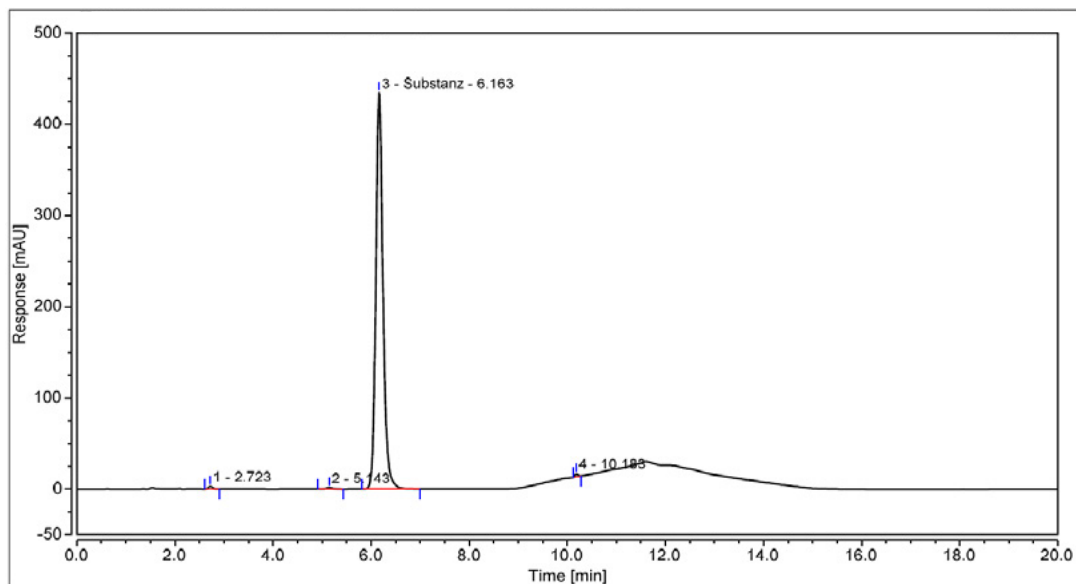
II. Purity

IIa. High Performance Liquid Chromatography (HPLC)

The purity of the reference substance was analysed by high performance liquid chromatography (HPLC).

HPLC Conditions:

Column:	Conditions:	Detector:	Injector:
Hypersil Gold C18	1.0 ml/min, 40 °C	DAD	Auto
5 µm, 150 x 4.6 mm	0-6 min Water/Acetonitrile 82/18	220 nm	1 µl; 0.0926 mg/ml in
	6-9 min Water/Acetonitrile to 30/70		Water/Acetonitrile 50/50 (v/v)
	9-12 min Water/Acetonitrile to 82/18		
	12-20 min Water/Acetonitrile 82/18 (v/v);		
	0.1 % H ₃ PO ₄		





Area Percent Report - Sorted by Signal

Pk #	Retention Time	Area	Area %
1	2.723	0.303	0.41
2	5.143	0.248	0.33
3	6.163	73.794	98.94
4	10.183	0.240	0.32
Totals		74.585	100.00

For the calculation the system peaks were ignored. The content of the analyte was determined as ratio of the peak area of the analyte and the cumulative areas of the purities, added up to 100 %.

Results:

Average	98.94 %
Number of results	n=3
Standard deviation	< 0.01 %

IIb. Water Content

Method: Karl Fischer titration

Results:

Average	0.24 %
Number of results	n=3
Standard deviation	0.02 %

IIc. Residual Solvents

Method: $^1\text{H-NMR}$

No significant amounts of residual solvents were detected (< 0.05 %).



III. Final Result

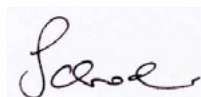
Chromatographic purity (HPLC)	98.94 %
Water content	0.24 %
Residual solvents	No significant amounts of residual solvents were detected (< 0.05 %).
Assay (100 % method)¹	98.70 %

The assay is assessed to be 98.7 % 'as is'

The assay 'as is' is equivalent to the assay based on the not anhydrous and not dried substance respectively.

Release Date:

Luckenwalde, 2017-07-10



Dr. Sabine Schröder
Product Release

¹ The calculation of the 100 % method follows the formula:

$$\text{Assay (\%)} = (100 \% - \text{volatile contents}) * \frac{\text{Purity (\%)}}{100 \%}$$

Volatile contents are considered as absolute contributions, purity is considered as relative contribution.

Table of products

S-oxides

A.

Albendazole

B.

Butoconazole Nitrate

C.

Carbocisteine — Clindamycin Phosphate

D.

Diethazine Hydrochloride —
Dosulepin Hydrochloride

E.

Emtricitabine —
Esomeprazole Magnesium Trihydrate

F.

Famotidine — Fluphenazine Dihydrochloride

L.

Lansoprazole — Levomepromazine Maleate

M.

Mequitazine — Methionine

O.

Omeprazole — Oxfendazole

P.

Pantoprazole Sodium Sesquihydrate —
Protionamide

R.

Ranitidine Hydrochloride

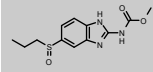
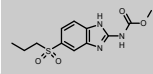
S.

Sulforidazine

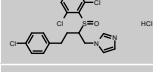
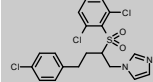
T.

Thioridazine Hydrochloride —
Trimeprazine Tartrate

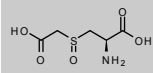
Albendazole

MM0382.02	Imp. B (EP): Methyl [5-Propylsulphinyl]-1H-benzimidazol-2-yl]carbamate	54029-12-8	100mg	
MM0382.03	Imp. C (EP): Methyl [5-Propylsulphonyl]-1H-benzimidazol-2-yl]carbamate	75184-71-3	100mg	

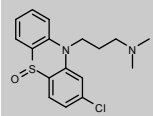
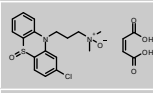
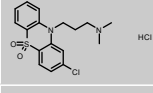
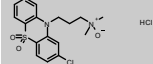
Butoconazole Nitrate

MM1637.03	Butoconazole Sulfoxide Hydrochloride	n/a	100mg	
MM1637.02	Butoconazole Sulfone	n/a	100mg	

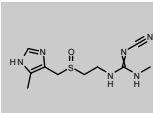
Carbocisteine

MM0236.01	(S)-Carboxymethyl-L-cysteine (R/S)-Sulphoxide	5439-87-2	100mg	
---------------------------	--	-----------	-------	---

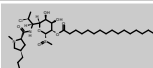
Chlorpromazine Hydrochloride

MM0420.01	Imp. A (EP): 3-(2-Chloro-10H-phenothiazin-10-yl)-N,N-dimethylpropan-1-amine S-Oxide (Chlorpromazine Sulfoxide)	969-99-3	100mg	
MM0420.02	Chlorpromazine Sulphoxide N-Oxide Maleate	150111-59-4	10mg	
MM0420.12	Chlorpromazine Sulfone Hydrochloride	18683-73-3	50mg	
MM0420.11	Chlorpromazine Sulfone N-Oxide Hydrochloride (Chlorpromazine N,S,S-Trioxide Hydrochloride)	109724-46-1	100mg	

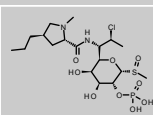
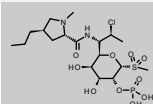
Cimetidine Hydrochloride

MM0020.04	Imp. E (EP): 2-Cyano-1-methyl-3-[2-[(5-methyl-1H-imidazol-4-yl)methyl]sulphonyl]ethyl]guanidine (Cimetidine Sulphoxide)	54237-72-8	100mg	
---------------------------	--	------------	-------	---

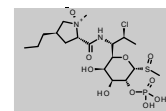
Clindamycin Palmitate Hydrochloride

MM1989.02	Clindamycin Palmitate Sulfoxide	1123211-65-3	50mg	
---------------------------	---------------------------------	--------------	------	---

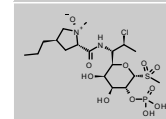
Clindamycin Phosphate

MM1520.02	Clindamycin Phosphate Sulfoxide	1228573-90-7	100mg	
MM1520.03	Clindamycin Phosphate Sulfone	n/a	100mg	

[MM1520.04](#) Clindamycin Phosphate Sulfoxide trans-N-Oxide n/a 100mg

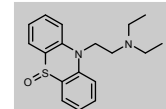


[MM1520.05](#) Clindamycin Phosphate Sulfone trans-N-Oxide n/a 100mg

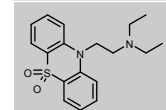


Diethazine Hydrochloride

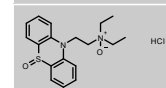
[MM1593.03](#) Diethazine Sulfoxide 10078-16-7 100mg



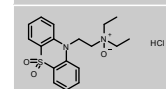
[MM1593.04](#) Diethazine Sulfone 13401-03-1 100mg



[MM1593.09](#) Diethazine Sulfoxide N-Oxide Hydrochloride (Diethazine N,S-Dioxide Hydrochloride) n/a 100mg

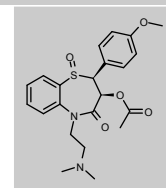


[MM1593.10](#) Diethazine Sulfone N-Oxide Hydrochloride (Diethazine N,S,S-Trioxide Hydrochloride) n/a 100mg



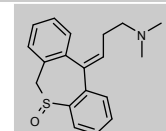
Diltiazem Hydrochloride

[MM0068.07](#) Diltiazem Sulphoxide 370094-12-5 100mg

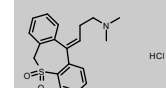


Dosulepin Hydrochloride

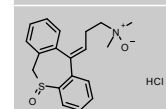
[MM0510.01](#) **Imp. A** (EP): (E)-3-(5-Oxo-5λ⁴-dibenzo[b,e]thiepin-11(6H)-ylidene)-N,N-dimethylpropan-1-amine (Dosulepin Sulfoxide) 42046-35-5 100mg



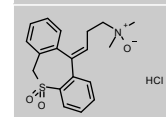
[MM0510.15](#) **Imp. D** (EP) as Hydrochloride: (E)-3-(5,5-Dioxo-5λ⁶-dibenzo[b,e]thiepin-11(6H)-ylidene)-N,N-dimethylpropan-1-amine Hydrochloride (Dosulepin Sulfone Hydrochloride) 25659-71-6 100mg



[MM0510.13](#) Dosulepin Sulfoxide N-Oxide Hydrochloride (Dosulepin N,S-Dioxide Hydrochloride) n/a 100mg

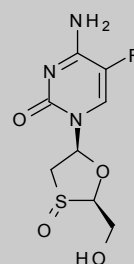


[MM0510.14](#) Dosulepin Sulfone N-Oxide Hydrochloride (Dosulepin N,S,S-Trioxide Hydrochloride) n/a 100mg

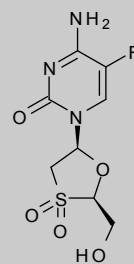


Emtricitabine

[MM1325.02](#) Emtricitabine Sulfoxide 152128-77-3 100mg

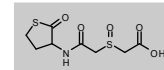


[MM1325.03](#) Emtricitabine Sulfone 1161846-23-6 100mg



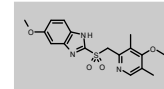
Erdosteine

[MM0544.08](#) Erdosteine Sulfoxide n/a 100mg



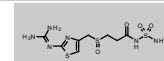
Esomeprazole Magnesium Trihydrate

[MM0095.05](#) **Imp. D** (EP): 5-Methoxy-2-[[[(4-methoxy-3,5-dimethylpyridin-2-yl)methyl]sulphonyl]-1H-benzimidazole (Omeprazole Sulphone) 88546-55-8 100mg

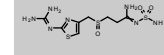


Famotidine

[MM0029.10](#) **Imp. I** (EP): 3-[[[2-[(Diaminomethylene)amino]thiazol-4-yl]methyl]sulfinyl]-N-sulfamoylpropanamide 1020719-36-1 50mg

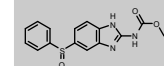


[MM0029.04](#) Famotidine Sulfoxide 90237-03-9 100mg

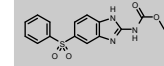


Fenbendazole

[MM0518.01](#) Fenbendazole Sulphoxide (Oxfendazole) 53716-50-0 100mg

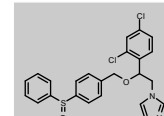


[MM0518.02](#) Fenbendazole Sulphone 54029-20-8 100mg

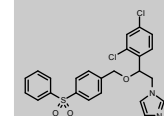


Fenticonazole Nitrate

[MM1216.02](#) **Imp. B** (EP): 1-[(2RS)-2-(2,4-Dichlorophenyl)-2-[[4-(benzenesulfinyl)benzyl]oxy]ethyl]-1H-imidazole (Fenticonazole Sulfoxide) 80639-94-7 100mg



[MM1216.03](#) **Imp. C** (EP): 1-[(2RS)-2-(2,4-Dichlorophenyl)-2-[[4-(benzenesulfonyl)benzyl]oxy]ethyl]-1H-imidazole (Fenticonazole Sulfone) 80676-28-4 100mg



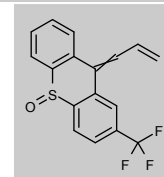
Flupentixol Dihydrochloride

[MM0223.15](#)

(EZ)-3-[2-(Trifluoromethyl)-9H-thioxanthen-9-ylidene]propene Sulfoxide (9-Allylidene-2-(trifluoromethyl)thioxanthene 10-Oxide)

n/a

100mg

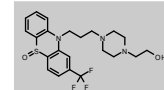


Fluphenazine Dihydrochloride

[MM0114.01](#)**Imp. A** (EP): 2-[4-[3-[5-Oxo-2-(trifluoromethyl)-10H-5λ⁴-phenothiazin-10-yl]propyl]piperazin-1-yl]ethanol (Fluphenazine S-Oxide)

1674-76-6

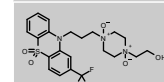
100mg

[MM0114.18](#)

Fluphenazine Sulfone N1,N4-Dioxide (Fluphenazine N1,N4,S,S-Tetraoxide)

86137-45-3

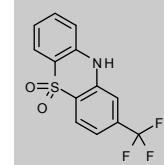
100mg

[MM0441.10](#)

2-(Trifluoromethyl)-10H-phenothiazine 5,5-Dioxide

345-38-0

100mg



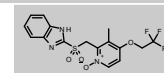
Lansoprazole

[MM0474.08](#)

Lansoprazole Sulphone N-Oxide

953787-54-7

100mg

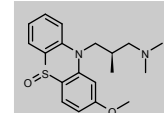


Levomepromazine Maleate

[MM0019.01](#)**Imp. B** (EP): 10-[(2R)-3-(Dimethylamino)-2-methylpropyl]-2-methoxy-10H-phenothiazine 5-Oxide (Levomepromazine S-Oxide)

7606-29-3

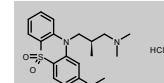
100mg

[MM0019.09](#)

Levomepromazine Sulphone Hydrochloride

60119-90-6

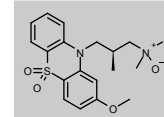
100mg

[MM0019.11](#)

Levomepromazine Sulfone N-Oxide (Levomepromazine N,S,S-Trioxide)

n/a

50mg



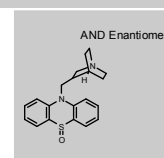
Mequitazine

[MM3131.02](#)

Mequitazine Sulfoxide

40765-34-2

100mg

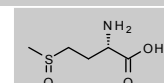


Methionine

[MM0358.05](#)**Imp A** (EP): (2S)-2-Amino-4-[(RS)-methylsulfinyl]butanoic Acid (L-Methionine Sulfoxide)

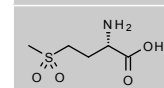
3226-65-1

100mg

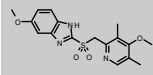
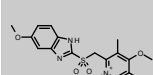
[MM0358.06](#)**Imp B** (EP): (2S)-2-Amino-4-(methylsulfonyl)butanoic Acid (L-Methionine Sulfone)

7314-32-1

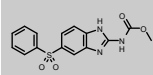
100mg



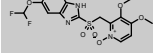
Omeprazole

MM0095.05	Imp. D (EP): 5-Methoxy-2-[[[(4-methoxy-3,5-dimethylpyridin-2-yl)methyl]sulphonyl]-1H-benzimidazole (Omeprazole Sulphone)	88546-55-8	100mg	
MM0095.16	Imp. I (EP): 4-Methoxy-2-[[[(5-methoxy-1H-benzimidazol-2-yl)sulphonyl]methyl]-3,5-dimethylpyridine 1-Oxide (Omeprazole Sulphone N-Oxide)	158812-85-2	100mg	

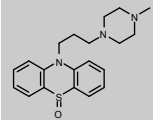
Oxfendazole

MM0518.02	Imp. B (EP): Methyl [5-(Phenylsulphonyl)-1H-benzimidazol-2-yl]carbamate (Fenbendazole Sulphone)	54029-20-8	100mg	
---------------------------	--	------------	-------	---

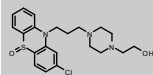
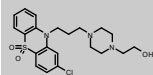
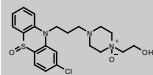
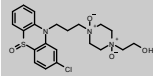
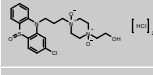
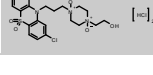
Pantoprazole Sodium Sesquihydrate

MM0099.07	Pantoprazole Sulphone N-Oxide	953787-55-8	100mg	
---------------------------	-------------------------------	-------------	-------	---

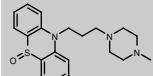
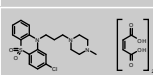
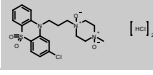
Perazine Dimalonate

MM0157.01	Perazine Sulphoxide	20627-44-5	100mg	
---------------------------	---------------------	------------	-------	--

Perphenazine

MM0826.01	Imp. A (EP): 2-[4-[3-(2-Chloro-5-oxido-10H-phenothiazin-10-yl)propyl]piperazin-1-yl]-ethanol (Perphenazine Sulphoxide)	10078-25-8	100mg	
MM0826.04	Perphenazine Sulfone	n/a	50mg	
MM0826.05	Perphenazine Sulfoxide N1-Oxide (Perphenazine N1,S-Dioxide)	n/a	100mg	
MM0826.08	Perphenazine Sulfoxide N1,N4-Dioxide (Perphenazine N1,N4,S-Trioxide)	n/a	100mg	
MM0826.10	Perphenazine Sulfoxide N1,N4-Dioxide Dihydrochloride (Perphenazine N1,N4,S-Trioxide Dihydrochloride)	n/a	100mg	
MM0826.11	Perphenazine Sulfone N1,N4-Dioxide Dihydrochloride (Perphenazine N1,N4,S,S-Tetraoxide Dihydrochloride)	n/a	100mg	

Prochlorperazine Maleate

MM0411.02	Prochlorperazine Sulfoxide	10078-27-0	100mg	
MM0411.11	Prochlorperazine Sulfone Dimaleate	n/a	100mg	
MM0411.13	Prochlorperazine Sulfone N1,N4-Dioxide Dihydrochloride (Prochlorperazine N1,N4,S,S-Tetraoxide Dihydrochloride)	n/a	50mg	

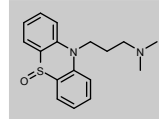
Promazine Hydrochloride

[MM0290.01](#)

Imp. A (EP): 3-(10H-Phenothiazin-10-yl)-N,N-dimethylpropan-1-amine S-Oxide (Promazine Sulphoxide)

146-21-4

100mg



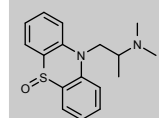
Promethazine Hydrochloride

[MM0412.04](#)

Imp. D (EP): (2RS)-N,N-Dimethyl-1-(10H-phenothiazin-10-yl)propan-2-amine S-Oxide (Promethazine Sulphoxide)

7640-51-9

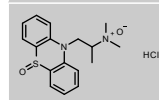
100mg


[MM0412.05](#)

Promethazine Sulphoxide N-Oxide Hydrochloride

1135334-50-7

100mg



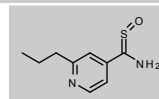
Protonamide

[MM0844.01](#)

Protonamide Sulfoxide

62178-61-4

50mg



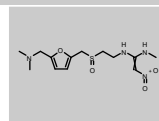
Ranitidine Hydrochloride

[MM0086.03](#)

Imp. C (EP): N-[2-[[[5-[(Dimethylamino)-methyl]furan-2-yl]methyl]sulphonyl]ethyl]-N'-methyl-2-nitroethene-1,1-diamine (Ranitidine Sulphoxide)

73851-70-4

100mg



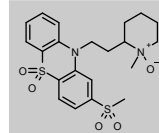
Sulforidazine

[MM1195.04](#)

Sulforidazine 5-Sulfone N-Oxide (Sulforidazine N,S5,S5-Trioxide)

53926-90-2

100mg



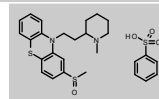
Thioridazine Hydrochloride

[MM0116.01](#)

Imp. B (EP) as Besilate: 10-[2-[(2RS)-1-Methylpiperidin-2-yl]ethyl]-2-(methylsulfinyl)-10H-phenothiazine Besilate (Mesoridazine Besilate)

32672-69-8

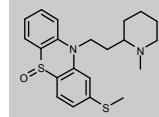
50mg


[MM0116.03](#)

Imp. C (EP): 10-[2-[(2RS)-1-Methylpiperidin-2-yl]ethyl]-2-(methylsulfonyl)-10H-phenothiazine 5-Oxide (Thioridazine 5-Sulfoxide)

7776-05-8

100mg



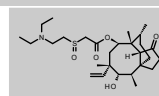
Tiamulin Hydrogen Fumarate

[MM0394.25](#)

Tiamulin Sulfoxide

n/a

100mg



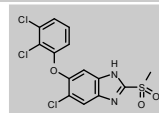
Triclabendazole

[MM0313.02](#)

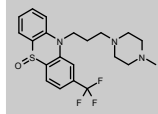
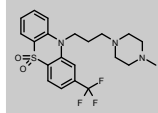
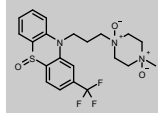
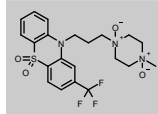
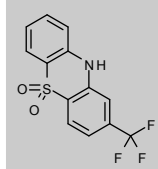
Triclabendazole Sulfone

106791-37-1

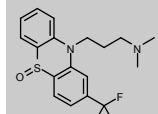
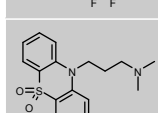
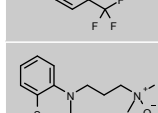
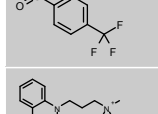
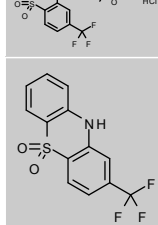
100mg



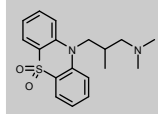
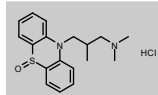
Trifluoperazine Hydrochloride

MM0441.01	Trifluoperazine Sulfoxide	1549-88-8	50mg	
MM0441.04	Trifluoperazine Sulfone	n/a	100mg	
MM0441.07	Trifluoperazine Sulfoxide N1,N4-Dioxide (Trifluoperazine N1,N4,S-Trioxide)	150111-58-3	100mg	
MM0441.09	Trifluoperazine Sulfone N1,N4-Dioxide (Trifluoperazine N1,N4,S,S-Tetraoxide)	n/a	100mg	
MM0441.10	2-(Trifluoromethyl)-10H-phenothiazine 5,5-Dioxide	345-38-0	100mg	

Triflupromazine Hydrochloride

MM1675.02	Triflupromazine Sulfoxide	4248-38-8	100mg	
MM1675.03	Triflupromazine Sulfone	3852-84-4	100mg	
MM1675.04	Triflupromazine Sulfoxide N-Oxide (Triflupromazine N,S-Dioxide)	94163-91-4	100mg	
MM1675.09	Triflupromazine Sulfone N-Oxide Hydrochloride (Triflupromazine N,S,S-Trioxide Hydrochloride)	n/a	100mg	
MM0441.10	2-(Trifluoromethyl)-10H-phenothiazine 5,5-Dioxide	345-38-0	100mg	

Trimeprazine Tartrate

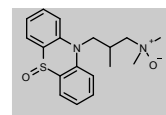
MM0957.00	Trimeprazine Sulphone (Oxomemazine)	3689-50-7	100mg	
MM0958.02	Trimeprazine Sulphoxide Hydrochloride	n/a	100mg	

[MM0958.07](#)

Trimeprazine Sulfoxide N-Oxide (Trimeprazine N,S-Dioxide)

n/a

100mg





For full listing of offices see:
lgcstandards.com

1 Brazil

Tel: +55 12 3302 5880
Email: bz@lgcstandards.com

2 Bulgaria

Tel: +359 (0)2 971 4955
Email: bg@lgcstandards.com

3 China

Tel: +86 400 9216156
Email: infochina@lgcgroup.com

4 France

Tel: +33 (0)3 88 04 82 82
Email: fr@lgcstandards.com

5 Germany

Tel: +49 (0)281 9887 0
Email: de@lgcstandards.com

6 Hungary

Tel: +49 (0)281 9887 0
Email: de@lgcstandards.com

7 Ireland

Tel: +44 (0)20 8943 8480
Email: uksales@lgcstandards.com

8 Italy

Tel: +39 02 22476412
Email: it@lgcstandards.com

9 Middle East

Tel: +49 (0)281 9887 0
Email: global.sales@lgcgroup.com

10 Netherlands

Tel: +49 (0)281 9887 0
Email: de@lgcstandards.com

11 Nordic countries

Tel: +49 (0)281 9887 0
Email: de@lgcstandards.com

12 Poland

Tel: +48 22 751 31 40
Email: pl@lgcstandards.com

13 Romania

Tel: +40 364 116890
Email: ro@lgcstandards.com

14 Russia

Tel: +7 812 777 04 88
Email: ru@lgcgroup.com

15 South Africa

Tel: +27 (0)11 466 4321
Email: sales.za@lgcgroup.com

16 Spain

Tel: +34 (0)93 308 4181
Email: es@lgcstandards.com

17 Turkey

Tel: +90 530 880 33 90
Email: tur@lgcstandards.com

18 United Kingdom

Tel: +44 (0)20 8943 8480
Email: uksales@lgcstandards.com

19 USA + Canada

Tel: +1 (603) 622 7660
Email: lgcusa@lgcstandards.com

● Export queries

Tel: +49 (0) 281 9887 250
Email: global.sales@lgcgroup.com