



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



Course Syllabus

MGPS Verification and Validation to HTM 02-01 Section 15

(Testing and Commissioning of Medical Gas Pipeline Systems)

1. Course Overview

This intensive three-day online course provides comprehensive training on the verification, validation, and commissioning of Medical Gas Pipeline Systems (MGPS) in accordance with Health Technical Memorandum 02-01 Section 15.

Unlike design-focused courses, this programme is exclusively concerned with proving that installed systems perform as intended. Delegates will learn every test required by HTM 02-01, from initial carcass inspection through to final certification and handover, including pharmaceutical quality testing and Anaesthetic Gas Scavenging (AGS) disposal systems.

The course combines structured teaching, practical demonstrations, document walkthroughs, and interactive case studies to ensure delegates can confidently perform, witness, and document all required tests. A dedicated module addresses the upcoming revision of HTM 02-01, ensuring delegates are prepared for future changes.

Aspect	Detail
Format	Live online instructor-led (Zoom/Teams/Webex)
Duration	3 consecutive days
Daily schedule	09:30 – 16:30 (UK time)
Total live instruction	18 hours
CPD Hours	20 (including pre-reading and assessment)
Focus	Verification and validation only – not design

2. Target Audience

This course is designed for professionals involved in the testing, commissioning, and quality assurance of medical gas pipeline systems, including:

Role	Relevance
Commissioning Engineers	Directly responsible for performing tests
Testers and Technicians	Undertaking site testing and measurement
Quality Controllers (MGPS)	Witnessing tests and verifying results



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



Role	Relevance
Authorised Persons (MGPS)	Overseeing commissioning and signing off systems
Contractors	Installing MGPS and needing to understand test requirements
Facility Engineers	Maintaining and extending existing systems
Consultants	Advising on HTM compliance and commissioning

Geographic focus: Global – designed for delegates unable to attend UK-based classroom training.

3. Learning Outcomes

Upon successful completion of this course, delegates will be able to:

Knowledge and Understanding

Outcome	Assessment Method	
K1	Explain the regulatory framework governing MGPS testing, including HTM 02-01, European Pharmacopoeia, and relevant standards	MCQ
K2	Identify the roles and responsibilities of key personnel: Contractor, Quality Control Pharmacist, and Authorised Person (MGPS)	MCQ
K3	Describe the three phases of testing: pipeline carcass, complete system commissioning, and final quality tests	MCQ
K4	State the specific pass/fail criteria for all mandatory tests, including pressure decay limits, particulate clarity, and chemical purity thresholds	MCQ
K5	Recall correct test pressures for each gas service and test type	MCQ
K6	Explain safety procedures for modifications and extensions, including physical isolation and inert gas shielding	MCQ



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



Practical Skills

Outcome	Assessment Method	
S1	Perform carcass leakage tests using high-resolution electronic pressure equipment and interpret results against HTM criteria	Scenario exercise
S2	Conduct cross-connection tests on pipeline carcass using sequential method	Scenario exercise
S3	Execute AVSU and LVA closure tests, including 15-minute hold procedures	Scenario exercise
S4	Verify zoning of AVSUs and correct identification of terminal units	Scenario exercise
S5	Undertake cross-connection testing on complete systems using the sequential method (Oxygen/Vacuum, Air, N ₂ O, mixtures)	Scenario exercise
S6	Perform terminal unit flow, pressure drop, and mechanical function tests	Scenario exercise
S7	Test NIST connectors for correct identification and self-sealing function	Scenario exercise
S8	Conduct performance tests using metered leaks to simulate diversified design flow	Scenario exercise
S9	Verify alarm and warning system operation under normal, emergency, and fault conditions	Scenario exercise
S10	Complete all mandatory commissioning documentation (Forms B1–B16) to required standard	Form-filling exercise
S11	Undertake pharmaceutical quality tests: particulates, oil, water content, chemical purity (CO, CO ₂ , SO ₂ , NO _x)	Scenario exercise
S12	Confirm gas identity using appropriate instrumentation (oxygen analysers, thermal conductivity meters)	Scenario exercise
S13	Perform final purging and filling procedures with working gases	Scenario exercise
S14	Test Anaesthetic Gas Scavenging (AGS) disposal systems to required standards	Scenario exercise



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



Professional Judgement

Outcome	Assessment Method	
J1	Determine appropriate test programmes for new installations, modifications, extensions, and repairs based on scope of work	Case study
J2	Evaluate test results and decide on necessary remedial actions or retesting	Case study
J3	Advise on system status during interim periods before handover, including client responsibilities	Case study
J4	Interpret the 20-joint rule and its implications for test programmes	Case study
J5	Prepare for transition to revised HTM 02-01, including dental scope and form number changes	Discussion

4. Course Structure

Day	Focus	HTM References	CPD Hours
1	Foundations, Safety, and Carcass Testing	15.1–15.55	6
2	System Commissioning and Performance	15.57–15.91	6
3	Quality Testing, AGS, Sign-Off, and Future Updates	15.100–15.184	6
	Live instruction total		18
	Pre-reading and final assessment		2
	Total CPD		20



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



5. Detailed Syllabus

Day 1: Foundations, Safety, and Carcass Testing

Module 1.1: Introduction and Regulatory Framework (45 mins)

- Scope and objectives of HTM 02-01 Section 15
- Relationship with other standards: European Pharmacopoeia, ISO 7396, BS 6834
- Key personnel: Contractor, Quality Control Pharmacist, Authorised Person (MGPS)
- Instrumentation requirements and calibration certificates
- The three phases of testing: carcass, complete system, final quality
- Applicability: New installations, additions, modifications

Module 1.2: Safety and Modification Procedures (75 mins)

- The permit-to-work system
- Physical isolation methods: Spades, cutting and capping
- Inert gas shielding requirements
- The "20-joint rule": Small extensions vs. larger modifications
- Prohibition labels and terminal unit status during work
- Safety isolation for modifications in occupied areas
- Pre-modification testing of existing systems
- Client responsibilities for existing system integrity

Break: 15 mins

Module 1.3: Pipeline Carcass Tests – Visual and Leakage (75 mins)

- Visual checks: Labelling, marking, sleeving, and supports (Form B1)
- Leakage test procedures and equipment requirements
 - Test pressures: 18 bar (surgical air), 10 bar (other gases), 5 bar (vacuum)
 - High-resolution electronic pressure equipment (0.2 kPa / 0.5 kPa resolution)
 - Pass criteria: <0.2 kPa loss over 2 hours (400 kPa systems), <0.5 kPa (700 kPa systems)
 - Temperature compensation rules
 - Interlinking of pressure systems during test
 - Vacuum systems must never be interlinked with pressure systems
- Documentation: Form B1

Lunch: 45 mins

Module 1.4: Pipeline Carcass Tests – Cross-Connection (60 mins)

- Cross-connection testing procedure
 - Preparation: Remove links, open all valves, atmospheric pressure
 - Apply pressure to one system at a time
 - Check all other systems for flow
 - Repeat for each gas service
- Nitrogen as preferred test gas
- Documentation: Form B2



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



Module 1.5: Practical Workshop – Carcass Testing (75 mins)

- Case study 1: Interpreting pressure decay results – pass or fail?
- Case study 2: The 20-joint rule in practice – which tests apply?
- Group exercise: Completing Form B1 from a given scenario
- Group exercise: Completing Form B2 from a given scenario
- Q&A and Day 1 recap

End of Day 1

Day 2: System Commissioning and Performance

Module 2.1: Complete System Tests – Leakage and Vacuum (60 mins)

- Leakage tests on completed system (Form B3)
 - Setup with all terminal units, AVSUs, safety valves fitted
 - Isolation from plant
 - Same pass criteria as carcass (<0.2 kPa / <0.5 kPa over 2 hours)
- Vacuum system leakage (leakage into system) (Form B4)
 - Procedure: Operate plant, isolate, establish distribution pressure
 - Pass criteria: <1 kPa pressure increase over 1 hour
 - No temperature correction allowed

Module 2.2: Valve Closure Tests – AVSU and LVA (60 mins)

- AVSU closure tests for pressure systems
 - Upstream at distribution pressure
 - Downstream reduced to ~100 kPa
 - 15-minute hold – no change permitted
- AVSU closure tests for vacuum systems
 - Supply side at distribution pressure
 - Terminal side set to ~15 kPa
 - 15-minute hold – no change permitted
- LVA tests – same procedure
- Residual pressure principle explained
- Documentation: Forms B5A and B5B

Break: 15 mins

Module 2.3: Zoning and Terminal Unit Identification (45 mins)

- Verifying AVSUs control only intended terminal units
- Cross-referencing AVSUs with zone drawings
- Visual checks for correct gas-specific components
- Testing pendant fittings
- Documentation: Forms B5A and B5B (continued)

Module 2.4: Cross-Connection Testing – Complete System (75 mins)

- Sequential testing method explained
 - Stage 1: Oxygen and Vacuum
 - Stage 2: Medical Air and Surgical Air
 - Stage 3: Nitrous Oxide
 - Stage 4: Nitrous Oxide/Oxygen mixture



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



- Stage 5: Helium/Oxygen and other special gases
- Verification of flow/no-flow conditions
- No need to return previously tested systems to atmospheric pressure
- Retesting requirements after modifications
- Documentation: Form B6

Lunch: 45 mins

Module 2.5: Terminal Unit and NIST Connector Tests (60 mins)

- Flow and pressure drop tests against Table 28
- Directional check valves for test instruments (safety)
- Mechanical function: Probe insertion, capture, and release
- Anti-swivel pin verification
- Documentation: Form B7A
- NIST connector checks:
 - Correct gas flow direction (upstream vs downstream)
 - Self-sealing device function
 - Safety precautions during testing
- Documentation: Form B7B

Module 2.6: Performance Tests (60 mins)

- Simulating diversified design flow using metered leaks
- Calibrated metered leaks at specified flow rates
- Representative sampling strategies:
 - 28-bed ward: Furthest points, entrance points, treatment room
 - Operating department: One per suite, 20% of recovery terminals
 - Oxygen flush simulation: 100 L/min minimum
- Pressure measurements against Table 28
- Documentation: Form B8

Break: 15 mins

Module 2.7: Functional and Alarm System Tests (60 mins)

- Supply system functional tests
 - Normal and emergency operation
 - Normal and stand-by power supplies
 - Documentation: Form B9
- Pressure safety valves – certification checks (not testing)
 - Correct rating, BS EN ISO 4126-1 compliance
 - Test certificate verification
 - Documentation: Form B10
- Warning and alarm systems
 - Operation within tolerance limits (Tables 23, 24)
 - Normal, emergency, and fault conditions
 - Power failure and line fault simulation
 - Visual and audible indication verification
 - Return-to-normal testing
 - Documentation: Form B11



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



Module 2.8: Practical Workshop – System Commissioning (30 mins)

- Group exercise: Planning a cross-connection test sequence
- Case study: Interpreting valve closure test results
- Interactive: Completing Form B6 from a scenario
- Q&A and Day 2 recap

End of Day 2

Day 3: Quality Testing, AGS, Sign-Off, and Future Updates

Module 3.1: Interim Periods and Handover Preparation (30 mins)

- Verification of as-fitted drawings (Form B12)
- Interim system status: Filled with medical air if not immediately used
- Vacuum systems – not required to be maintained under vacuum
- Client responsibilities during interim period
 - System integrity and maintenance
 - Regular running and maintenance of supply plant
- Interim particulate and odour tests with medical air

Module 3.2: Purging and Filling with Specific Gases (45 mins)

- Disconnecting test gas sources
- Removing special connectors from site (recording removal)
- Filling to pipeline distribution pressure
- Purging each terminal unit with working gas
 - Volume at least equal to pipeline section
 - Known flow rate
- Safe discharge of gases (O₂, N₂O, mixtures)
- Vacuum systems – purging not required
- Documentation: Form B13

Break: 15 mins

Module 3.3: Pharmaceutical Quality Testing – Principles (30 mins)

- Objective: Detecting contamination during construction/modification
- Relationship with European Pharmacopoeia (minimum standard)
- Repetition of tests after filling with working gas
- Quality Controller's discretion on extent of testing
- Safe discharge of test gases

Module 3.4: Particulate Contamination Testing (60 mins)

- Subjective nature of the test – visual judgement in good light
- Test criteria:
 - Flow rate: ≥150 L/min for 30 seconds (standard)
 - Surgical air: 350 L/min for 30 seconds
 - N₂O/O₂ mixture: 275 L/min for 30 seconds
- Filter must be completely free of visible particles
- Sampling: Every terminal unit for new systems
- Managing older systems that continue to shed particles
- Lower flow rates if operational supply cannot be compromised
- Appendix D test device



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



Module 3.5: Oil, Water, and Chemical Purity Tests (75 mins)

- Oil contamination:
 - Mandatory at plant test point
 - Quarterly testing requirement
 - After component strip-down (Quality Controller discretion)
 - Total oil content per Table 28
 - Appendix E test device
- Water/moisture content:
 - Maximum 67 vpm (approx -46°C dew-point)
 - Older plants: Possible allowance for 127 vpm (-40°C) per HTM 2022:1997
 - Electronic dew-point meter preferred
 - Plant test point and representative terminal units
 - Flexible hose considerations – desorption effect

Lunch: 45 mins

Module 3.6: Chemical Purity – Detector Tube Methods (60 mins)

- Chemical purity requirements:
 - Carbon Monoxide (CO): ≤ 5 ppm v/v
 - Carbon Dioxide (CO₂): ≤ 500 ppm (medical air), ≤ 300 ppm (PSA oxygen)
 - Sulphur Dioxide (SO₂): ≤ 1 ppm v/v
 - Oxides of Nitrogen (NO_x): ≤ 2 ppm v/v
- Detector tubes: Quantitative, agent-specific preferred
- Alternative instruments: Equivalent repeatability, resolution, accuracy
- Sampling: Most distant terminal unit on each branch (max 5)
- Polytest tubes as optional general contamination check
- Detector limitations: Ambient conditions, cross-sensitivities

Module 3.7: Residual Nitrogen and Odour/Taste Tests (45 mins)

- Checking for adequate nitrogen purge:
 - Oxygen and N₂O/O₂ systems: Oxygen analyser (concentration not less than Table 30)
 - Nitrous oxide systems: Thermal conductivity or infrared meter
 - Checking for other shield gases (e.g., CO₂) using chemical reagent tubes
- Odour/taste test:
 - Qualitative broad check for many impurities
 - Odour threshold for particulate: 0.3 mg/m³
 - Not performed by inhalation for N₂O, N₂O/O₂, or CO₂
 - May be performed with medical air during interim periods
 - Sampling: All new terminal units + representative sample of existing
 - Flexible hose considerations (BS 5682:1984)

Break: 15 mins

Module 3.8: Final Gas Identity Tests (45 mins)

- Requirement: Test all new terminal units + representative sample of disturbed existing units
- Prerequisite: Systems purged and filled with working gas (15.100)



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



- Methods by gas type:
 - Oxygen, N₂O/O₂, Air: Oxygen analyser
 - Nitrous oxide: Thermal conductivity or infrared meter
 - Vacuum: Observation of suction
- Expected concentrations per Table 31
- Safety: N₂O discharge to minimise pollution and exposure
- Helium/Oxygen two-stage procedure:
 - Stage 1: Test with oxygen-free nitrogen (zero reading)
 - Stage 2: Test with product gas (correct O₂ content per Table 31)
- Documentation: Form B15

Module 3.9: Anaesthetic Gas Scavenging (AGS) Disposal Systems (45 mins)

- Applicable standards: BS 6834:1987, ISO DIS 7396-2
- Performance requirements:
 - Continuous operation at full load for 1 hour
 - Correct rotation and current draw (electrical equipment)
 - Pressure and flow standards per Table in 15.173
- Test procedure:
 - Individual terminal unit checks (Appendix K of BS 6834)
 - Design flow replication using metered leaks
 - Sequential testing
- Controls, alarms, and check valve verification

Module 3.10: Final Certification and Documentation (30 mins)

- Final certification requirements (15.179)
 - All required tests completed (15.46–15.100, 15.109–15.178)
 - All systems comply with requirements
 - As-fitted drawings correct and supplied
 - Manuals supplied
- Documentation: Form B16
- Signatories: Contractor, supervising officer, witnesses
- Removal of "Danger – do not use" labels (by Authorised Person only)
- Record-keeping and operational policy

Module 3.11: HTM 02-01 Update – What's Changing (30 mins)

- Overview of the revision process
- Addition of dental installations (scope expansion)
- Form number changes (B series to D series)
- What remains unchanged: All test procedures, pressure limits, pass/fail criteria
- Preparing for transition
- Q&A session

Module 3.12: Final Assessment and Course Close (60 mins)

- Multiple-choice assessment (30 questions, 40 minutes)
- Course evaluation and feedback
- Issue of CPD certificates

End of Day 3



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



6. Assessment Methods

Method	Description	Weighting	Pass Requirement
Formative assessment	In-session polls, breakout room contributions, Q&A participation	0%	Engagement monitored
Summative assessment	30-question multiple-choice test (online)	100%	80% correct
Practical exercises	Completion of test forms from scenarios (optional)	0%	Satisfactory completion recorded

Delegates who successfully complete the MCQ assessment will receive a certificate confirming 20 CPD hours.

7. Delegate Pre-requisites

While there are no formal entry requirements, the course is designed for professionals with some background in:

- Engineering services in healthcare
- Medical gas systems installation or maintenance
- Commissioning or quality assurance roles
- Authorised Person (MGPS) or aspiring APs

Delegates are encouraged to read HTM 02-01 Section 15 in advance if possible.

8. Delegate Pack (Provided Digitally)

- Course slides (PDF, 3-per-page for notes)
- Blank Forms B1–B16
- HTM 02-01 Section 15 extract (key paragraphs)
- Table 28: Performance requirements (single-page reference)
- Table 30/31: Gas quality and composition references
- Scenario booklet with 8–10 real-world cases
- Completed example forms for reference
- Links to pre-recorded equipment demonstrations (optional pre-work)
- Glossary of MGPS terms
- Assessment login instructions



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



9. Course Materials Cross-Reference

Module	HTM 02-01 Paragraphs	Forms
1.1 Introduction	15.1–15.11	–
1.2 Safety & Modifications	15.4–15.5, 15.27–15.44	–
1.3 Carcass – Visual & Leakage	15.46–15.51	B1
1.4 Carcass – Cross-Connection	15.52–15.55	B2
2.1 System Leakage & Vacuum	15.57–15.62	B3, B4
2.2 Valve Closure Tests	15.63–15.66	B5A, B5B
2.3 Zoning	15.67–15.69	B5A, B5B
2.4 Cross-Connection (System)	15.70–15.76	B6
2.5 Terminal Units & NIST	15.77–15.82	B7A, B7B
2.6 Performance Tests	15.83–15.84	B8
2.7 Functional & Alarms	15.85–15.91	B9, B10, B11
3.1 Interim & Handover	15.92–15.99	B12
3.2 Purging & Filling	15.100–15.102	B13
3.3–3.7 Quality Tests	15.109–15.162	–
3.8 Gas Identity	15.163–15.168	B15
3.9 AGS	15.169–15.178	–
3.10 Certification	15.179–15.184	B16

10. CPD Accreditation Statement

This course is designed to provide 20 hours of continuing professional development for engineers, testers, and healthcare engineering professionals involved in the verification and validation of Medical Gas Pipeline Systems.

Delegates who complete all sessions and achieve 80% or above in the final assessment will receive a CPD certificate confirming:



HTM02-01 Design Consulting Specialist in HTM02-01 Design.

+66(0)63 082 9692

kevin@htm02-01designconsult.com

Website: www.htm02-01designconsult.com



- Course title: MGPS Verification and Validation to HTM 02-01 Section 15
- CPD hours: 20
- Learning outcomes achieved: As listed in Section 3
- Date of completion
- Accreditation body: The CPD Group

11. Course Tutor

Kevin Pugh

- **HNC in Mechanical Engineering, BTEC level 4 Authorised Person MGPS.**
- **15 years in MGPS design and 12 years as a Authorised Person MGPS**

Kevin Pugh is a leading consultant in healthcare engineering with over 27 years of experience. He holds an HNC in Mechanical Engineering and is a qualified Authorised Person (MGPS). For the last 15 years, Kevin has specialized in the design and validation of Medical Gas Pipeline Systems, working on projects ranging from small dental surgeries to major hospital redevelopments. As an Authorised Person for the last 12 years, he has personally overseen the commissioning and handover of numerous complex MGPS installations. Kevin founded HTM 02-01 Design Consulting to provide expert guidance and training, bridging the gap between complex technical standards and practical, on-site application.

12. Booking and Fees

Detail	Website: https://htm02-01designconsult.com/training-courses Email: kevin@htm02-01designconsult.com Whatsapp: (Kevin) +66 (0)63 082 9692
Course fee	£1050
Includes	All live sessions, digital delegate pack, CPD certificate
Dates	N/A
Booking	https://htm02-01designconsult.com/training-courses
Group discounts	Available for 3+ delegates