

I. Overview

Humimic SimuGel™ is a proprietary synthetic tissue-mimicking medium developed to support realistic medical training, trauma preparation, and device testing. This document provides an overview of SimuGel™ properties, formulation guidance, and validated mechanical and acoustic characterization.

II. What is SimuGel™

SimuGel™ is a synthetic material designed to look, feel, and respond like human tissue in simulation environments. It provides a safe, shelf-stable, and repeatable alternative to biological materials.

Core Properties

- Realistic, tissue-like mechanical response
- Reusable and remoldable for repeated training sessions
- Safe, synthetic composition free of biological material, reducing handling and disposal risk
- Shelf-stable with no refrigeration required
- Ultrasound compatible with characterized acoustic behavior

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

III. Formulation Selection Philosophy

Human soft tissue properties vary widely based on anatomy, age, hydration, pathology, and measurement method. SimuGel™ formulations are therefore designed as a relative compliance system spanning a controlled range of mechanical response from baseline to ultra-soft. Selection should be based on desired mechanical behavior and training context rather than direct equivalence to a specific tissue type.

IV. SimuGel™ Formulation and Relative Compliance Scale

Formulation	Relative Compliance / Resistance	Typical Use Scenarios	Intended Feel / Training Context	Color Options
SimuGel™ #0	Baseline / balanced	General procedural training, imaging-guided practice	All-purpose baseline with moderate resistance	Clear or tinted
SimuGel™ #1	Slightly lower resistance	Repetitive practice, reduced insertion-force training	Softer, more forgiving response while retaining structure	Clear or tinted
SimuGel™ #2	Medium-soft / compliant	Manipulation-focused training, imaging-guided procedures	Increased internal compliance with controlled deformation	Clear or tinted
SimuGel™ #3	Soft / high compliance	Imaging-focused training, fine needle control	Soft, highly compliant response with gentle recovery	Clear or tinted
SimuGel™ #4	Very soft	Layered models, palpation-focused training	Very low resistance suited for soft internal layers	Clear or tinted
SimuGel™ #5	Ultra-soft	Specialty high-compliance simulation models	Maximum deformation with minimal applied force	Clear or tinted

SimuGel™ formulations are intended to be interpreted relative to one another within the 0–5 system. Human tissue properties vary by anatomy, age, hydration, and pathology.

V. Mechanical Properties

Mechanical properties are reported as population mean \pm 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/m ³)
SimuGel™ #0	0.58 \pm 0.08	0.93 \pm 0.14	686 \pm 52	1.10	945.3
SimuGel™ #1	0.38 \pm 0.04	0.62 \pm 0.07	428 \pm 32	1.16	935.0
SimuGel™ #2	0.26 \pm 0.04	0.46 \pm 0.05	308 \pm 32	1.12	967.5
SimuGel™ #3	0.19 \pm 0.03	0.37 \pm 0.04	226 \pm 22	1.11	856.8
SimuGel™ #4	0.15 \pm 0.02	0.30 \pm 0.04	179 \pm 14	1.12	934.6
SimuGel™ #5	0.11 \pm 0.02	0.22 \pm 0.03	128 \pm 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.

VI. Acoustic Properties

Acoustic properties were characterized using pulse-echo ultrasound testing in degassed water at controlled temperature across clinical imaging frequencies.

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 $\alpha(f) = a \times f^b$. Acoustic properties are characterized and controlled to support consistent ultrasound imaging behavior across clinical frequencies.

VII. Quality & 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.

VIII. Key Notes & Intended Use

- SimuGel™ formulations are designed to provide realistic tactile, mechanical, and ultrasound behavior for medical simulation and evaluation environments
- Every production batch ships with a Certificate of Analysis (COA) verifying compliance with Humimic Medical's validated performance tolerances
- Materials remain stable, reusable, and remoldable at room temperature
- Available in clear or tinted variations to support anatomical modeling, vascular embedding, and layered 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 (3–10 MHz)