



Acoustic Performance

Credit	LEED® Credit	Points	Armstrong Ceilings Contribution
EQ	Acoustic Performance (now all Rating Systems)	BD&C – 2 ID&C – 2	<p>ARMSTRONG ACOUSTIC CEILING & WALLS</p> <p>BD&C – 2, Option 2: Choose Armstrong® Wall Panels to add to drywall for a higher combined STC value, significantly reducing Sound Transmission.</p> <p>BD&C – 2, Option 2: Armstrong® acoustic ceilings absorb sound, contributing to the reduction of Reverberation Time and increased speech intelligibility. Schools must meet ANSI Standard S12.60 contributing to the reduction of reverberation time.</p>

Acoustics play an integral role in any space. Surface finishes selected must enhance the indoor environmental quality of a space relative to its functionality. Armstrong ceilings with Total Acoustics™ performance reduce noise levels in interior spaces, allowing for an ideal combination of high performance sound absorption and room-to-room sound attenuation to maximize speech intelligibility.

NRC + CAC = Total Acoustics™ Performance

Setting	Situation	Acoustical Suggestion	Recommended Ceiling System
Workplace			
Open Office	Employees have difficulty focusing on tasks due to noisy office space. Contributors of distractions include conversations of co-workers in collaboration areas, benching workstations, and use of speaker phones.	Worker effectiveness can be increased with ceilings that provide Total Acoustics™ performance using high NRC products in open plan areas to absorb and block sound.	Lyra™ High CAC, Optima®, Calla™, TechZone® Ceiling Systems Ultima® High NRC, Cirrus® High NRC, Fine Fissured™ High NRC Ultima®, Cirrus®, Formations™ Acoustical Clouds
Closed Office	Concentrating on technical work is difficult when sound can be heard through doorways, windows, and HVAC ducts transferring sound from room to room. Employees ranked acoustics the lowest of key attributes in the workplace.	Ceilings that provide Total Acoustics™ performance have high CAC and NRC to provide privacy from adjoining offices and corridors.	Lyra™ High CAC, Ultima® High CAC, Cirrus®, WoodWorks® Ultima, Cirrus, Mesa™ High CAC MetalWorks™ perforated panels
Education			
Classroom	Excessive reverberation inhibits student understanding and increases teacher vocal strain. Studies indicate that students typically hear only 3 out of every 4 words, missing 25% of what is said in the classroom.	Ceilings with Total Acoustics™ performance provide shorter reverberation time, better sound absorption, and sound blocking, which promotes higher speech intelligibility.	Ultima, Optima, Lyra™ High CAC, TechZone Ceiling Systems School Zone® Fine Fissured™, Cirrus® High NRC School Zone Fine Fissured, Cirrus
Cafeterium	Open multi-purpose spaces change from cafeterias to auditoriums to gymnasiums requiring different acoustical needs depending on use.	Sound absorption is key and can be accomplished with Total Acoustics™ ceilings with high NRC products along with CAC for sound blocking to prevent sound from traveling into adjacent classrooms.	MetalWorks™ perforated panels, Lyra™ High CAC Calla, Ultima, Formations Acoustical Clouds School Zone Fine Fissured
Healthcare			
Patient Room	The need to share private medical information between patients, doctors, and other medical staff without worrying about being overheard by others is key in a healthcare environment.	A ceiling with Total Acoustics™ performance helps to block noise and control reverberation, and from transferring noise to other spaces. The result is a private, secure environment for sharing confidential information, holding discreet conferences, and understanding critical instructions.	Ultima® High CAC, Ultima® High NRC, Ultima® Health Zone™, Ultima® Health Zone™ High NRC Mesa™ High CAC, Fine Fissured™ High NRC, Ultima, Ultima® Create!™, Calla Cirrus® High NRC, Mesa
Lobby and Nurses' Station	Noise caused by hard surfaces, active corridors, busy nurses' stations, alarms, non-private treatment areas, and a 24/7 work environment all help to create sound levels that exceed those recommended by the World Health Organization.	Spot absorption in larger open spaces, and cleanable, scrubbable ceilings with Total Acoustics™ performance offer noise reduction and sound blocking in spaces with wall-to-wall ceilings, addressing excessive noise and reverberation.	Optima® Health Zone™, Ultima® Health Zone™ Lyra™ High CAC, Optima® High CAC, Calla, Ultima, WoodWorks perforated panels, MetalWorks perforated panels Cirrus, Mesa™ High CAC



NRC + CAC = Total Acoustics
 Total Acoustics Ceilings have an ideal combination of noise reduction and sound-blocking performance in one product



Acoustic Performance

Acoustics Key Terms Whether your acoustical concerns are basic, specific, or revolve around achieving Total Acoustics™ performance, here's a quick reference guide to help make acoustics terms a little more simple.

Reverberation

The persistence of sound in an enclosed space after the source of the sound has stopped. The level of the reverberant sound within a room is dependent on both the volume of the room and the amount of sound absorption installed within the room, such that small hard surfaced rooms are "louder" than large well-treated rooms.



Sound Reflection

Intentional use of non-absorptive surfaces that enhance a lively acoustical sound quality, typically for nightclubs or music venues.



NRC + CAC = Total Acoustics™ Performance

CEILINGS

Noise Reduction Coefficient (NRC)

A measure for rating the overall sound absorption of a material when used in an enclosed architectural space where sound is reflected at many angles of incidence.

A ceiling system with an NRC < 0.50 is low performance, an NRC > 0.70 is high performance.

NRC is important in any space where reverberation time and noise levels are an issue.

- NRC is measured according to ASTM C423
- NRC is a key metric used in the Americas. Europe and other geographics use the weighted sound absorption coefficient α_w .



Ceiling Attenuation Class (CAC)

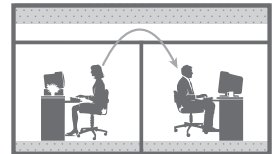
A measure for rating the performance of a ceiling system as a barrier to airborne sound transmission through a common plenum between adjacent closed spaces, such as private offices, and open spaces used for collaboration and focus areas.

A ceiling system with a CAC < 25 is considered low performance, whereas one with CAC of 35 or higher is high performance.

CAC is important between closed spaces needing privacy and from closed rooms to adjacent spaces such as:

- Closed offices to corridors
- Classrooms to group learning areas
- Healthcare offices and exam rooms to waiting rooms

CAC is measured according to ASTM E1414.



REFERENCE – ACOUSTIC PERFORMANCE

CLOUDS, CANOPIES / VERTICAL ELEMENTS

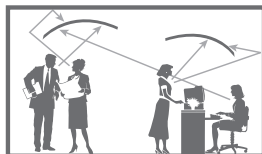
Sabin

A measure of sound absorption provided by a material when installed within an architectural space. The number of sabin per unit is approximately equal to the total surface area of the unit (in square feet) that is exposed to sound, multiplied by the absorption coefficient of the material.

Sabin per unit is preferred to characterize the absorption provided by an individual "space absorber," such as a baffle, blade, cloud, or canopy in:

- Open offices or retail spaces
- Open plenum areas
- Corridors/lobbies

Absorption of sabin is measured according to ASTM C423.





Acoustic Performance

Acoustics Key Terms Whether your acoustical concerns are basic, specific, or revolve around achieving Total Acoustics™ performance, here's a quick reference guide to help make acoustics terms a little more simple.

A wall system with an NRC < 0.50 is low performance, an NRC > 0.70 is high performance. NRC is important in any space where reverberation time and noise levels are an issue.

- NRC is measured according to ASTM C423
- NRC is a US-based measure. Other geographics use the weighted sound absorption coefficient α_w .

Articulation Class (AC)

A measure for rating the attenuation of reflected speech passing over the top of wall partitions or furniture into the adjoining workstations.

A ceiling system with AC < 150 is low performance, whereas one with AC \geq 180 is high performance.

AC is important between adjacent cubicles in open plan spaces:

- Office – focus spaces
- Office – collaboration areas
- Open plan healthcare/partial height cubicle areas

AC is measured according to ASTM E1110 and E1111.



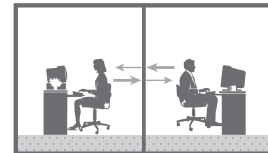
Sound Transmission Class (STC)

A measure for rating the performance of a wall system as a barrier to airborne sound transmission between adjacent closed spaces, such as offices.

A wall system with an STC < 35 is considered low performance, whereas one with an STC > 55 is high performance. STC is the wall equivalent of CAC.

STC is important between closed spaces and in many open plan spaces:

- Closed offices, corridors
 - Open offices with dividers
- STC is measured according to ASTM E90.



WALLS

ONLINE TOOLS

Online Reverberation Calculator

Our new interactive web-based tool calculates reverberation and sound quality for speech intelligibility which is very important for the built environment. This tool allows you to hear the before and after difference. Providing recommendations for both new spaces and upgrades to existing spaces, this easy-to-use tool makes specifying recommended sound-absorptive ceilings and walls easy, and cost effective.

armstrong.com/reverbtool



MOBILE TOOLS

Sound Level Meter App From Armstrong

Visualize the noise in your space with the Sound Level Meter app by Armstrong.

- Record the noise in your space with your iPhone® mobile device
- See how it measures against recommended ranges for similar spaces
- If there's a problem, learn how to improve the acoustics





Visit our web site and
 watch our video for
Acoustics in Education
armstrong.com/quieterschools

Acoustic Performance

Speech Intelligibility – Why it's Important The quality of the acoustic environment in a classroom or learning facility is vital, since students must be able to understand the teacher to learn effectively. This ability is especially important to students with hearing impairments, very young children, and students for whom English is a second language. Teachers must also be taken into consideration, since vocal strain can contribute to fatigue, frustration, and even “burnout.”

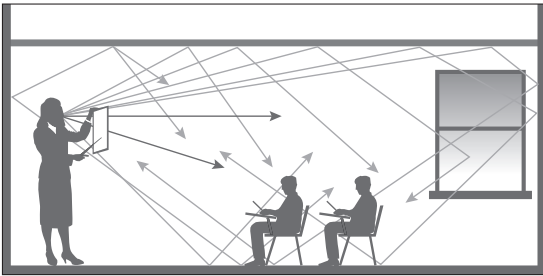
Ceiling panels with Total Acoustics™ Performance provide the ideal combination of noise reduction and sound-blocking performance to help keep noise levels down and sound levels where you want them for optimum communications.

NRC + CAC = Total Acoustics™ Performance

EDUCATION

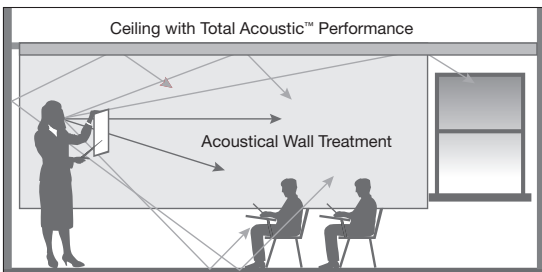
Hard Surface Classroom

Black arrows represent direct sound from teacher to student.
 Green arrows represent reflected sound.



Acoustically Treated Classroom

The addition of sound absorbing materials reduces late arriving reflected sound, lowers reverberation time, and improves speech intelligibility.



The intelligibility of speech in a classroom depends on both reverberation time and the signal-to-noise ratio.

The signal-to-noise ratio, or S/N, is the ratio of the speech level reaching the student's ear relative to the background noise that interferes with hearing the speech.

The potential for good sound quality is determined by the architectural design as represented by reverberant sound and reverberation time. To protect the sound quality provided by the architecture requires that the intruding background noise be kept low.

There are several ways to increase the signal-to-noise ratio:

- Raise speech level
 - The teacher can speak louder, but, of course, runs the risk of vocal strain
- Reduce noise traveling through the ceiling plenum, from the floor above, or an adjacent classroom
 - Choose a ceiling with a high CAC value; the higher the number, the better it acts as a sound barrier
- Reduce noise traveling through the walls
 - The new ANSI standard requires a minimum STC of 50 for a wall separating two adjacent classrooms. The higher the number, the better the performance.
- Reduce noise within the room
 - Use a quiet heating/ventilation (HVAC) system

The reverberation time in a space is essentially the time it takes for the reflected sound within the space, such as from a loud hard clap, to become “inaudible.” A long reverberation time is detrimental to good speech intelligibility, since the reflections of words just spoken can interfere with words now being spoken.

Sound-absorptive material can be added to the room to reduce reverberation time and help meet ANSI S12.60:

- Reduce reflected sound (reverberation time)
 - Add sound-absorbing material to reduce reverberation.
 - A ceiling with an NRC of at least 0.70 is recommended
 - If the ceiling is high, Soundsoak® wall treatments will also be beneficial

REFERENCE – ACOUSTIC PERFORMANCE



Visit our web site and watch our videos for
Acoustics in Offices, Healthcare, and Education
 armstrong.com/quieteroffices
 armstrong.com/quieterhospitals

Acoustic Performance

Speech Privacy – Why it’s Important The two leading sources of workplace dissatisfaction are lack of speech privacy and noise, both of which adversely affect work performance. In healthcare, maintaining patient confidentiality, including oral privacy, is a HIPAA requirement. Noise can also affect patient recovery and HCAHPS outcomes. Total Acoustics™ ceiling panels provide the ideal combination of noise reduction and sound blocking to help keep noise levels down and private conversations private.

NRC + CAC = Total Acoustics™ Performance

OFFICE



NEED:

Confidentiality in a private office or conference room

SOLUTION:

Total Acoustics ceiling to block sound to keep conversation private and decreased reverberation needed for focus

Defining Speech Privacy Levels

- ① **CONFIDENTIAL**
partially overheard, but not understood
- ② **NON-INTRUSIVE/NORMAL**
can be overheard, partially understood
- ③ **POOR**
mostly overheard and understood
- ④ **NO PRIVACY**
fully overheard and understood

Recommended Applications*

Confidential Privacy:

Expected for most private offices, PI: 95%-100%.

Normal Privacy:

Allows people to think and concentrate and is expected for most open plan spaces. PI: 80%-95%.

Marginal or No Privacy:

Common in many office environments.

*Commonly recognized levels of Speech Privacy as defined by ASTM E1130.

Effective Building Design for Speech Privacy Using Sound Blocking Techniques

Building design can have significant impact on speech privacy and construction costs. Below are typical construction scenarios showing how speech privacy is affected.

Scenario 1: Typical Design

- Mineral fiber ceiling (NRC 0.50/CAC 33)
- Wall to ceiling
- No plenum barrier
- Background noise at ASHRAE recommended 37 dBA

Privacy Index* is less than 95%

Scenario 2: Perceived Upgrade

- Fiberglass or stone wool ceiling (NRC 0.90/CAC 22-27)
- Wall to ceiling
- No plenum barrier
- Background noise at ASHRAE recommended 37 dBA

Privacy Index* is significantly lower than 95%

Scenario 3: HIPAA Compliant Solution

- Mineral fiber ceiling (NRC 0.70/CAC 35)
- Wall to ceiling
- No plenum barrier
- Background noise at ASHRAE recommended 37 dBA

Privacy Index* is greater than 95% and confidential speech privacy is achieved

*Privacy Index measurement and calculation are defined in ASTM E1130

HEALTHCARE



NEED:

Patient recovery and oral privacy

SOLUTION:

Total Acoustics ceilings provide sound blocking for recuperation and decreased reverberation for optimum communications

HIPAA, FGI & HCAHPS Guidelines in Healthcare

All healthcare facilities, including hospitals, doctors' offices, and pharmacies, need to comply with the Health Insurance Portability and Accountability Act (HIPAA) as well as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). Fortunately, there are easy and economical ways to meet these oral privacy regulations and expectations in treatment and patient rooms, and waiting and reception areas. Armstrong® high-performance acoustical ceiling systems absorb and block sound to create a more quiet and therapeutic environment.

The FGI Guidelines for the Design and Construction of Healthcare Facilities also include recommendations for acoustical finishes and details, room noise levels, sound isolation, and sound masking and paging.

By using Total Acoustics™ ceilings, you can help ensure compliance with HIPAA and FGI, and assure positive HCAHPS outcomes.

REFERENCE – ACOUSTIC PERFORMANCE



UL Classified Acoustical Performance Summary

Acoustic Performance

Product Family	Sound absorption co-efficients ^A – e-400 mounting						Published value: sound absorption ^B	Published value: sound transmission ^C
	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	NRC ^D	CAC ^D

Soft Fiber

Lyra™	0.75	0.95	0.79	1.00	1.03	1.00	.95	–
Optima® 1.5" w/CAC Backing	0.51	0.85	0.91	1.13	1.09	1.01	1.00	26
Optima 1.5"	0.73	0.95	0.92	1.06	1.03	0.94	1.00	–
Optima 1"	0.76	0.89	0.84	1.02	1.09	0.99	0.95	–
Optima 3/4"	0.81	0.94	0.76	0.93	1.05	1.01	0.90	–
Optima® Vector® 7/8" w/CAC Backing	0.42	0.44	0.78	0.94	1.09	1.05	0.80	26
Optima Vector 7/8"	0.72	0.84	0.79	0.99	1.06	1.00	0.90	–
Optima® Health Zone™ 1"	0.72	1.00	0.80	1.01	1.06	0.98	0.95	–
Painted Nubby™ 1"	0.76	0.89	0.84	1.02	1.09	0.99	0.95	–
Painted Nubby 3/4"	0.73	0.94	0.70	0.90	0.99	1.01	0.90	–
Pebble™ High NRC Perforated	0.74	0.78	0.68	0.88	0.78	0.66	0.80	–
Pebble 5/8" Perforated	0.59	0.70	0.56	0.84	0.89	0.71	0.70	–
Pebble Unperforated	0.50	0.31	0.28	0.77	0.66	0.67	0.50	–
Random Fissured™ 5/8" Perforated	0.59	0.70	0.56	0.84	0.89	0.71	0.70	–
Random Fissured Unperforated	0.44	0.35	0.33	0.83	0.84	0.64	0.55	–
Shasta® 5/8" Perforated	0.59	0.70	0.56	0.84	0.89	0.71	0.70	–
Shasta Unperforated	0.50	0.31	0.28	0.77	0.66	0.67	0.50	–

Mineral Fiber

Armatuff®	0.33	0.32	0.69	0.65	0.52	0.36	0.50	33-35
Calla™	0.58	0.65	0.74	0.94	0.98	0.95	0.85	32
Ceramaguard® Perforated	0.28	0.27	0.43	0.72	0.90	0.86	0.55	38-40
Ceramaguard Unperforated	–	–	–	–	–	–	–	40
Cirrus® 3/4"	0.31	0.35	0.62	0.86	0.94	0.89	0.70	35
Cirrus® 3/4" Fire Guard™	0.27	0.25	0.29	0.36	0.46	0.53	0.35	35
Cirrus 7/8"	0.36	0.40	0.66	0.84	0.88	0.91	0.70	38
Cirrus® 7/8" High CAC	0.27	0.37	0.70	0.91	0.94	0.96	0.70	40
Cirrus® 7/8" High NRC	0.33	0.39	0.85	1.00	0.96	0.96	0.75	35
Cirrus 3/4" 1-Up Profiles	0.26	0.36	0.57	0.82	0.89	0.85	0.65	35
Cirrus 3/4" 4-Up Profiles	0.32	0.29	0.55	0.87	0.96	0.91	0.65	35
Cirrus® Second Look®	0.23	0.31	0.59	0.83	0.95	0.95	0.65	35
Cirrus® Themes™	–	–	–	–	–	–	0.65	35
Clean Room™ FL (field units)	0.28	0.30	0.69	0.94	0.77	0.54	0.55	35
Clean Room FL (border units)	–	–	–	–	–	–	–	35
Clean Room VL Unperforated	–	–	–	–	–	–	–	40
Clean Room VL Perforated	0.22	0.24	0.53	0.90	0.78	0.47	0.55	35
Cortega® 5/8"	0.21	0.26	0.51	0.78	0.75	0.69	0.55	35
Cortega 5/8" Fire Guard	0.22	0.26	0.46	0.78	0.92	0.82	0.55	35
Cortega Second Look	0.20	0.30	0.48	0.72	0.73	0.73	0.55	30-35
Cortega Second Look Fire Guard	0.23	0.31	0.56	0.87	0.85	0.82	0.55	40

A = These are representative data for the product family. Sound absorption test data for specific item tested. Data and test reports for most products available upon request. Contact TechLine™ at bpotechline@armstrong.com

B = Sound Absorption Data and NRC rating obtained by ASTM Procedure C423, "Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method." Sample mountings follow procedures outlined in ASTM E795, "Standard Practices for Mounting Test Specimens During Sound Absorption Tests."

C = Sound Transmission loss data obtained by procedures outlined in AMA-1-II, "Test Method for Ceiling Sound Transmission Test by the Two-Room Method" or by the ASTM Procedure E1414, "Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum." CAC rating determined by following procedures outlined in ASTM Procedure E413, "Classification for Rating Sound Insulation."

D = NRC and CAC single number ratings comply with ASTM E1264 classification requirements.

REFERENCE – ACOUSTIC PERFORMANCE



UL Classified Acoustical Performance Summary

Acoustic Performance

Product Family	Sound absorption co-efficients ^A – e-400 mounting						Published value: sound absorption ^B	Published value: sound transmission ^C
	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	NRC ^D	CAC ^D
Mineral Fiber (continued)								
Dune™ 5/8"	0.33	0.34	0.65	0.64	0.59	0.42	0.55	30-35
Dune 3/4"	0.21	0.33	0.81	0.76	0.61	0.48	0.50	35
Dune™ 5/8" Fire Guard™	0.21	0.28	0.51	0.74	0.60	0.42	0.50	33-35
Dune™ Second Look®	0.34	0.35	0.64	0.60	0.53	0.40	0.50	35
Fine Fissured™ Concealed / T&G	0.43	0.31	0.42	0.66	0.79	0.70	0.55	35
Fine Fissured 5/8"	0.28	0.28	0.49	0.74	0.75	0.65	0.55	33-35
Fine Fissured 5/8" Fire Guard	0.18	0.25	0.51	0.86	0.83	0.72	0.55	35
Fine Fissured™ 5/8" High Durability	0.18	0.25	0.51	0.86	0.83	0.72	0.55	35
Fine Fissured™ 3/4" High Acoustics Lay-In	0.25	0.32	0.74	0.92	0.86	0.84	0.70	35-40
Fine Fissured™ 3/4" High Acoustics Tegular	0.29	0.30	0.65	0.91	0.85	0.79	0.70	40
Fine Fissured™ 3/4" High Acoustics Fire Guard™	0.20	0.30	0.74	0.95	0.87	0.82	0.70	35-40
Fine Fissured™ 7/8" High NRC	0.28	0.39	0.86	1.01	1.01	1.02	0.75	35
Fine Fissured Second Look I, II	0.20	0.30	0.48	0.72	0.73	0.73	0.55	30-35
Fine Fissured Second Look III	0.28	0.30	0.56	0.60	0.60	0.60	0.50	35
Fine Fissured Second Look II Fire Guard	0.21	0.30	0.70	0.82	0.84	0.85	0.55	35
Fissured™	0.23	0.23	0.49	0.72	0.73	0.72	0.55	30
Fissured Fire Guard	0.22	0.26	0.46	0.78	0.92	0.82	0.60	35
Georgian™ 5/8"	0.28	0.23	0.49	0.81	0.80	0.75	0.55	33
Georgian 5/8" Tegular	0.32	0.33	0.60	0.71	0.56	0.40	0.55	35
Georgian™ High Acoustics	0.30	0.28	0.60	0.97	0.85	0.54	0.65	35
Georgian™ High Washability	-	-	-	-	-	-	-	33
Georgian™ High Washability Fire Guard™	-	-	-	-	-	-	-	35
Graphis® Finetex™	-	-	-	-	-	-	-	35
Graphis® Rustex™	0.39	0.31	0.44	0.69	0.89	0.98	0.55	30
Ledges®	-	-	-	-	-	-	-	35
Mesa™	0.35	0.40	0.67	0.78	0.76	0.67	0.60	33-35
Mesa™ High CAC	0.30	0.32	0.69	0.84	0.73	0.62	0.60	40
Tincraft™	-	-	-	-	-	-	-	35
Tundra®	0.23	0.27	0.57	0.67	0.52	0.41	0.50	33-35
Ultima®	0.33	0.33	0.70	0.89	0.92	0.96	0.70	35
Ultima® Health Zone™	0.30	0.32	0.71	0.92	0.90	0.89	0.70	35
Ultima® Health Zone™ High NRC	0.28	0.36	0.82	1.06	0.99	0.98	0.80	35
Ultima® High CAC	0.26	0.31	0.59	0.78	0.80	0.69	0.60	40
Ultima® High NRC	0.31	0.44	0.85	0.95	0.93	0.92	0.80	35
Ultima® Vector®	0.34	0.38	0.67	0.89	0.82	0.80	0.70	33

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