


# Schedule of Accreditation

issued by

## United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

 <p><b>0590</b></p> <p>Accredited to <b>ISO/IEC 17025:2005</b></p>	<b>EffecTech Limited</b>	
	<b>Issue No: 048    Issue date: 07 January 2019</b>	
<b>Dove House</b> <b>Dove Fields</b> <b>Uttoxeter</b> <b>Staffordshire</b> <b>ST14 8HU</b>	<b>Contact: Dr Gavin Squire</b> <b>Tel: +44 (0)1889 569229</b> <b>Fax: +44 (0)1889 569220</b> <b>E-Mail: gavin.squire@effectech.co.uk</b> <b>Website: www.effectech.co.uk</b>	
<b>Calibration performed by the Organisations at the locations specified below</b>		

### Locations covered by the organisation and their relevant activities

#### Laboratory locations:

Location details	Activity	Location code
<b>Address</b> Dove House Dove Fields Uttoxeter Staffordshire ST14 8HU  <b>Local contact</b> Dr Gavin Squire  Tel: +44 (0)1889 569229 Fax: +44 (0)1889 569220 email: gavin.squire@effectech.co.uk	Gas Calibration Process Gas Analysers Liquefied Natural Gas (LNG) Analysers	Uttoxeter
<b>Address</b> N-163 MIDC Tarapur Boisar District Palghar - 401506 Maharashtra India  <b>Local contact</b> Padmakar Tillu  Tel: +91 (0)2525 276137 Fax: +91 (0)2525 276827 email: padmakar.tillu@effectech.co.in	Gas Calibration	Tarapur
<b>Address</b> QP West Support Services Area Ghuwairiya Street IR # 1 Ras Laffan Qatar  <b>Local contact</b> Biju Davis  Tel: +974 5589 8625 Fax: +974 4451 5319 email: biju.davis@effectech.com.qa	Gas Calibration	Qatar

#### Site activities performed away from the locations listed above:

Location details	Activity	Location
<b>Customers' sites or premises</b>  The customers' site or premises must be suitable for the nature of the particular calibrations undertaken and will be the subject of contract review arrangements between the laboratory and the customer.	Process Gas Analysers	Customers' sites



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**DETAIL OF ACCREDITATION**

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k = 2$ )	Remarks	Location Code
PRIMARY REFERENCE GAS MIXTURES (PRGM) Preparation of synthetic gas mixtures by high-precision gravimetry in accordance with ISO 6142-1:2015 (Class I mixtures individually verified by analysis)				<b>Uttoxeter</b>
SYNTHETIC NATURAL GAS MIXTURES	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM016/UT</b>	
nitrogen	0.02 to 25	0.12 % relative + 0.00034	Preparation of primary reference gas mixtures (PRGM) by ISO 6142-1:2015 using high precision gravimetry	
carbon dioxide	0.05 to 25	0.10 % relative + 0.00006		
methane	34 to 100	0.055 - 0.05 % relative		
ethane	0.1 to 35	0.12 % relative + 0.00026		
propane	0.05 to 20	0.15 % relative + 0.00002		
iso-butane	0.01 to 2	0.15 % relative + 0.00011		
n-butane	0.01 to 2	0.15 % relative + 0.00011		
neo-pentane	0.001 to 0.5	0.35 % relative + 0.00005		
iso-pentane	0.002 to 0.6	0.25 % relative + 0.00005		
n-pentane	0.002 to 0.6	0.25 % relative + 0.00005		
n-hexane	0.001 to 0.5	0.50 % relative + 0.00005		
2-methylpentane	0.001 to 0.35	0.65 % relative + 0.00003		
3-methylpentane	0.001 to 0.35	0.65 % relative + 0.00003		
2,2-dimethylbutane	0.001 to 0.35	0.65 % relative + 0.00003		
benzene	0.001 to 0.2	0.65 % relative + 0.00003		
cyclohexane	0.001 to 0.2	0.65 % relative + 0.00003		
n-heptane	0.001 to 0.2	0.65 % relative + 0.00003		
toluene	0.001 to 0.1	0.65 % relative + 0.00003		
methylcyclohexane	0.001 to 0.1	0.65 % relative + 0.00003		
n-octane	0.0005 to 0.05	0.65 % relative + 0.00003		
n-nonane	0.0001 to 0.02	0.65 % relative + 0.00003		
n-decane	0.0001 to 0.005	0.65 % relative + 0.00003		
helium	0.005 to 0.2	0.85 % relative + 0.00022		
hydrogen	0.005 to 0.2	0.80 % relative + 0.0002		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k = 2$ )	Remarks	Location Code
PRIMARY REFERENCE GAS MIXTURES (PRGM) (continued)				
SYNTHETIC FUEL GAS MIXTURES	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM016/UT</b>	<b>Urtometer</b>
nitrogen	0.1 to 60	0.12 % relative + 0.00033	Preparation of primary reference gas mixtures (PRGM) by ISO 6142-1:2015 using high precision gravimetry	
carbon dioxide	0.1 to 30	0.35 % relative		
hydrogen	1 to 40 40 to 70	0.15 % relative + 0.015 0.075		
carbon monoxide	0.1 to 30	0.13 % relative + 0.0038		
methane	1 to 70	0.04		
ethane	0.5 to 28	0.13 % relative + 0.005		
ethene	0.5 to 12	0.6 % relative + 0.0025		
propane	0.1 to 1 1 to 15	0.01 0.2 % relative + 0.0065		
propene	0.1 to 5	0.25 % relative + 0.001		
SULPHUR GAS MIXTURES	amount fraction (ppm mol/mol)	amount fraction (ppm mol/mol)	<b>In-house method TM016/UT</b> matrix gas : methane or nitrogen	
hydrogen sulphide	0.2 to 200	1 % relative + 0.01	Preparation of primary reference gas mixtures (PRGM) by ISO 6142-1:2015 using high precision gravimetry	
carbonyl sulphide	0.2 to 200	1 % relative + 0.01		
carbon disulphide	0.2 to 200	1 % relative + 0.01		
methanethiol (methyl mercaptan)	0.2 to 200	1 % relative + 0.01		
ethanethiol (ethyl mercaptan)	0.2 to 200	1 % relative + 0.01		
dimethyl sulphide	0.2 to 200	1 % relative + 0.01		
1-propanethiol (n-propyl mercaptan)	0.2 to 200	1 % relative + 0.01		
2-propanethiol (iso-propyl mercaptan)	0.2 to 200	1 % relative + 0.01		
ethyl methyl sulphide (methyl ethyl sulphide)	0.2 to 200	1 % relative + 0.01		
1-butanethiol (n-butyl mercaptan)	0.2 to 200	1 % relative + 0.01		
2-methyl-2-propanethiol (tert-butyl mercaptan)	0.2 to 200	1 % relative + 0.01		



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PRIMARY REFERENCE GAS MIXTURES (PRGM) (continued)				
SULPHUR GAS MIXTURES (continued)	amount fraction (ppm mol/mol)	amount fraction (ppm mol/mol)	<b>In-house method TM016/UT</b> matrix gas : methane or nitrogen (continued)	<b>Uttoxeter</b>
2-methyl-1-propanethiol (iso-butyl mercaptan)	0.2 to 200	1 % relative + 0.01		
1-methyl-1-propanethiol (sec-butyl mercaptan)	0.2 to 200	1 % relative + 0.01		
diethyl sulphide	0.2 to 200	1 % relative + 0.01		
n-hexyl mercaptan	0.2 to 200	1 % relative + 0.01		
tetrahydrothiophene (THT)	0.2 to 200	1 % relative + 0.01		
BINARY GAS MIXTURES	amount fraction (mol/mol)	amount fraction (mol/mol)	<b>In-house method TM016/UT</b>	
carbon monoxide/nitrogen	10 ppm to 200 ppm 200 ppm to 1000 ppm	1.3 % to 0.45 % relative 0.35 % to 0.30 % relative	Preparation of primary reference gas mixtures (PRGM) by ISO 6142-1:2015 using high precision gravimetry	
carbon dioxide/nitrogen	0.1 % to 15 %	0.45 % to 0.15 % relative		
oxygen/nitrogen	0.5 % to 25 %	1.0 % to 0.2 % relative		
nitric oxide/nitrogen	5 ppm to 5000 ppm	0.6 % to 0.25 % relative		
nitrogen dioxide/synthetic air	5 ppm to 500 ppm	2.0 % relative		
sulphur dioxide/nitrogen	5 ppm to 2000 ppm	1.5 % to 0.5 % relative		
methane/nitrogen	0.1 % to 5 %	0.4 % to 0.15 % relative		
methane/synthetic air	0.1% to 2.5 %	0.4 % to 0.15 % relative		
propane/nitrogen	1 ppm to 1000 ppm 0.1 % to 2 %	2 % to 0.4 % relative 0.4 % to 0.15 % relative		
propane/synthetic air	1 ppm to 1000 ppm 0.1 % to 1.1 %	2 % to 0.4 % relative 0.4 % to 0.15 % relative		
PROPANE BALANCE GAS MIXTURES	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM016/UT</b>	
nitrogen	0.1 to 3	0.15 % relative + 0.001	Preparation of primary reference gas mixtures (PRGM) by ISO 6142-1:2015 using high precision gravimetry	
ethane	0.25 to 3	0.15 % relative + 0.001		
propane	92 to 99.5	0.055 - 0.05 % relative		
iso-butane	0.03 to 1	0.15 % relative + 0.00025		



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PRIMARY REFERENCE GAS MIXTURES (PRGM) (continued)					
PROPANE BALANCE GAS MIXTURES (continued)	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM016/UT</b> (continued)		
n-butane	0.03 to 1	0.15 % relative +0.00025			
iso-pentane	0.02 to 0.08	0.6 % relative + 0.00005			
n-pentane	0.02 to 0.08	0.6 % relative + 0.00005			
SECONDARY REFERENCE GAS MIXTURES (SRGM) Calibration of synthetic gas mixtures by analysis					
SYNTHETIC NATURAL GAS MIXTURES	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM001/UT</b>	Uttoxeter	
nitrogen	0.1 to 22	0.25 % relative + 0.0005	Calibration of gas mixtures by ISO 6143:2001 using gas chromatography with thermal conductivity detection (GC-TCD)		
carbon dioxide	0.05 to 15	0.18 % relative + 0.0001			
methane	34 to 100	0.11 - 0.10 % relative			
ethane	0.1 to 35	0.25 % relative			
propane	0.05 to 15	0.3 % relative			
iso-butane	0.01 to 0.15 0.15 to 2	0.00045 0.3 % relative			
n-butane	0.01 to 0.15 0.15 to 2	0.00045 0.3 % relative			
neo-pentane	0.002 to 0.35	0.7 % relative + 0.0001			
iso-pentane	0.005 to 0.35	0.5 % relative + 0.0001			
n-pentane	0.005 to 0.35	0.5 % relative + 0.0001			
n-hexane	0.001 to 0.35	1.0 % relative + 0.0001			Calibration of gas mixtures using gas chromatography with flame ionisation detection (GC-FID)
2-methylpentane	0.001 to 0.35	1.3 % relative + 0.00005			
3-methylpentane	0.001 to 0.35	1.3 % relative + 0.00005			
2,2-dimethylbutane	0.001 to 0.35	1.3 % relative + 0.00005			
benzene	0.001 to 0.2	1.3 % relative + 0.00005			
cyclohexane	0.001 to 0.2	1.3 % relative + 0.00005			
n-heptane	0.001 to 0.2	1.3 % relative + 0.00005			
toluene	0.001 to 0.1	1.3 % relative + 0.00005			



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SECONDARY REFERENCE GAS MIXTURES (SRGM) (continued)				
SYNTHETIC NATURAL GAS MIXTURES (continued)	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM001/UT</b> (continued)	<b>Uttoxeter</b>
methylcyclohexane	0.001 to 0.1	1.3 % relative + 0.00005		
n-octane	0.0005 to 0.05	1.3 % relative + 0.00005		
n-nonane	0.0005 to 0.02	1.3 % relative + 0.00005		
n-decane	0.0005 to 0.005	1.3 % relative + 0.00005		
C <sub>6</sub> +	0.001 to 0.35	1.0 % relative + 0.0001	C <sub>6</sub> + is the sum of all hydrocarbons containing six carbon atoms or greater	
helium	0.005 to 0.2	1.7 % relative + 0.0004	Calibration of gas mixtures using gas chromatography with thermal conductivity detection (GC-TCD)	
hydrogen	0.005 to 0.2	1.7 % relative + 0.0002		
	amount fraction (mol/mol)	amount fraction (mol/mol)	<b>In-house method TM026/UT</b>	
oxygen	5 ppm to 100 ppm 100 ppm to 1000 ppm 0.1 % to 1.0 % 1.0 % to 22.5 % [1]	1.6 % relative + 0.1 ppm 0.9 % relative + 0.5 ppm 0.7 % relative + 1.0 ppm 0.18 % relative + 30 ppm	Calibration of oxygen in gas mixtures by ISO 12963:2017 using galvanic fuel cell sensors  Note [1] - The upper limit for oxygen may be limited due to restrictions in place required for the safe manufacture of such mixtures.	



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SECONDARY REFERENCE GAS MIXTURES (SRGM) (continued)					
SYNTHETIC NATURAL GAS MIXTURES (continued)	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM005/TA</b>	<b>Tarapur</b>	
nitrogen	0.1 to 12	0.25 % relative + 0.0005	Calibration of gas mixtures by ISO 6143:2001 using gas chromatography with thermal conductivity detection (GC-TCD)		
carbon dioxide	0.05 to 8	0.18 % relative + 0.0001			
methane	64 to 100	0.11 - 0.10 % relative			
ethane	0.1 to 14	0.25 % relative			
propane	0.05 to 8	0.3 % relative			
iso-butane	0.01 to 0.15 0.15 to 1.2	0.00045 0.3 % relative			
n-butane	0.01 to 0.15 0.15 to 1.2	0.00045 0.3 % relative			
neo-pentane	0.002 to 0.35	0.7 % relative + 0.0001			
iso-pentane	0.005 to 0.35	0.5 % relative + 0.0001			
n-pentane	0.005 to 0.35	0.5 % relative + 0.0001			
n-hexane	0.001 to 0.35	1.0 % relative + 0.0001			Calibration of gas mixtures using gas chromatography with flame ionisation detection (GC-FID)
2-methylpentane	0.001 to 0.35	1.3 % relative + 0.00005			
3-methylpentane	0.001 to 0.35	1.3 % relative + 0.00005			
2,2-dimethylbutane	0.001 to 0.35	1.3 % relative + 0.00005			
benzene	0.001 to 0.2	1.3 % relative + 0.00005			
cyclohexane	0.001 to 0.2	1.3 % relative + 0.00005			
n-heptane	0.001 to 0.2	1.3 % relative + 0.00005			
toluene	0.001 to 0.1	1.3 % relative + 0.00005			
methylcyclohexane	0.001 to 0.1	1.3 % relative + 0.00005			
n-octane	0.0005 to 0.05	1.3 % relative + 0.00005			
n-nonane	0.0005 to 0.02	1.3 % relative + 0.00005			
n-decane	0.0005 to 0.005	1.3 % relative + 0.00005			
oxygen	0.005 to 1	5 % relative	Calibration of gas mixtures using gas chromatography with thermal conductivity detection (GC-TCD)		



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SECONDARY REFERENCE GAS MIXTURES (SRGM) (continued)					
SYNTHETIC NATURAL GAS MIXTURES (continued)	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM022/QA</b>	<b>Qatar</b>	
nitrogen	0.1 to 12	0.35 % relative + 0.0005	Calibration of gas mixtures by ISO 6143:2001 using gas chromatography with thermal conductivity detection (GC-TCD)		
carbon dioxide	0.05 to 8	0.20 % relative + 0.0005			
methane	64 to 100	0.13 – 0.11 % relative			
ethane	0.1 to 14	0.30 % relative +0.002			
propane	0.05 to 8	0.30 % relative			
iso-butane	0.01 to 0.15 0.15 to 1.2	0.0005 0.35 % relative			
n-butane	0.01 to 0.15 0.15 to 1.2	0.0005 0.35 % relative			
neo-pentane	0.004 to 0.35	3.5 % relative + 0.0005			
iso-pentane	0.005 to 0.1 0.1 to 0.35	0.001 0.9 % relative - 0.0006			
n-pentane	0.005 to 0.18 0.18 to 0.35	0.001 0.9 % relative - 0.0006			
n-hexane	0.001 to 0.35	1.7 % relative + 0.00005			Calibration of gas mixtures using gas chromatography with flame ionisation detection (GC-FID)
2-methylpentane	0.001 to 0.35	1.7 % relative + 0.00005			
3-methylpentane	0.001 to 0.35	1.7 % relative + 0.00005			
2,2-dimethylbutane	0.001 to 0.35	1.7 % relative + 0.00005			
benzene	0.001 to 0.2	1.7 % relative + 0.00005			
cyclohexane	0.001 to 0.2	1.7 % relative + 0.00005			
n-heptane	0.001 to 0.2	1.7 % relative + 0.00005			
toluene	0.001 to 0.1	1.7 % relative + 0.00005			
methylcyclohexane	0.001 to 0.1	1.7 % relative + 0.00005			
n-octane	0.0005 to 0.05	1.7 % relative + 0.00005	Calibration of gas mixtures using gas chromatography with thermal conductivity detection (GC-TCD)		
n-nonane	0.0005 to 0.02	1.7 % relative + 0.00005			
n-decane	0.0005 to 0.005	1.7 % relative + 0.00005			
oxygen	0.005 to 1	5 % relative			





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<b>GAS MIXTURE PROPERTIES</b> Calculated values from composition				
superior calorific value molar basis (kJ.mol <sup>-1</sup> ) mass basis (MJ.kg <sup>-1</sup> ) volume basis (MJ.m <sup>-3</sup> )	Calculations are restricted to gas mixtures with amount fraction (% mol/mol)	0.1 % relative 0.1 % relative 0.1 % relative	Values calculated according to <b>ISO 6976:1995</b> (including amendment No 1, May 1998) on a <i>real</i> or <i>ideal</i> gas basis assuming mixture is dry (free from water)	<b>All Sites</b>
inferior calorific value molar basis (kJ.mol <sup>-1</sup> ) mass basis (MJ.kg <sup>-1</sup> ) volume basis (MJ.m <sup>-3</sup> )	nitrogen < 30 carbon dioxide < 15 ethane < 15 other components < 5 methane no restriction	0.1 % relative 0.1 % relative 0.1 % relative	Combustion properties can be expressed in units of the Joule (J) or in kilowatt hours (kWh)	
relative density density (kg.m <sup>-3</sup> )		0.1 % relative 0.1 % relative		
superior Wobbe index (MJ.m <sup>-3</sup> ) inferior Wobbe index (MJ.m <sup>-3</sup> )		0.1 % relative 0.1 % relative		
molar mass (kg.kmol <sup>-1</sup> ) compression factor		0.1 % relative 0.1 % relative		
gross calorific value molar basis (kJ.mol <sup>-1</sup> ) mass basis (MJ.kg <sup>-1</sup> ) volume basis (MJ.m <sup>-3</sup> )	Calculations are applicable to any gaseous natural gas, natural gas substitute, or other combustible fuel, except that for properties on a volume basis, where the method is restricted only to gas mixtures for which the compression factor is greater than 0.9	1.0 kJ.mol <sup>-1</sup> 0.025 MJ.kg <sup>-1</sup> 0.040 MJ.m <sup>-3</sup>	Values calculated according to <b>ISO 6976:2016</b> on a <i>real</i> or <i>ideal</i> gas basis assuming mixture is dry (free from water)	
net calorific value molar basis (kJ.mol <sup>-1</sup> ) mass basis (MJ.kg <sup>-1</sup> ) volume basis (MJ.m <sup>-3</sup> )		0.9 kJ.mol <sup>-1</sup> 0.023 MJ.kg <sup>-1</sup> 0.037 MJ.m <sup>-3</sup>	Combustion properties can be expressed in units of the Joule (J) or in kilowatt hours (kWh)	
relative density density (kg.m <sup>-3</sup> )		0.0006 0.0008 kg.m <sup>-3</sup>		
gross Wobbe index (MJ.m <sup>-3</sup> ) net Wobbe index (MJ.m <sup>-3</sup> )		0.032 MJ.m <sup>-3</sup> 0.030 MJ.m <sup>-3</sup>		
molar mass (kg.kmol <sup>-1</sup> ) compression factor		0.017 kg.kmol <sup>-1</sup> 0.0001		
gross heating value net heating value relative density compressibility factor	There are no composition or property-related restrictions on the method specified	0.1 % relative 0.1 % relative 0.1 % relative 0.1 % relative	Calculated values according to methods given in <b>GPA 2172-09</b> (2009) using data tables from <b>GPA 2145-09</b>	
gross heating value net heating value relative density density compressibility factor	There are no composition or property-related restrictions on the method specified	0.1 % relative 0.1 % relative 0.1 % relative 0.1 % relative 0.1 % relative	Calculated values according to methods given in <b>ASTM D3588-98</b> (2011) using data tables from <b>GPA 2145-09</b>	



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SECONDARY REFERENCE GAS MIXTURES (SRGM) (continued)				
SULPHUR GAS MIXTURES	amount fraction (ppm mol/mol)	amount fraction (ppm mol/mol)	<b>In-house method TM002/UT</b> matrix gas : methane or nitrogen	<b>Uttoxeter</b>
hydrogen sulphide	0.2 to 10	2 % relative + 0.03	Calibration of gas mixtures using gas chromatography with sulphur chemiluminescence detection (GC-SCD)	
carbonyl sulphide	0.2 to 10	2 % relative + 0.03		
methanethiol (methyl mercaptan)	0.2 to 10	2 % relative + 0.03		
ethanethiol (ethyl mercaptan)	0.2 to 10	2 % relative + 0.03		
dimethyl sulphide	0.2 to 10	2 % relative + 0.03		
1-propanethiol (n-propyl mercaptan)	0.2 to 10	4 % relative + 0.03		
2-propanethiol (iso-propyl mercaptan)	0.2 to 10	2 % relative + 0.03		
ethyl methyl sulphide (methyl ethyl sulphide)	0.2 to 10	2 % relative + 0.03		
1-butanethiol (n-butyl mercaptan)	0.2 to 10	4 % relative + 0.03		
2-methyl-2-propanethiol (tert-butyl mercaptan)	0.2 to 10	2 % relative + 0.03		
2-methyl-1-propanethiol (iso-butyl mercaptan)	0.2 to 10	4 % relative + 0.03		
1-methyl-1-propanethiol (sec-butyl mercaptan)	0.2 to 10	4 % relative + 0.03		
diethyl sulphide	0.2 to 10	2 % relative + 0.03		
n-hexyl mercaptan	0.2 to 10	4 % relative + 0.03		
tetrahydrothiophene (THT)	0.2 to 10	2 % relative + 0.03		
BASIC OXYGEN STEELMAKING GAS (BOS)	amount fraction (% mol/mol)	amount fraction (% mol/mol)		<b>In-house method TM004/UT</b>
nitrogen	11 to 30	0.2 % relative + 0.02	Calibration of gas mixtures by ISO 6143:2001 using gas chromatography with thermal conductivity detection (GC-TCD)	
carbon dioxide	12 to 20	0.2 % relative + 0.02		
carbon monoxide	45 to 75	0.15 – 0.1 % relative		
hydrogen	0.4 to 3.0	0.5 % relative + 0.002		
oxygen	0.3 to 1.3	0.7 % relative + 0.0005		
BLAST FURNACE GAS MIXTURES	amount fraction (% mol/mol)	amount fraction (% mol/mol)		<b>Uttoxeter</b>
nitrogen	27 to 54	1.0 % relative		
carbon dioxide	20 to 31	1.0 % relative		
hydrogen	1 to 16	1.0 % relative		
carbon monoxide	20 to 31	1.0 % relative		



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**EffecTech Limited**

**Issue No: 048 Issue date: 07 January 2019**

**Calibration performed by the Organisation at the locations specified**

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k = 2$ )	Remarks	Location Code
SECONDARY REFERENCE GAS MIXTURES (SRGM) (continued)				
PROPANE BALANCE GAS MIXTURES	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM020/UT</b>	Uttoxeter
nitrogen	0.1 to 3	0.3 % relative + 0.002	Calibration of gas mixtures using gas chromatography with thermal conductivity detection (GC-TCD)	
ethane	0.25 to 3	0.3 % relative + 0.002		
propane	92 to 99.5	0.11 - 0.10 % relative		
iso-butane	0.03 to 1	0.3 % relative + 0.0005		
n-butane	0.03 to 1	0.3 % relative + 0.0005		
iso-pentane	0.02 to 0.08	1.2 % relative + 0.0001		
n-pentane	0.02 to 0.08	1.2 % relative + 0.0001		
BINARY EMISSION GAS MIXTURES	amount fraction (mol/mol)	amount fraction (mol/mol)	<b>In-house method TM025/UT</b>	
propane in nitrogen	1 ppm to 50 ppm	0.6 % relative + 0.003 ppm	Calibration of gas mixtures by ISO 12963:2017 using gas chromatography with flame ionisation detection (GC-FID)	
propane in synthetic air	1 ppm to 50 ppm	0.6 % relative + 0.003 ppm		
BINARY GAS MIXTURES	amount fraction (mol/mol)	amount fraction (mol/mol)	<b>In-house method TM026/UT</b>	
oxygen in nitrogen	5 ppm to 100 ppm 100 ppm to 1000 ppm 0.1 % to 1.0 % 1.0 % to 22.5 %	1.6 % relative + 0.1 ppm 0.9 % relative + 0.5 ppm 0.7 % relative + 1.0 ppm 0.18 % relative + 30 ppm	Calibration of gas mixtures by ISO 12963:2017 using galvanic fuel cell sensors	
TERTIARY EMISSION GAS MIXTURES	amount fraction (mol/mol)	amount fraction (mol/mol)		
nitric oxide nitrogen dioxide in nitrogen	5 ppm to 600 ppm 5 ppm to 500 ppm	1.1 % to 0.5 % relative 4 % relative	Calibration of gas mixtures by ISO 12963:2017 using dynamically generated reference gases in accordance with ISO 6145 Part 7 Thermal Mass Flow Controllers	



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<b>SECONDARY REFERENCE GAS MIXTURES (SRGM) (continued)</b>				
<b>BINARY EMISSION GAS MIXTURES</b>	amount fraction (mol/mol)	amount fraction (mol/mol)	<b>In-house method TM014</b>	<b>All Sites</b>
carbon monoxide in nitrogen or synthetic air	10 ppm to 200 ppm 200 ppm to 1000 ppm	1.5 % to 0.9 % relative 0.7 % to 0.6 % relative	Calibration of gas mixtures by ISO 12963:2017 using dynamically generated reference gases in accordance with ISO 6145 Part 7 Thermal Mass Flow Controllers	
carbon dioxide in nitrogen or synthetic air	0.1 % to 1 % 1 % to 15 %	0.9 % to 0.6 % relative 0.6 % to 0.3 % relative		
oxygen in nitrogen	0.5 % to 3 % 3 % to 25 %	2.1 % to 0.7 % relative 0.7 % to 0.4 % relative		
nitric oxide in nitrogen	5 ppm to 60 ppm 60 ppm to 600 ppm	1.1 % to 0.9 % relative 0.6 % to 0.5 % relative		
nitrogen dioxide in synthetic air	5 ppm to 500 ppm	4 % relative		
sulphur dioxide in nitrogen or synthetic air	5 ppm to 100 ppm 100 ppm to 1000 ppm	3.0 % to 1.2 % relative 1.2 % to 1.0 % relative		
methane in nitrogen	0.1 % to 1 % 1 % to 5 %	0.7 % to 0.4 % relative 0.4 % to 0.3 % relative		
methane in synthetic air	0.1 % to 1 % 1 % to 2.5 %	0.7 % to 0.4 % relative 0.4 % to 0.3 % relative		
<b>LIQUEFIED NATURAL GAS (LNG) ANALYSERS</b> Calibration of LNG analysers using reference liquid mixtures				
<b>LNG ANALYSERS</b>	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM024/UT</b>	<b>Uttoxeter</b>
nitrogen	0.1 to 1.8	0.10 % relative + 0.0065	Calibration of analysers used for direct measurement of liquefied natural gas (LNG) using cryogenically prepared reference liquid mixtures	
methane	79 to 100	0.035		
ethane	0.1 to 4 4 to 14	0.30 % relative + 0.001 0.05 % relative + 0.01		
propane	0.1 to 4	0.15 % relative + 0.0015		
iso-butane	0.02 to 1.3	0.25 % relative + 0.001		
n-butane	0.02 to 1.3	0.25 % relative + 0.001		
iso-pentane	0.01 to 0.16	0.50 % relative + 0.0002		
n-pentane	0.01 to 0.16	0.50 % relative + 0.0002		



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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k = 2$ )	Remarks	Location Code
<b>GAS ANALYSERS</b> Calibration of gas analysers using reference gas mixtures				
<b>NATURAL GAS ANALYSERS</b>	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM003</b>	<b>Customer's sites</b>
nitrogen	0.1 to 22	0.3 % relative + 0.002	Calibration of gas analysers used for natural gas analysis in accordance with ISO 10723:2012	
carbon dioxide	0.05 to 15	0.25 % relative + 0.0005		
methane	34 to 100	0.07		
ethane	0.1 to 23	0.25 % relative + 0.0015		
propane	0.05 to 10	0.3 % relative + 0.0005		
iso-butane	0.01 to 2.0	0.3 % relative + 0.0005		
n-butane	0.01 to 2.0	0.3 % relative + 0.0005		
neo-pentane	0.005 to 0.35	0.7 % relative + 0.0005		
iso-pentane	0.005 to 0.35	0.5 % relative + 0.0005		
n-pentane	0.005 to 0.35	0.5 % relative + 0.0005		
n-hexane	0.001 to 0.35	1.0 % relative + 0.0005		
n-heptane	0.001 to 0.20	1.3 % relative + 0.0001		
n-octane	0.0005 to 0.05	1.3 % relative + 0.0001		
n-nonane	0.0005 to 0.02	1.3 % relative + 0.0001		
n-decane	0.0005 to 0.005	1.3 % relative + 0.0001		
<b>OTHER FUEL GAS ANALYSERS</b>	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM006</b>	
C <sub>1</sub> - C <sub>3</sub>	0.0008 to 100	amount fractions from 1 % to 100 %	Calibration of gas analysers based on ISO 10723:2012	
C <sub>4</sub>	0.001 to 50	± 0.5 % relative		
C <sub>5</sub>	0.001 to 9	amount fractions from 0.1 % to 1 %		
C <sub>6</sub>	0.001 to 1.5	± 1 % relative		
C <sub>7</sub>	0.001 to 0.5	amount fractions from 0.0008 % to 0.1 %		
C <sub>8</sub>	0.001 to 0.2	± 2 % relative		
C <sub>9</sub>	0.001 to 0.2			
C <sub>10</sub>	0.001 to 0.05			
benzene	0.001 to 1			



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GAS ANALYSERS (continued)				<b>Customers' sites</b>
OTHER FUEL GAS ANALYSERS (continued)	amount fraction (% mol/mol)	amount fraction (% mol/mol)	<b>In-house method TM006</b> (continued)	
toluene	0.001 to 0.4	amount fractions from 1 % to 100 %		
xylene (m, p and o)	0.001 to 0.1	$\pm 0.5$ % relative		
argon	0.1 to 100	amount fractions from 0.1 % to 1 %		
carbon dioxide	0.03 to 100	$\pm 1$ % relative		
carbon monoxide	0.001 to 100	amount fractions from 0.0008 % to 0.1 %		
helium	0.1 to 100	$\pm 2$ % relative		
hydrogen	0.08 to 100			
nitrogen	0.1 to 100			
oxygen	0.05 to 100			
OTHER GAS ANALYSERS	amount fraction (ppm mol/mol)	amount fraction (ppm mol/mol)		
hydrogen sulphide	1 to 10	2 % relative + 0.03		
END				