ADCERAX
ADVANCED CERAMICS

Alumina Ceramic Grade Comparison

Six nominal-purity grades for furnace, insulation and mechanical components

Dense sintered Al_2O_3 | Select purity, product geometry and service conditions together

Property	Unit / condition	99.90% AD-ALU-999	99.70% AD-ALU-997	99.50% AD-ALU-995	99.00% AD-ALU-990	96% AD-ALU-960	95% AD-ALU-950
Alumina content	Al_2O_3 | wt% | nominal	99.90	99.70	99.50	99.00	96	95
IEC 60672-3 composition class	Composition grouping	C799	C799	C799	C795	C795	C795
Bulk density	g/cm³ | typical	3.94	3.94	3.90-3.92	3.80-3.91	3.70	3.75
Flexural strength	MPa | 20 °C | typical	315-340	330	320-350	300-320	300	280
Thermal conductivity	W/(m·K) | 25 °C except 96% | typical	35-42	35-40	30-38	24	25 (20 °C)	18-25
Mean linear thermal expansion	10^{-6}/K | 25-800 °C except 96%	7.6	7.6	7.6	7.2	8.2 (25-1000 °C)	7.6
Color	Visual	Ivory	Ivory	Ivory	Ivory	White	Ivory / white
Water absorption	% | selection limits; 96% typical	≤0.01	≤0.05	≤0.10	≤0.10	≈0 (typical, rounded)	≤0.20
Mohs hardness	Mohs scale | typical	9	9	9	9		9
Vickers hardness	HV1 | 1 kgf | typical					1600	

Selection priorities

For furnace tubes, assess atmosphere, contamination, wall thickness and thermal cycling before selecting the highest purity. For electrical insulation, compare temperature, frequency and specimen thickness. For wear components, include surface finish, counterface and contact stress.

96% measurement basis

AD-ALU-960: thermal conductivity is at 20 °C; mean CTE is over 25-1000 °C. These conditions differ from the other grades. Vickers 1600 HV1 uses a 1 kgf test force and is not a Mohs conversion. Near-zero water absorption is a rounded typical value, not an absolute-zero limit or proof of hermeticity.

Value notation: nominal identifies grade composition; typical values and ranges are not manufacturing tolerances. Inequalities indicate bounds, not exact measurements; ≈ denotes rounding. Hardness scales are not interchangeable. Apply the stated measurement conditions and agreed purchase acceptance criteria.

Values support material selection for the stated product and conditions. They are not component design allowables. Purchase acceptance limits, test conditions and sampling are defined on the drawing or purchase order. IEC grouping describes composition and is not a product conformity certificate.

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Alumina Mechanical, Thermal & Tube Properties

Mechanical and thermal properties with a tube-straightness specification

Material strength is specimen-dependent | Furnace temperature is not a loaded-life rating

Property	Unit / condition	99.90% AD-ALU-999	99.70% AD-ALU-997	99.50% AD-ALU-995	99.00% AD-ALU-990	96% AD-ALU-960	95% AD-ALU-950
Flexural strength	MPa | 20 °C | typical	315-340	330	320-350	300-320	300	280
Compressive strength	MPa | 20 °C | typical	2558-2900	2500	2400	2400	2000	2000
Young's modulus	GPa | typical	359-375	370	365	355	275 (20 °C)	340
Fracture toughness, K_{IC}	MPa·m½ | method-dependent	3.8-4.2	3.6	3.5	3.3	3.5 (20 °C)	3.0
Thermal conductivity	W/(m·K) | 25 °C except 96% | typical	35-42	35-40	30-38	24	25 (20 °C)	18-25
Mean linear thermal expansion	10^{-6}/K | 25-800 °C except 96%	7.6	7.6	7.6	7.2	8.2 (25-1000 °C)	7.6
Service temperature guide	°C | application-dependent	1750	1700	1650	1600	1600 (maximum, air)	1400

Tube property	Unit / measurement basis	AD-ALU-997 / 995 / 990 / 950
Tube straightness	mm/m | datum and gauge length defined on drawing	1

Thermal and mechanical design

Define creep/deformation allowance, support span and heating/cooling rates. Thermal-shock qualification shall specify component geometry, quench medium, cycles and failure criterion. Tube straightness of 1 mm/m equals 1‰ (0.1%); it is not sintering shrinkage.

Service temperature

Temperature values support material selection; they are not continuous-duty or loaded-life ratings. Suitability depends on atmosphere, load, dwell time, thermal cycling, allowable creep and required service life. AD-ALU-960: 1600 °C maximum in air.

For sliding or abrasive wear, specify the counterbody, load, velocity, distance and mass/volume-loss metric. Hardness alone does not establish wear life.

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Alumina Electrical Properties & Chemistry Requirements

Temperature- and frequency-specific electrical selection with composition control

Compare electrical properties at the stated temperature, frequency, specimen thickness and waveform

Property	Unit / condition	99.90% AD-ALU-999	99.70% AD-ALU-997	99.50% AD-ALU-995	99.00% AD-ALU-990	96% AD-ALU-960	95% AD-ALU-950
Dielectric strength	kV/mm | 5 mm except 96% | typical	10	10	10	10	8.3 (AC; 6.35 mm)	10
Relative permittivity, ε_r	1 MHz | 25 °C except 96% | typical	9.8	9.8	9.7	9.6	9.0 (room temperature)	9.4
Dissipation factor, tan δ	1 MHz | 25 °C except 96%	<0.0001	<0.0001	<0.0001	0.0006	0.0002 (20 °C)	0.0004
Volume resistivity	Ω·cm | 20 °C	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$	10^{14} (typical)	$>10^{12}$

96% electrical measurement basis

AD-ALU-960: breakdown is an AC coupon value at 6.35 mm thickness; permittivity is at room temperature and 1 MHz; dissipation factor is at 20 °C and 1 MHz; volume resistivity is typical at 20 °C. Different thicknesses, waveforms and temperatures are not directly interchangeable. Select the test geometry before comparing breakdown fields.

Purchase-critical characteristic	Reporting basis	Requirement to specify
Alumina and secondary constituents	Representative finished ceramic | mass basis	Al_2O_3, SiO_2, Na_2O, Fe_2O_3, MgO, CaO and other constituents relevant to the application
Trace contamination	ppm = mg/kg | declared chemical species	Individual maximum levels, analytical quantification limits, sampling and sample preparation
High-temperature insulation	Actual operating temperature and atmosphere	DC resistivity or insulation resistance with voltage, electrode geometry and electrification time
RF / microwave insulation	Operating frequency and temperature	Permittivity and loss measured for the ordered grade and relevant specimen geometry
Hermetic components	Finished part with defined pressure difference	Maximum helium leak rate, fixture, seals and acceptance test

Coupon breakdown fields at 5 mm or 6.35 mm are not finished-part working-voltage ratings. Creepage, clearance, edges, electrodes, humidity and voltage waveform must be considered separately.

Alumina: Test & Purchase Requirements

Methods and reporting conditions for reproducible acceptance testing

Specify the product, condition, specimen and acceptance rule before comparing test results

Characteristic	Test method / standard	Reporting requirements
Major and secondary oxides	ISO 12677 | oxide ceramics	Validate fused-bead XRF for the finished-body matrix; report oxide mass basis, calibration and quantification limits.
Trace analysis	Validated decomposition + ICP-OES	Declare element or oxide species. Validate recovery and matrix effects for the ceramic digest.
Density / apparent porosity	ISO 18754	Displacement liquid, saturation, specimen condition and calculation.
Flexural strength at room temperature	ISO 14704	Three/four-point mode, span, surface finish, rate and number of specimens.
Compressive strength	ASTM C1424	Specimen geometry, end preparation, alignment and loading rate.
Elastic modulus / Poisson's ratio	ISO 17561	Resonance/sonic method, geometry, density and calculation.
Vickers hardness	ISO 14705 / ASTM C1327	Report HV, force, dwell, finish and valid indent count. ASTM C1327 applies to Vickers; keep HV and HK distinct.
Fracture toughness	ISO 23146 / ASTM C1421	Crack/notch method, orientation and calculation; keep methods distinct.
Linear thermal expansion	ISO 17562	Mean or instantaneous coefficient, start/end temperatures and atmosphere.
Thermal conductivity	ISO 18755	Flash diffusivity; calculate conductivity with density and heat capacity at the same temperature. State direction.
Thermal shock	ASTM C1525	Quench medium, temperatures, cycles and retained-strength criterion.
Dielectric breakdown	IEC 60243-1 (AC) / -2 (DC)	Waveform, thickness, electrodes, test medium, ramp and failure criterion.
Permittivity / dielectric loss	IEC 62631-2-1	Frequency, temperature, electrode geometry and conditioning.
Volume resistivity	IEC 62631-3-1 / -3-4	State temperature, DC voltage, dwell, humidity/atmosphere and guarded electrodes. Use -3-4 within its elevated-temperature scope.
Surface texture / dimensional geometry	ISO 21920 series / drawing	Ra filter and direction; datums, gauge length, support and temperature.

Select the applicable method and edition in the purchase specification. Listed standards define testing options; they do not imply that every value was measured by each method.

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