HUMIMIC MEDICAL

Humimic SimuGel™ Technical Documentation

For medical simulation, ultrasound training and device development and evaluation

1. Overview

Humimic SimuGel™ is a calibrated synthetic tissue platform developed to support medical simulation, procedural training, and device evaluation. This document covers the SimuGel™ platform properties, formulation guidance, and validated mechanical and acoustic characterization.

2. What is SimuGel

SimuGel is a synthetic tissue material engineered to provide calibrated mechanical and acoustic behavior in simulation environments. It provides a safe, shelf-stable, and repeatable alternative to cadaver tissue.

Core properties:

- Calibrated mechanical response across the SimuGel formulation range
- Self-healing and remeltable, maintaining calibration through 8 to 10 remelts
- Safe synthetic composition free of cadaver tissue, reducing handling and disposal requirements
- Shelf-stable with no refrigeration required
- Validated acoustic response across clinical ultrasound frequencies
- Available in clear or tinted variations

SimuGel is designed for external simulation, evaluation, and training environments. SimuGel is not designed for implantation or clinical use.

3. Formulation selection

Human soft tissue properties vary based on anatomy, age, hydration, pathology, and measurement method. SimuGel formulations are designed as a relative compliance system spanning a controlled range of mechanical response from baseline to ultra-soft.

Selection is based on the mechanical behavior and procedural context required for your application. Each formulation delivers calibrated, predictable compliance across the SimuGel range. For application-specific guidance and tissue-by-tissue formulation recommendations, see the Humimic SimuGel Tissue Selection Guide.

4. SimuGel formulations and tissue applications

Formulation	Relative compliance	Primary tissue applications	Typical use scenarios
SimuGel #0	Baseline	High-use surface and needle-guided target training, cartilage, dense fibrous tissue, bulk material for embedded vessels and targets	General procedural training, IV access, ultrasound-guided needle placement, structural phantom backbone
SimuGel #1	Lower resistance	General adult surface response, dense	Incision and cutting practice, IM

Formulation	Relative compliance	Primary tissue applications	Typical use scenarios
		skeletal muscle, cardiac muscle (anatomical)	access, catheter placement
SimuGel #2	Medium-soft	Fibroglandular breast, prostate, lungs, postpartum uterus, average skeletal muscle	Manipulation-focused training, imaging-guided biopsy, OB/GYN training
SimuGel #3	Soft	Glandular tissue, pancreas, higher-compliance procedural models	Imaging-focused training, fine needle control, soft inclusions
SimuGel #4	Very soft	Subcutaneous fat, breast bulk, liver, kidney, spleen, intestine	Palpation-focused training, abdominal phantoms, soft organ analogs
SimuGel #5	Ultra-soft	Brain tissue, blood clot analog, neonatal soft tissue	Specialty high-compliance simulation, ultra-soft inclusions

All formulations available in clear or tinted variations. SimuGel formulations are intended to be interpreted relative to one another within the 0 to 5 system. For complete tissue selection including alternate formulations and application-specific guidance, see the Humimic SimuGel Tissue Selection Guide.

5. Mechanical properties

Mechanical properties are reported as population mean ± variance across validated production batches and are used to verify consistency and reproducibility within the SimuGel system.

Formulation	Young's Modulus (MPa)	Needle Resistance (N)	Firmness (g)	Resilience	Density (kg/m³)
SimuGel #0	0.58 ± 0.08	0.93 ± 0.14	686 ± 52	1.10	945.3
SimuGel #1	0.38 ± 0.04	0.62 ± 0.07	428 ± 32	1.16	935.0
SimuGel #2	0.26 ± 0.04	0.46 ± 0.05	308 ± 32	1.12	967.5
SimuGel #3	0.19 ± 0.03	0.37 ± 0.04	226 ± 22	1.11	856.8
SimuGel #4	0.15 ± 0.02	0.30 ± 0.04	179 ± 14	1.12	934.6
SimuGel #5	0.11 ± 0.02	0.22 ± 0.03	128 ± 19	1.13	1118.7

Mechanical properties are derived from internal specification windows and third-party testing. Values are reported as representative means with observed batch-to-batch variability. Resilience and density are reported as representative values due to minimal variation across production batches.

6. Acoustic properties

Acoustic properties were characterized using pulse-echo ultrasound testing in degassed water at controlled temperature across clinical imaging frequencies (3 to 10 MHz).

Formulation	Speed of Sound (m/s)	Impedance (MRayl)	α (3 MHz)	α (5 MHz)	α (10 MHz)	η
SimuGel #0	1449	1.37	1.44	3.44	11.21	1.700
SimuGel #1	1465	1.37	1.29	3.02	9.71	1.681
SimuGel #2	1457	1.41	1.11	2.52	7.68	1.600
SimuGel #3	1459	1.25	0.99	2.35	7.60	1.679
SimuGel #4	1455	1.36	0.91	2.25	7.59	1.761
SimuGel #5	1466	1.64	0.91	2.21	7.17	1.737

Acoustic attenuation follows a power-law model $\alpha(f) = a \times f^{n}$. Attenuation values reported in dB/cm at the named frequency. η is the power-law exponent. Acoustic properties are characterized and controlled to support consistent ultrasound imaging behavior across clinical frequencies.

7. Quality and certification

Each SimuGel batch is produced within validated manufacturing specifications and undergoes standardized mechanical testing. Each unit ships with a Certificate of Analysis verifying compliance with established performance tolerances.

8. Key notes and intended use

- SimuGel formulations provide calibrated tactile, mechanical, and ultrasound behavior for medical simulation and evaluation environments
- Every production batch ships with a Certificate of Analysis verifying compliance with Humimic Medical's validated performance tolerances
- Available in clear or tinted variations to support anatomical modeling, vascular embedding, and composite simulation structures
- Intended for use by clinical educators, simulation centers, medical device developers, and research laboratories
- Acoustic performance is characterized and validated across the clinical ultrasound frequency range (3 to 10 MHz)
- Manufactured in the USA with next-business-day shipping on most orders
- SimuGel is designed for external training and simulation environments only. SimuGel is not intended for implantation, internal clinical use, or any application inside the human body

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Companion reference: For tissue-by-tissue formulation guidance, application-specific recommendations, and full tissue selection by body system, see the **Humimic SimuGel Tissue Selection Guide**.

Humimic Medical. Greenville, South Carolina. Made in USA.