



CHENGDU SHUOWU TECHNOLOGY CO., LTD.

Advanced Insulation Solutions for Industrial Piping & Equipment

Thermal · Cryogenic · Acoustic

Industrial piping and equipment, engineered around the actual operating duty.

International Introduction

Contents

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09 **What Can Shuowu Do for My Project?**

Technical Appendix · Complete technical data, case conditions, engineering calculations, standards and certificates

The background of the slide is a blue-tinted photograph of an industrial facility. In the foreground, a large, polished metal pipe curves from the bottom left towards the right. In the background, several tall industrial towers with ladders and platforms are visible against a clear blue sky. The overall aesthetic is clean and professional, with a focus on industrial engineering.

01

What Shuowu Does?

Three insulation problems, one engineering discipline.

What Shuowu Does

Three insulation problems — and one engineering discipline behind all of them.



THERMAL

Keep heat In

Industrial hot service up to 1,000 ° C



CRYOGENIC

Keep cold in

Low-temperature service down to -196 ° C



ACOUSTIC

Control industrial noise

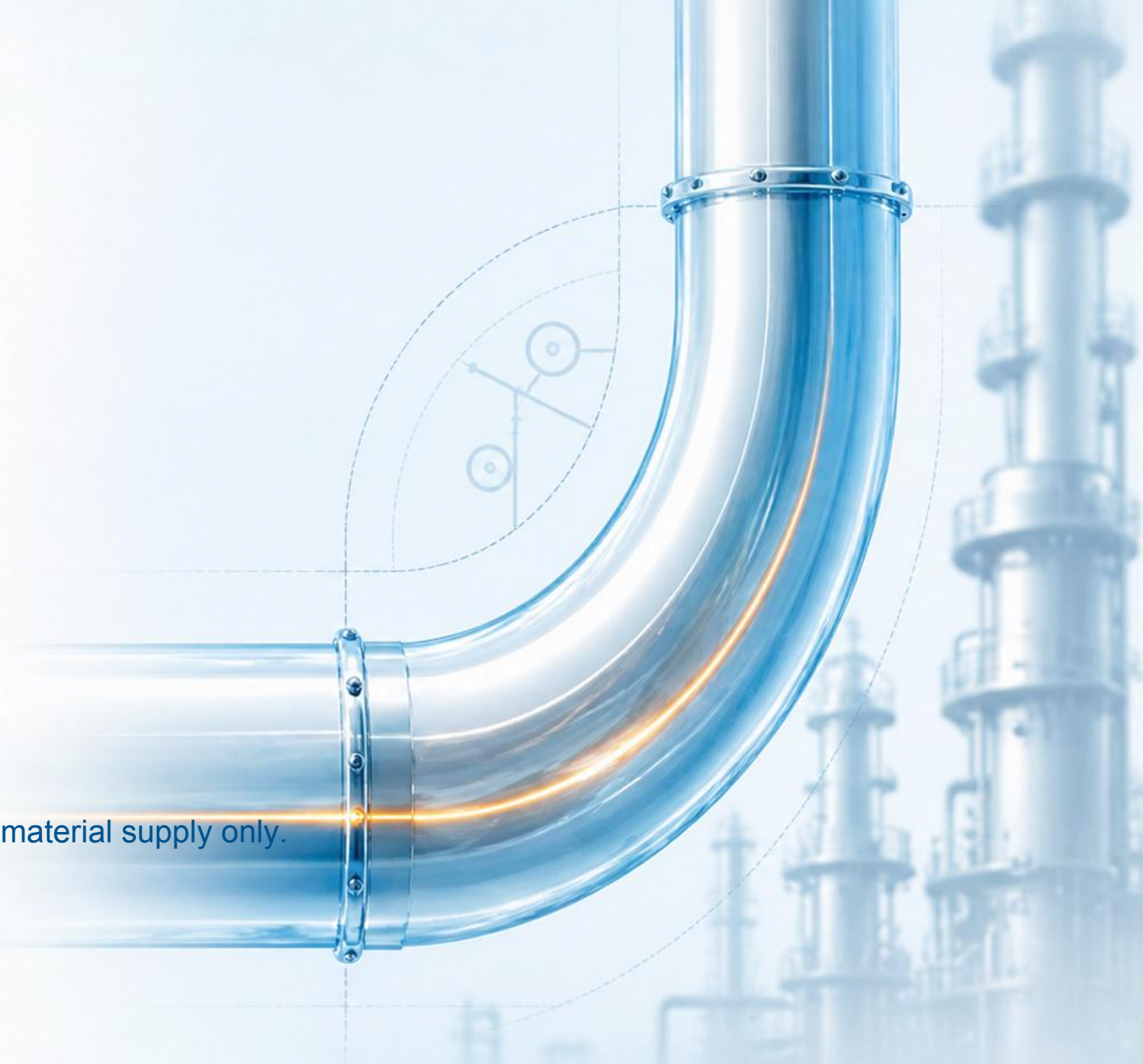
Noise control for industrial piping and equipment

Engineered insulation solutions for every industrial application.

02

Services We Provide

From operating data to field verification — not material supply only.



More Than Material Supply

Shuowu provides engineering support throughout the insulation project lifecycle, from initial assessment to field verification.

1 Site assessment
Operating conditions and project requirements

2 Engineering calculation
Heat loss, surface temperature and acoustic performance

3 Material selection
Grade, thickness and system build-up

4 System design
Cladding, joints, vapour control and drainage

5 Installation support
On-site technical guidance

6 Field verification
On-site performance measurement



Engineering Deliverables

- Thermal and acoustic calculations
- Material and thickness recommendations
- Insulation system design
- Installation guidance
- Field performance verification

03

Why Shuowu?

Experience, delivered sites, patents and standards participation.



Why Shuowu

More than 20 years of industrial insulation work, backed by patents, certified systems and standards participation.

SINCE 2006 Industrial insulation experience	DELIVERED 100+ Industrial sites	PATENTS GRANTED 26 Including invention patents and one PCT filing	INVENTION PATENTS 15 Of the 26 patents granted
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CERTIFIED MANAGEMENT SYSTEMS		
ISO 9001	ISO 14001	ISO 45001
Work-safety standardisation		

CE

Founded in Chengdu in 2006. National high-tech enterprise and a Sichuan province specialised and sophisticated SME, delivering customised energy-saving and noise-control packages to industrial groups including Sinopec, BASF, PetroChina, Huadian, Huaneng and Guoneng.

Proven Across Industry

100+ delivered industrial sites, grouped by industry — not by company name.

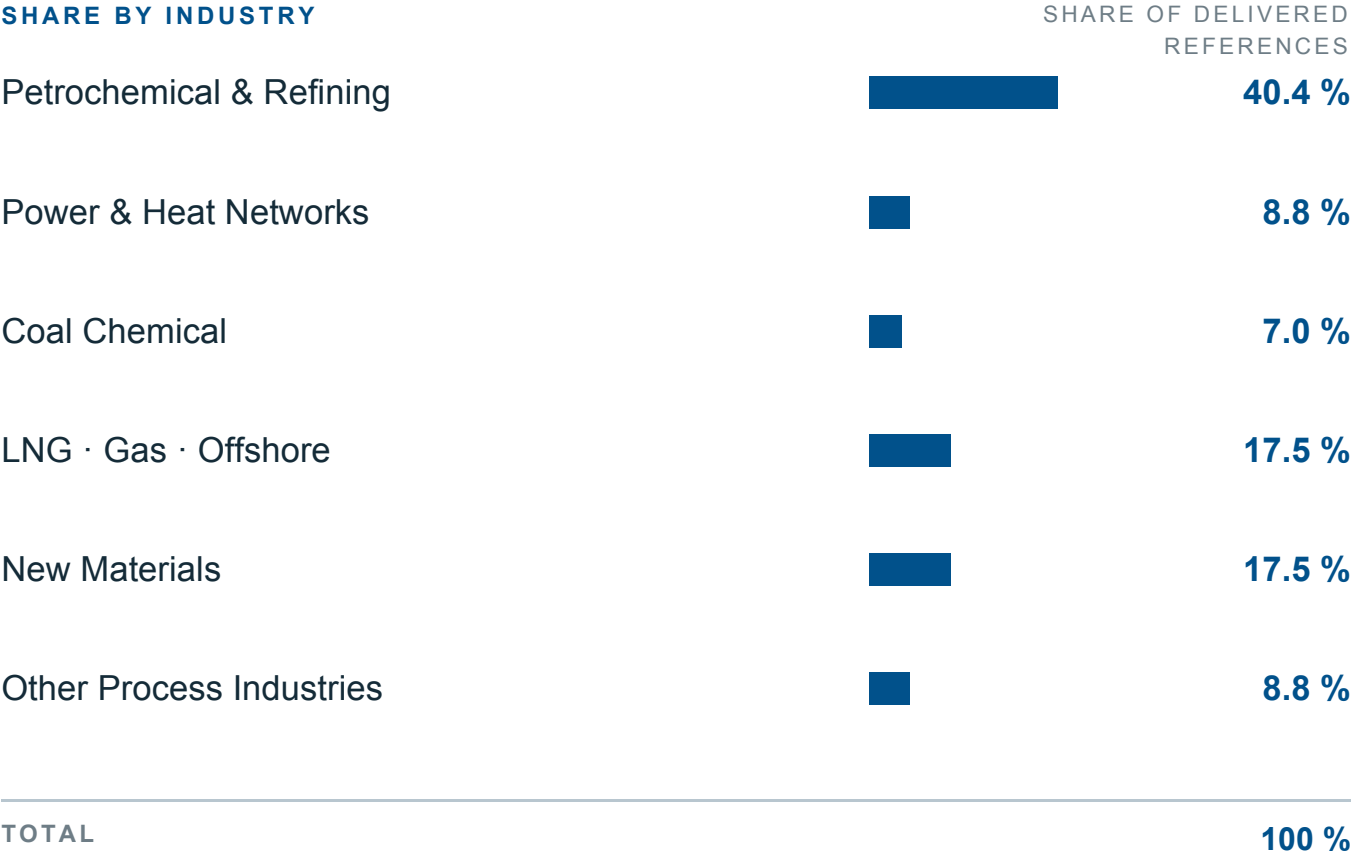
DELIVERED INDUSTRIAL SITES

100+

Site count is maintained in the Shuowu project database.

REPRESENTATIVE CLIENTS INCLUDE

Sinopec, PetroChina, CNOOC, BASF, and other industrial groups.



Selected Project References

Representative projects selected from 100+ delivered industrial sites.

The following references represent selected delivered projects and do not constitute Shuowu's complete project list.

SINOPEC

Zhongke Guangdong Refinery
Qingdao Petrochemical
Hainan Refining & Chemical
Jinling Petrochemical
Luoyang Company
Yangzi Petrochemical
Luoyang Engineering
Tahe Refining & Chemical
Beihai Refining & Chemical
Maoming Company
Qilu Company
Anqing Company
Chongqing SVW Chemical
Zhenhai Refining & Chemical

PETROCHINA / CNPC

Qinghai Oilfield
Liaohe Oilfield
Dushanzi Petrochemical
Karamay Petrochemical
Daqing Petrochemical
Urumqi Petrochemical

CNOOC

Suizhong 36-1 Crude Oil Terminal

BASF · SHELL

BASF Verbund Site (Guangdong)
BASF-YPC Co., Ltd.
Shell

POWER & HEAT NETWORKS

China Huadian Zhangping Energy
Fujian Huadian Yong'an Power
Fujian Huadian Kemeng Power
Huaneng Hainan Nanshan Power
China Energy Tianming Power
China Resources Power (Shenshan)
Guangdong Yudean Dapu Power
Taicang GCL Power Generation
Zibo Ruiyang Thermal

LNG RECEIVING TERMINALS PIPECHINA

Hainan LNG Terminal (Yangpu)
Beihai LNG Terminal
Yuedong LNG Terminal (Jieyang)
Tianjin LNG Terminal (Nanjiang)
Shenzhen LNG Terminal (Diefu)

COAL CHEMICAL, NEW MATERIALS & ENGINEERING

China Pingmei Shenma Group
Shanxi Meijin Coal Chemical
Inner Mongolia Tongwei Polysilicon
Yunnan Tongwei Polysilicon
Qinghai Lihao Semiconductor
Chalco Huasheng New Materials
China Baowu Steel Group
TBEA
Wison Engineering
Jilin Future Era Technology
Wanhua Chemical Group
Shenghong Refining (Lianyungang)

Shuowu Helps Write the Standards

Three group standards drafted under Shuowu's lead; four national and industry standards contributed to.

EDITOR-IN-CHIEF · 3 STANDARDS

T/CPCIF 0210-2022

Nanoporous alumina-magnesia fibre insulation felt

T/CSTM 01375-2025

Alumina-magnesia fibre thermal and acoustic insulation felt

T/CECA-G0421-2026

Nanoporous silica-based cryogenic insulation

CONTRIBUTING DRAFTER · 4 STANDARDS

SPMP-STD-EM2019-2026

Sinopec anti-corrosion and insulation code

SH/T 3010-2025

Insulation design for petrochemical equipment and piping

GB 50264 (under revision)

Insulation design standard for industrial equipment

SH/T 3146 (submitted)

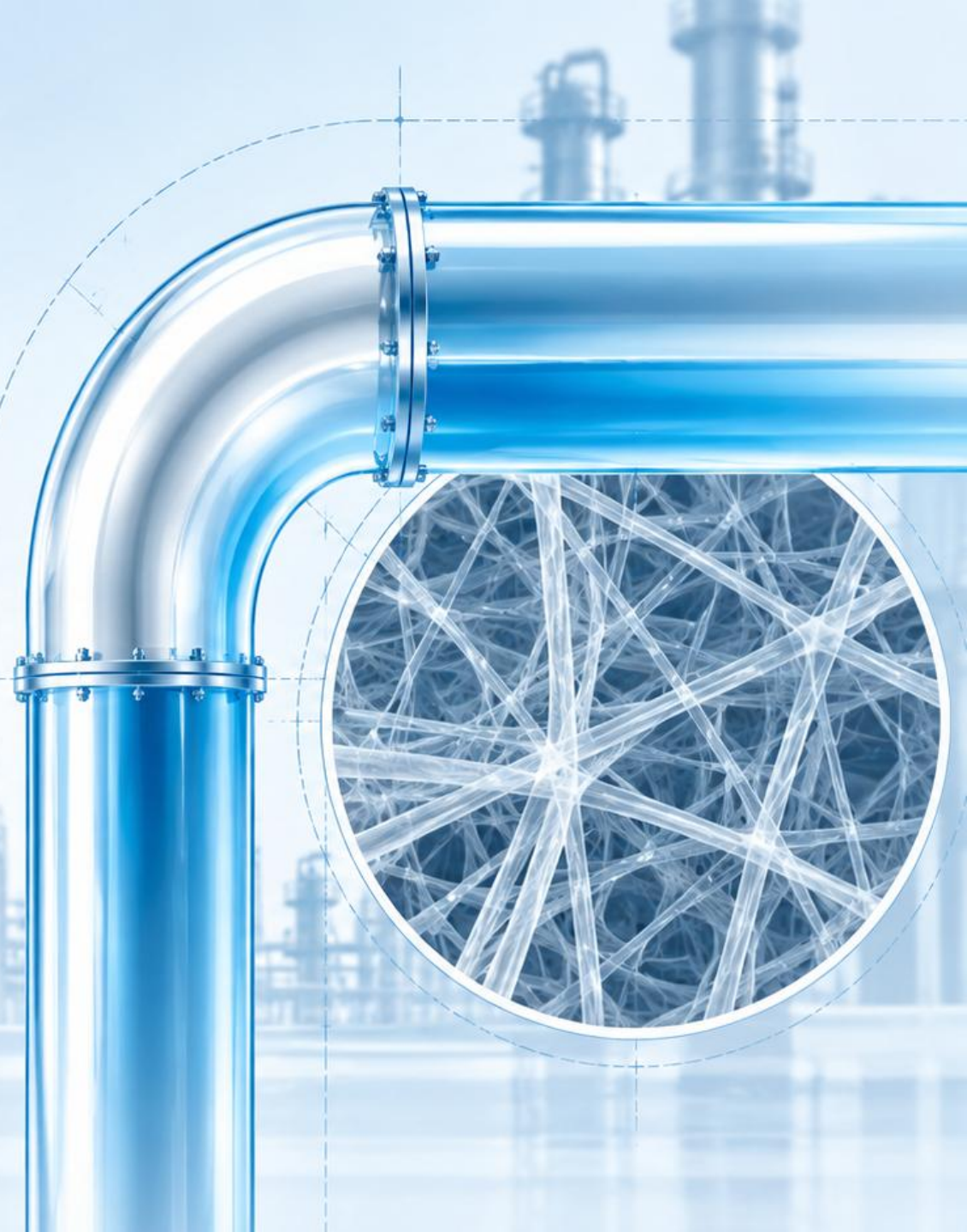
Noise control design for petrochemical industry

Writing a standard means the test methods, the limits and the engineering practice were reviewed by the whole industry.

04

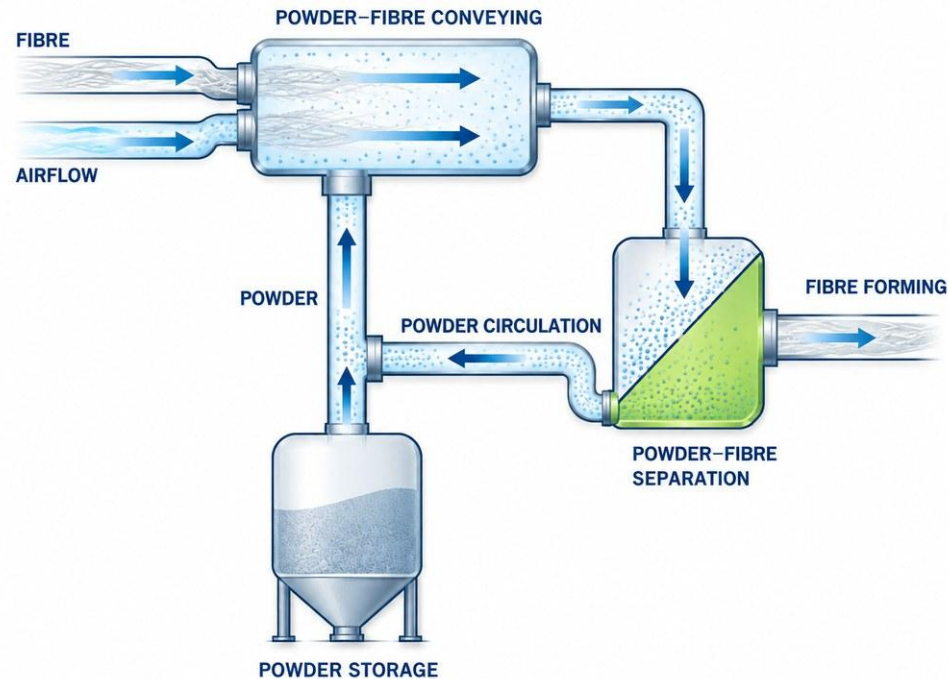
Why CAS Nano Insulation?

Why less thickness, why lower conductivity, and what it changes.



SHUOWU-DEVELOPED SOLID-STATE FLUIDIZATION TECHNOLOGY

A proprietary manufacturing technology developed by Shuowu for nanoporous fibre composite insulation materials.



DEVELOPED BY SHUOWU

Shuowu developed its solid-state fluidization process to integrate nanoporous powders and functional particles with a fibre matrix during material production.

CORE MATERIAL SYSTEM

Nanoporous Powders
+ Functional Particles
+ Fibre Matrix

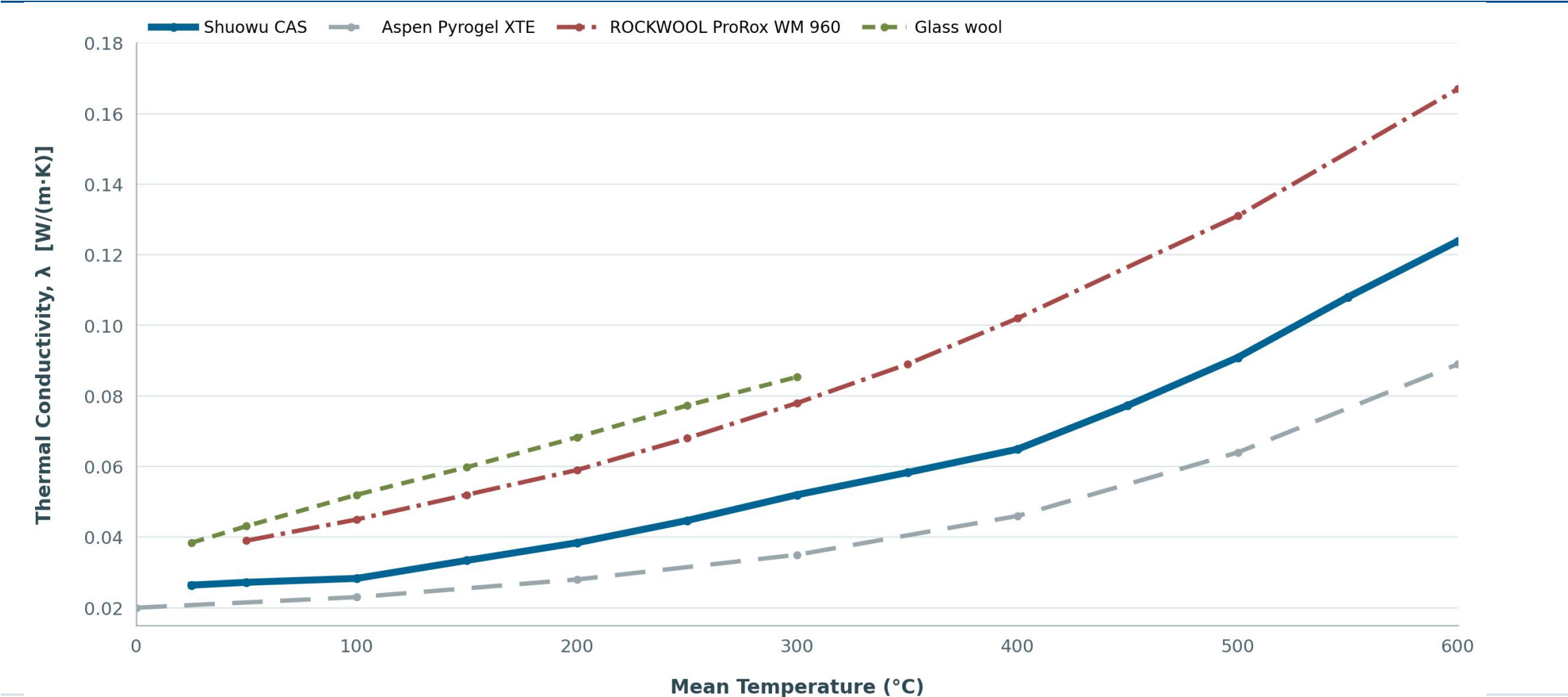
RESULT

A reinforced nanoporous fibre composite engineered for industrial insulation.

Process schematic from the Shuowu engineering drawing: powder storage, airflow, powder circulation, powder-fibre conveying, powder-fibre separation and fibre forming.

Q1 · It Starts with Lower Thermal Conductivity

Why can Shuowu use less thickness?

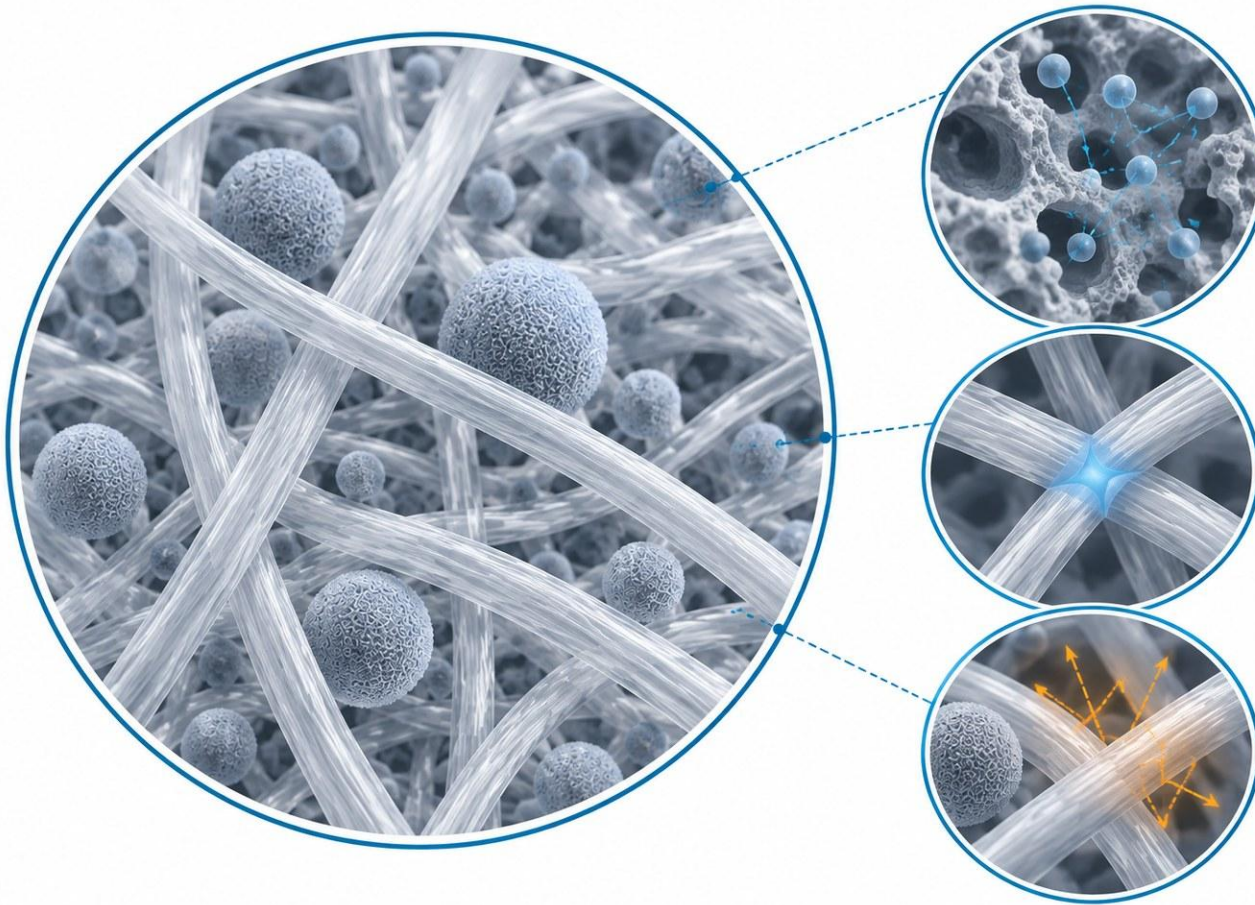


Sources: Shuowu test data; Aspen Aerogels Pyrogel® XTE Product Data Sheet (ASTM C177); ROCKWOOL ProRox® WM 960 Product Data Sheet (EN 12667). Comparative data are shown for engineering reference.

13

Q2 · How CAS Nano Insulation Works

Three mechanisms, one composite structure.



A · GAS CONDUCTION

Nanopores restrict gas-molecule movement and reduce gas-phase heat transfer.

B · SOLID CONDUCTION

Controlled fibre contact limits continuous solid conduction paths.

C · THERMAL RADIATION

Radiation-control components reduce radiative heat transfer.

CONCLUSION

Nanoporous particles + inorganic fibre network reduce all three modes of heat transfer.

Q3 · What Less Thickness Changes for a Project

A thinner insulation build-up reduces material volume and changes the surrounding system.

WHAT CHANGES WHEN THE BUILD-UP GETS THINNER

Insulation volume

Less material for the same thermal duty.

Installation labour

Fewer layers to cut, fit and secure.

Lower Heat Loss

Lower conductivity reduces heat transfer through the insulation system.

Longer service life

Designed for long-term industrial service.

Transport & handling

Fewer cubic metres to ship, lift and store.

Less cladding & Support

A smaller system diameter reduces cladding area and support requirements.

Initial installed cost

Material, labour, cladding and vapour barrier all change.



100,000 m³ CRUDE OIL STORAGE TANK

Insulation volume	581 m³ to 110 m³ (-81%)
Installation labour	-76%
Support steel	DATA REQUIRED
Initial installed cost	10–20% higher
Heat loss	20–50% lower
Reported service life	3–4 × longer

Compared with conventional insulation

LOWER λ → LESS THICKNESS → SMALLER SYSTEM → LOWER PROJECT QUANTITIES

Tank comparison from the Shuowu case record. Absolute quantities are being extracted from the source chart — DATA REQUIRED (Appendix A10).

05

Reliability

Engineered for long-term performance
in real operating environments.

PROTECTION · DURABILITY · LONG-TERM VALUE



Tested Under Water and Chemical Exposure

Two questions decide service life: what water does to it, and what the process environment does to it.

96 h

Boiling water at 100 ° C

After 96 hours in boiling water the material still keeps its insulation performance — rain during installation is not a problem.

2,160 h

Acid, alkali and salt immersion (SGS)

After 2,160 hours (90 days) in acid, alkali and salt solutions the thermal conductivity is essentially unchanged and tensile strength is still above 80 kPa.

ADDITIONAL DOCUMENTED EVIDENCE

ROHS and VOC

Passed — no harm to people, animals or the environment

Fluoride and chloride content

Very low — no corrosive effect on equipment

Recycling commitment

Uncontaminated material is taken back for reuse

Designed to Help Reduce CUI Risk

CUI = Corrosion Under Insulation — corrosion that starts when water gets under the insulation and stays there.

HOW CUI STARTS

Water enters the insulation, a wet environment forms on the metal surface and, together with oxygen, starts corrosion. Corrosive components and structural defects in the insulation accelerate it.

WHAT THE MATERIAL AND THE SYSTEM CONTRIBUTE

Hydrophobicity

Overall hydrophobicity above 98 % slows water-vapour ingress.

Mechanical stability

A high-tensile fibre structure avoids breakdown of the insulation body.

Inspection access

System detailing keeps the insulation removable for inspection.

System detailing

Coating, cladding, joint sealing, drainage and inspection all matter.



CUI is not controlled by the insulation material alone.

Coating quality, cladding integrity, joint sealing, drainage and inspection regime all determine whether water reaches the metal — and how long it stays there.

06

Thermal Insulation

Keeping heat inside hot piping and equipment.



Thermal Insulation — Keeping Heat In

For hot piping and equipment in refining, chemical, power and new-materials plants.



DELIVERED ON EQUIPMENT SUCH AS

Turbine main steam	545 ° C
Long-distance steam pipeline	7 km, 426 ° C
Directly-buried steam pipeline	12 km, 330 ° C
Reactor	420 ° C

WHAT IT IS FOR

- Reduce heat loss and energy cost
- Control surface temperature for personnel protection
- Meet the current national heat-loss limits
- Keep the medium at the required process temperature

Hot service up to 1,000 ° C is covered by a dedicated high-temperature grade.

Thermal Product Range

Four grades for export markets: standard, hydrophobic, ultra-high-temperature and ASTM Type V aerogel service.

A0 STANDARD INDUSTRIAL 650 ° C MAXIMUM SERVICE TEMPERATURE λ @ 300 ° C 0.060 W/(m·K) λ @ 500 ° C 0.097 W/(m·K) Hydrophobicity On request Fire performance A1	A0TH MOISTURE-EXPOSED 650 ° C MAXIMUM SERVICE TEMPERATURE λ @ 300 ° C 0.060 W/(m·K) λ @ 500 ° C 0.097 W/(m·K) Hydrophobicity ≥ 98 % Fire performance A1	HT ULTRA-HIGH TEMPERATURE 1,000 ° C MAXIMUM SERVICE TEMPERATURE λ @ 300 ° C 0.069 W/(m·K) λ @ 500 ° C 0.120 W/(m·K) Hydrophobicity On request Fire performance A1 SPECIAL GRADE · 1,000 ° C	Aerogel Type V FLEXIBLE AEROGEL INSULATION 649 ° C MAXIMUM SERVICE TEMPERATURE λ @ 23.9 ° C 0.029 W/(m·K) λ @ 371 ° C 0.073 W/(m·K) Density 120–180 kg/m³ Fire performance A1 ASTM C1728-25a · TYPE V
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Aerogel Type V per ASTM C1728-25a Type V. Compressive strength ≥ 20.7 kPa; water absorption ≤ 8 %, and ≤ 16 % after 24 h preheat at 316 ° C.
Main-deck data limited to the values shown. Density, tensile strength, water absorption, complete λ tables and test standards for all grades are given in Appendix A1.

BASF-YPC Steam Line Retrofit

Medium-pressure steam · 20 in pipe · 260 ° C · 1,217 m



BASF-YPC · Medium-pressure steam line

■ FIELD MEASUREMENT

Same 1,217 m steam line, measured before and after the insulation retrofit in March 2020.

INSULATION THICKNESS

CONVENTIONAL → SHUOWU CAS

120 mm → 60 mm

50% LESS THICKNESS

Insulation thickness along the same 1,217 m steam line.

PIPELINE TEMPERATURE LOSS

BEFORE → AFTER RETROFIT

33 ° C → 16 ° C

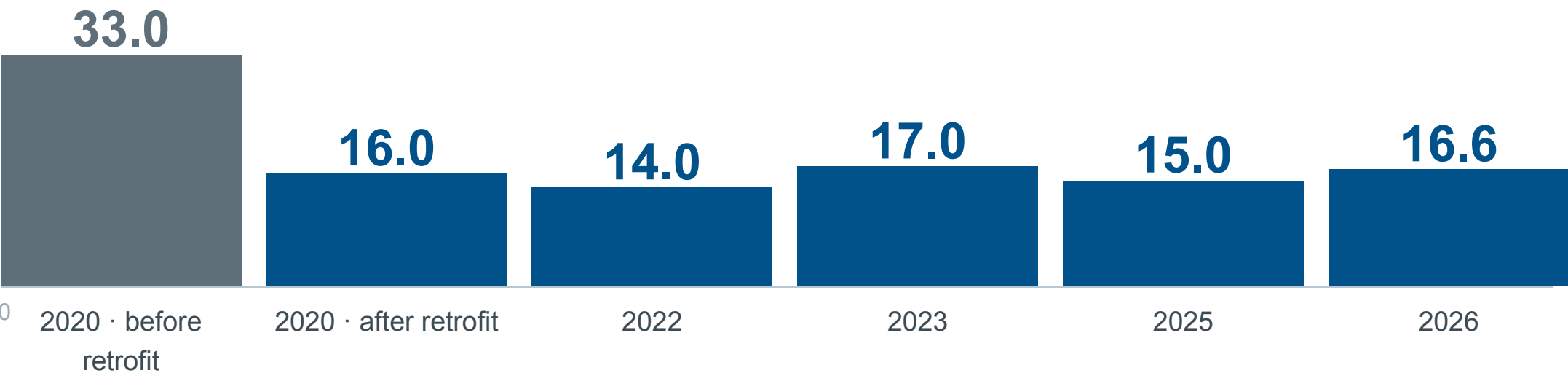
≈52% LOWER

Pipeline temperature loss.

BASF-YPC: Long-Term Field Performance

Measured pipeline temperature loss after the Shuowu retrofit · 20 in pipe · 260 ° C · 1,217 m

MEASURED PIPELINE TEMPERATURE LOSS (° C)



COMPARISON BASIS

All readings were taken on the same 1,217 m pipeline at the same measurement positions.

At 50% of the original insulation thickness, measured pipeline temperature loss remained between 14.0° C and 17.0° C from 2020 to 2026.

Field records: 2020-03, 2022-09, 2023-11, 2025-04 and 2026-04. Operating records are available on request.

High-Pressure Steam Retrofit Reduced Steam Flow by 8.4%

SAME OPERATING CONDITIONS

88 t/h 520 ° C

PLANT LOAD FURNACE OUTLET TEMPERATURE

Ethylene production

Both conditions remained the same before and after the retrofit.

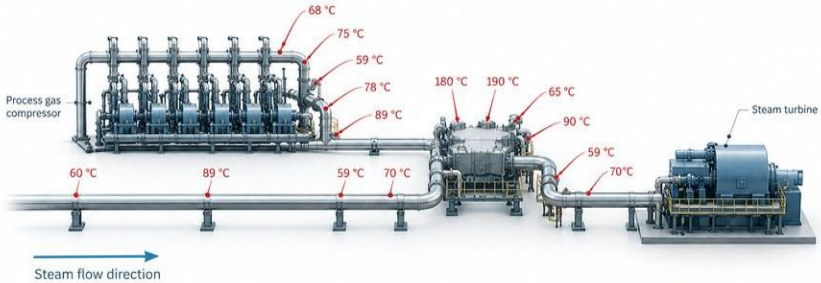
Operating steam flow decreased

356 t/h → 326 t/h

Before After

COMPRESSOR – STEAM TURBINE SYSTEM

Typical surface temperature measurement points



RESULT

–8.4%

STEAM FLOW REDUCTION

SUPPORTING OPERATING RECORDS

PARAMETER

	BEFORE	AFTER
Turbine inlet temperature	509 ° C	516 ° C
Inlet pressure	11.2 MPa	11.5 MPa
Valve opening	89 %	83 %
Insulation surface temperature	50–190 ° C	below 50 ° C

■ FIELD MEASUREMENT

Steam flow decreased from 356 t/h to 326 t/h while plant load remained at 88 t/h ethylene production and furnace outlet temperature remained at 520 ° C.

1,000 m Steam Line: 110 mm CAS Reduces Calculated Heat Loss by 64%

545 ° C steam · 219 mm pipe · 1,000 m line

DESIGN BASIS

1,000 m
PIPELINE LENGTH

545 ° C
OPERATING TEMPERATURE

219 mm
PIPE DIAMETER

CONVENTIONAL SYSTEM	
Insulation thickness	160 mm
Surface temperature	54.9 ° C
Total heat loss	798.8 kW
Heat flux	462.25 W/m²
External surface area	1,728 m²

SHUOWU CAS	
Insulation thickness	110 mm
Surface temperature	30.9 ° C
Total heat loss	288.4 kW
Heat flux	203.96 W/m²
External surface area	1,414 m²

RESULT

160 to 110 mm	798.8 to 288.4 kW	452 t/month	< 1 year
50 mm LESS THICKNESS	64% LOWER HEAT LOSS	STEAM SAVING	REPORTED PAYBACK

110 mm CAS: 50 mm less thickness and 798.8 to 288.4 kW heat loss for this 1,000 m calculation.

Engineering calculation at the stated duty. Final insulation thickness is calculated for each project according to operating temperature, ambient conditions, surface-temperature limits and heat-loss targets.

07

Cryogenic Insulation

Keeping environmental heat out of low-temperature service.



Cryogenic Insulation Keeps Heat Out

Thermal insulation keeps heat in. Cryogenic insulation keeps environmental heat out.



Service range

–196 ° C to +80 ° C

Applications

LNG, petrochemical, cold storage, marine

Very low conductivity

About 1/3 conventional cryogenic materials

Fire performance

Non-combustible, class A1

Dimensional stability

Inorganic composition — no shrinkage cracking

Installation

Can be applied while the line is in service (wet application)

Cryogenic Product Range

Two hydrophobic grades for export markets: deep cryogenic service down to $-196\text{ }^{\circ}\text{C}$.

CIM4196

NON_HYDROPHOBIC CORE MATERIAL

$\geq -196\text{ }^{\circ}\text{C}$
SERVICE TEMPERATURE

Hydrophobicity (Overall Material)	$\geq 99.0\text{ }\%$
$\lambda @ 0\text{ }^{\circ}\text{C}$	$\leq 0.024\text{ W/(m}\cdot\text{K)}$
$\lambda @ -160\text{ }^{\circ}\text{C}$	$\leq 0.010\text{ W/(m}\cdot\text{K)}$
Density	$110 - 140\text{ kg/m}^3$
Tensile strength	$\geq 100\text{ kPa}$
Fire performance	A1

CIM6196

HYDROPHOBIC CORE MATERIAL

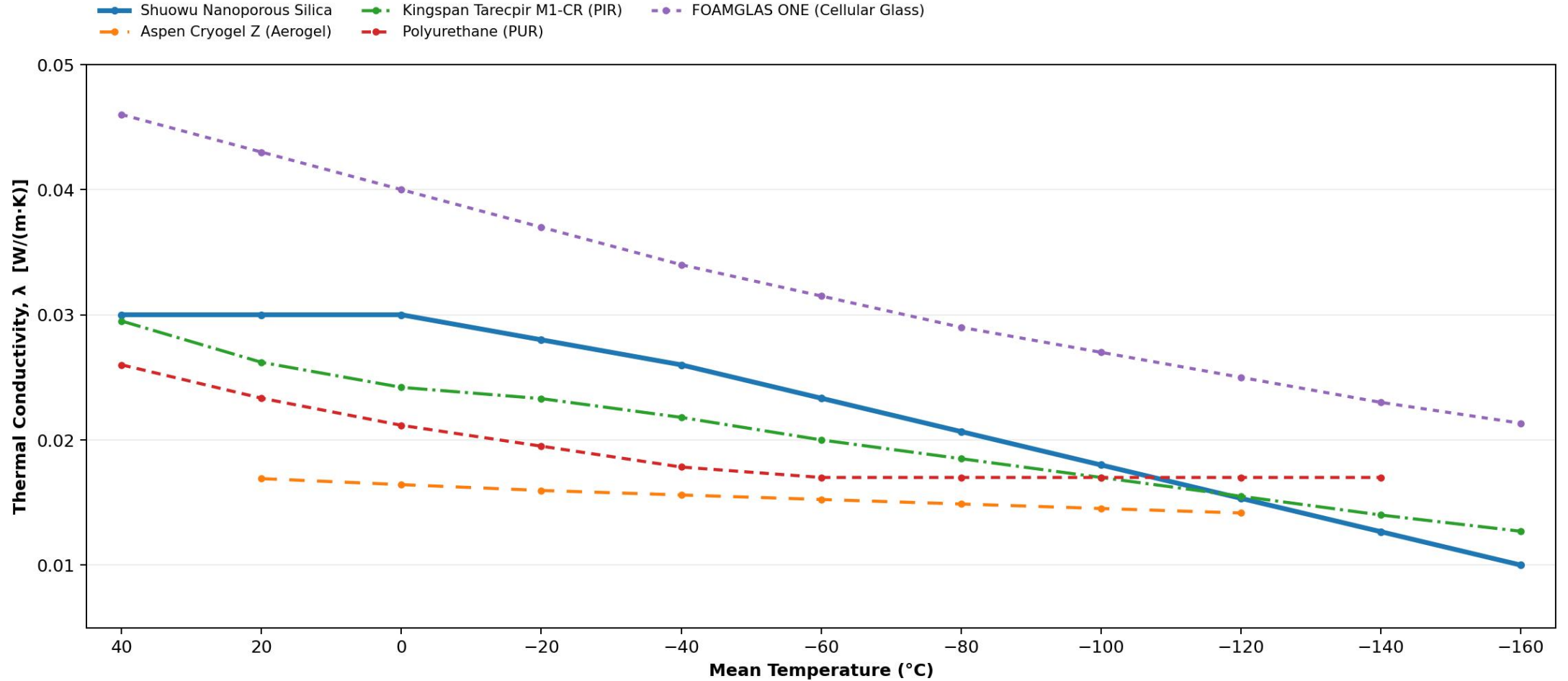
$> -196\text{ }^{\circ}\text{C}$
SERVICE TEMPERATURE

Hydrophobicity (Overall Material)	$\geq 99.0\text{ }\%$
$\lambda @ 0\text{ }^{\circ}\text{C}$	$\leq 0.024\text{ W/(m}\cdot\text{K)}$
$\lambda @ -160\text{ }^{\circ}\text{C}$	$\leq 0.010\text{ W/(m}\cdot\text{K)}$
Density	$110 - 140\text{ kg/m}^3$
Tensile strength	$\geq 100\text{ kPa}$
Fire performance	A1

$\lambda @ -160\text{ }^{\circ}\text{C} \leq 0.010\text{ W/(m}\cdot\text{K)}$ is a series value covering the CIM cryogenic range. Complete data, including the non-hydrophobic grades and vapour transmission, is given in Appendix A2.

At -160°C , Shuowu Reaches $\leq 0.010\text{ W/(m}\cdot\text{K)}$

Cryogenic insulation materials compared at their stated reference temperatures · $\text{W/(m}\cdot\text{K)}$



Cryogenic Retrofit — Thinner Insulation, Verified in the Field

−63 ° C line · DN426 · Ambient 30.2 ° C

INSULATION THICKNESS

130 mm → **110 mm**

ORIGINAL SYSTEM

SHUOWU SYSTEM

20 mm THINNER

SURFACE TEMPERATURE VERIFICATION

28.1 ° C → **28.4 ° C**

CALCULATED

MEASURED

Δ 0.3 ° C

Calculation-to-field deviation



The Shuowu system reduced insulation thickness by **20 mm**, while the calculated surface temperature matched the field measurement **within 0.3 ° C**.

ENGINEERING CALCULATION + FIELD VERIFICATION

Surface temperature calculation and field measurement were performed at the retrofit location.

Same Cold Loss. Less Than Half the Insulation Thickness.

1,000 m line · -100 ° C service · 460 mm pipe · Ambient 35.1 ° C

SHUOWU NANOPOROUS SILICA

120 mm

INSULATION THICKNESS

52.0 W/m

CALCULATED COLD LOSS

CELLULAR GLASS

VS 270 mm

INSULATION THICKNESS

52.3 W/m

CALCULATED COLD LOSS

56% LESS INSULATION THICKNESS

120 mm instead of 270 mm at essentially equal calculated cold loss.

WHAT DOES THE THINNER SYSTEM CHANGE?

65% LESS

INSULATION VOLUME

229.6 m³ vs 650.3 m³

30% LESS

CLADDING AREA

2,749 m² vs 3,928 m²

30% LESS

VAPOUR-BARRIER AREA

3,299 m² vs 4,714 m²

INSTALLED COST

90.1%

OF THE CELLULAR-GLASS SYSTEM

For this 1,000 m engineering calculation.

At essentially equal calculated cold loss (52.0 vs 52.3 W/m), the Shuowu design reduces insulation thickness from 270 mm to 120 mm, significantly reducing total installed material quantities.

■ ENGINEERING
CALCULATION

All quantities are based on the same 1,000 m pipeline calculation. Results are specific to the stated design conditions and should not be interpreted as fixed savings for every project.

08

Acoustic Insulation

Industrial noise control that can be measured on site.



Why Industrial Noise Control Matters

Industrial equipment and piping can generate high noise levels that affect personnel, plant operations and environmental compliance.

PERSONNEL

Reduce occupational noise exposure around operating areas.

OPERATIONS

Control noise from compressors, turbines, valves, pumps and piping.

COMPLIANCE

Help meet project noise limits at operator positions and plant boundaries.

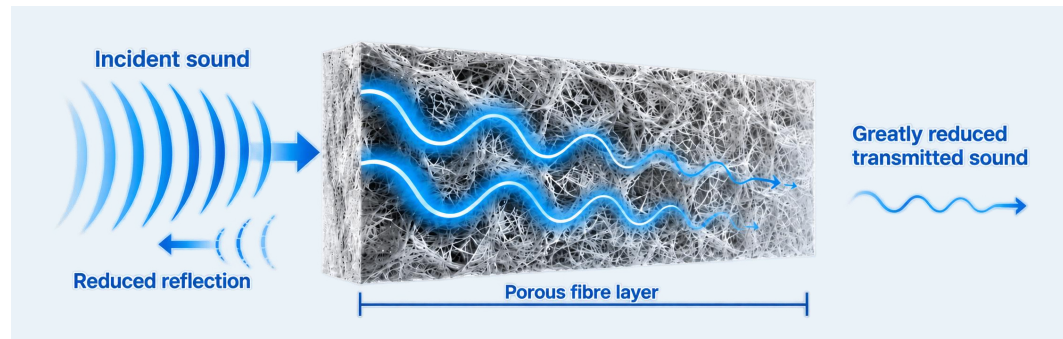


How Industrial Noise Is Controlled

Effective industrial noise control combines sound absorption and sound insulation.

01

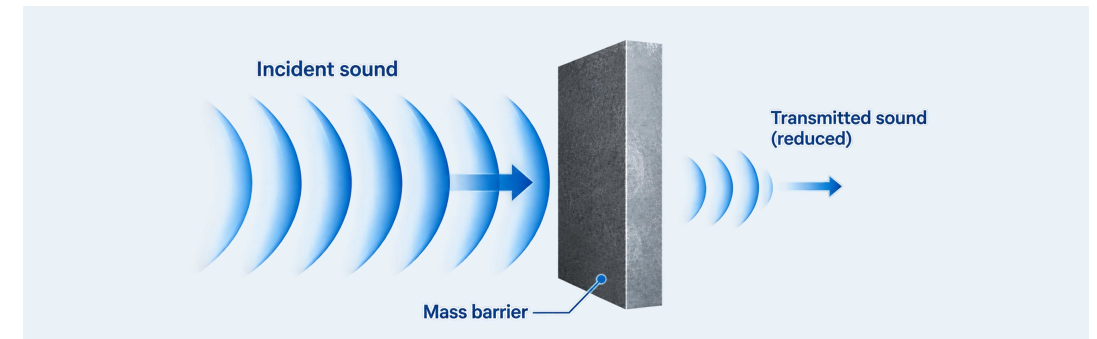
ABSORB SOUND



Porous materials absorb sound energy and reduce reflected noise. Especially effective for mid- and high-frequency noise.

02

BLOCK SOUND

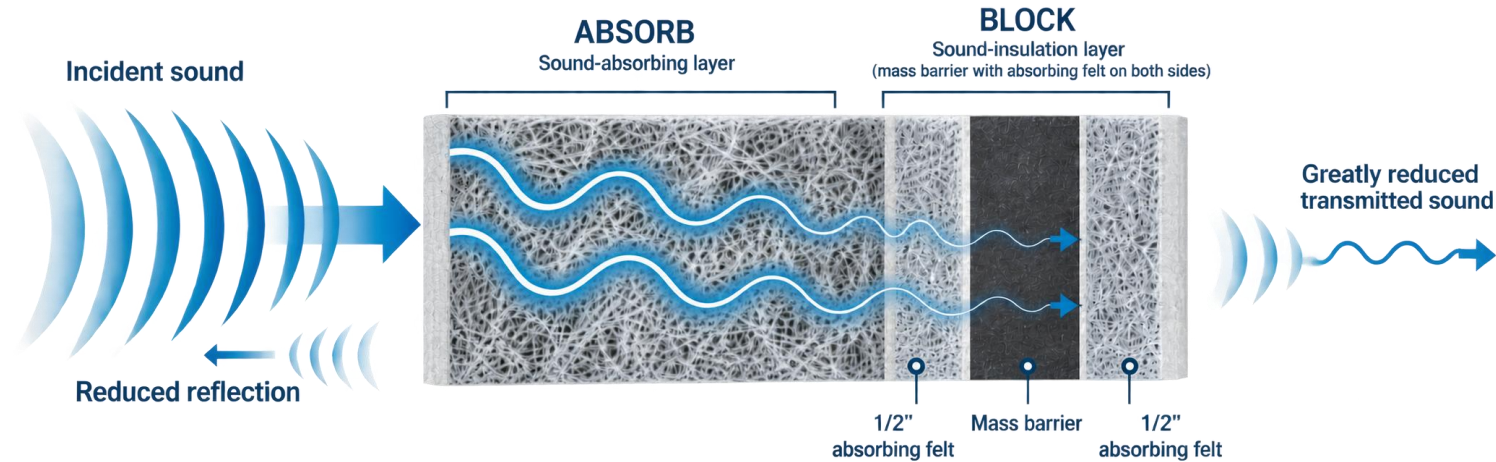


High-mass barrier materials reduce sound transmission through the acoustic system. Important where transmitted and low-frequency noise must be controlled.

SOUND ABSORPTION + SOUND INSULATION = COMPLETE ACOUSTIC SYSTEM

How Shuowu Turns Acoustic Principles into a Project Solution

Shuowu combines sound absorption and sound insulation into a project-specific system based on the actual noise source and required reduction.



PROJECT-SPECIFIC ENGINEERING

01

MEASURE

Source noise and frequency spectrum

02

CALCULATE

Required noise reduction

03

DESIGN

Material combination, thickness and system build-up

04

INSTALL

On-site technical support

05

VERIFY

Field noise measurement

The acoustic system is designed for the actual source — not selected by material thickness alone.

Shuowu Acoustic Material System

Two material functions work together within the engineered acoustic system.

SOUND ABSORPTION

CAS-AX

Al-Mg Sound Absorbing Blanket

NRC	0.88 at 50 mm
SERVICE TEMPERATURE	≤ 650 ° C
FIRE CLASS	A1 · non-combustible

Absorbs acoustic energy within the system.



SOUND INSULATION

CAS-AP SERIES

Composite Sound-Insulation Blankets

≥20 dB(A)

Single-layer sound transmission loss

CAS-AP	Standard
CAS-AP-IIA	High-Safety A2 overall fire rating · Up to 250 ° C



ABSORB
CAS-AX
Sound-absorbing blanket

+

BLOCK
CAS-AP SERIES
Composite sound-insulation blanket

=

ENGINEERED ACOUSTIC SYSTEM
Project-specific noise control solution

The final material combination is selected according to the measured frequency spectrum, operating temperature and required noise reduction.

Field-Proven Noise Reduction

Measured before and after acoustic treatment at the same inspection positions.

MAIN MEASUREMENT POINT

118.0 → 85.5

dB(A) — before and after

–32.5 dB(A)

Measured reduction at this position

OTHER MEASUREMENT POSITIONS, SAME PROJECTS

104.6 → 83.5 dB(A) –21.1 dB(A)

PSA lubricating-oil pump A

115.4 → 84.6 dB(A) –30.8 dB(A)

PSA desorption-gas compressor C-301A

100.4 → 84.5 dB(A) –15.9 dB(A)

Propylene compressor

103.0 → 85.0 dB(A) –18.0 dB(A)

Separator outlet gate valve



■ FIELD MEASUREMENT

Before-and-after measurements were taken at the same inspection positions.

09

Built Around Your Project

Every project starts with its actual operating conditions.



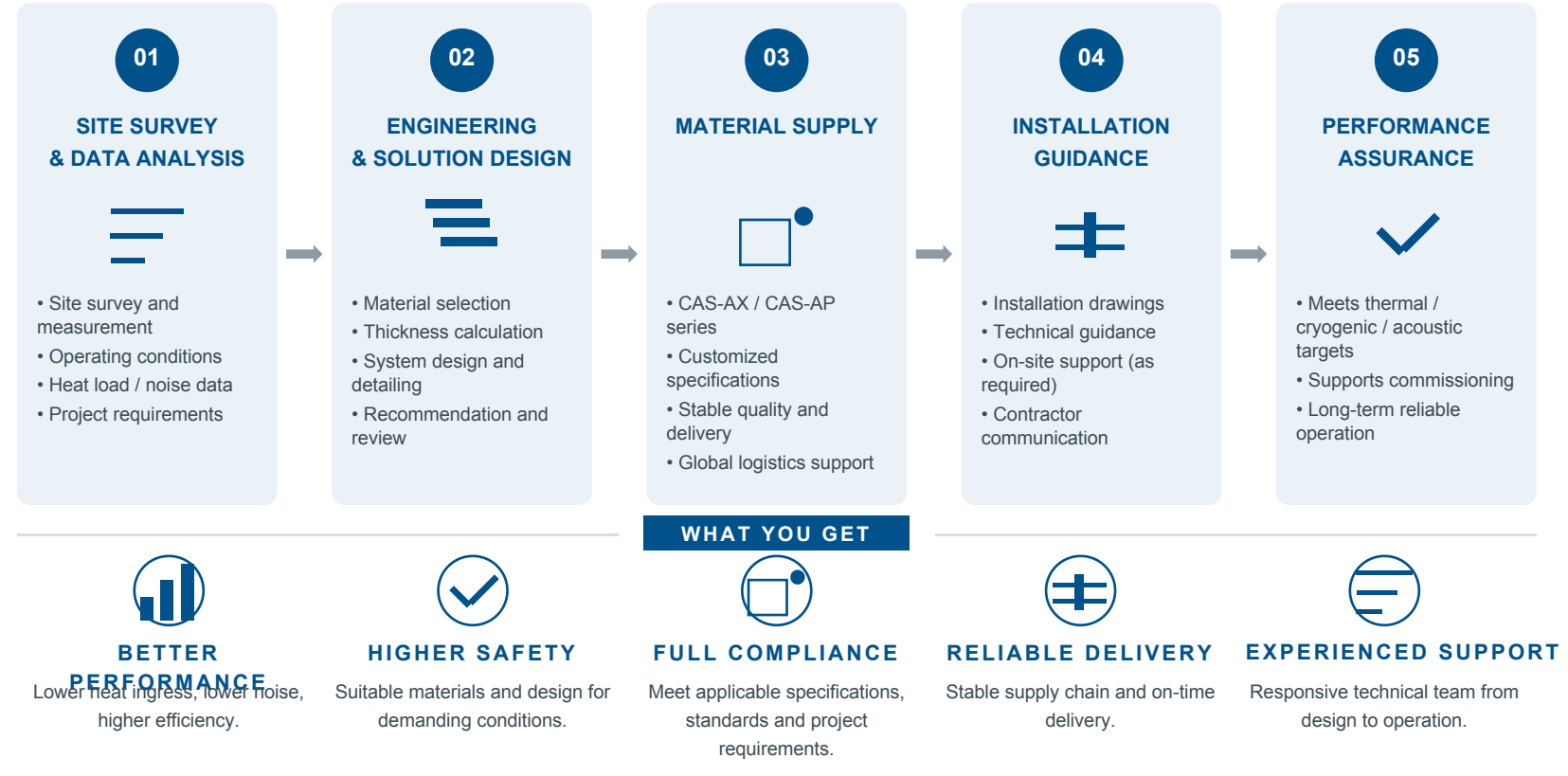
What Can Shuowu Do for My Project?

From your actual operating conditions to a reliable insulation solution.



Your project.
Our engineering.
A safer, more efficient operation.

OUR SUPPORT THROUGHOUT YOUR PROJECT



Engineered from your operating data and project requirements.



CHENGDU SHUOWU TECHNOLOGY CO., LTD.

Thermal · Cryogenic · Acoustic

Every project is engineered around the actual operating duty.

www.cdshuowu.com



Technical Appendix

Complete technical data, case conditions,
engineering calculations, standards and certificates.



Complete Thermal Technical Data

Material comparison as documented in the Shuowu technical files.

Property	Rock wool	Glass wool	Ceramic fibre	Shuowu nanoporous
Thermal conductivity at 25 ° C, W/(m·K)	0.045 – 0.050	0.045	0.044 – 0.050	0.025 – 0.031
Service life, years	3 – 5	3 – 5	3 – 5	10 – 15
Service temperature range, ° C	ambient – 350	ambient – 250	ambient – 1,000	ambient – 650
Fire classification	Class A	Class A	Class A	A1
Environmental impact	High	High	High	Low
Density, kg/m³	120	48	128	120
Hydrophobicity	Not hydrophobic	Not hydrophobic	Not hydrophobic	Hydrophobic

CAS CONDUCTIVITY BY TEMPERATURE

25 ° C	0.030 W/(m·K)
100 ° C	0.035 W/(m·K)
200 ° C	0.047 W/(m·K)
300 ° C	0.060 W/(m·K)

ALSO HELD ON FILE

Density — 120 kg/m³	Tensile strength — ≥ 100 kPa
Hydrophobicity (A0TH) — ≥ 98 %	Water absorption (A0TH) — ≤ 1.0 % by volume
Fire performance — A1	Complete λ table — on request
Test standards — on request	

Typical values. Test reports with method, laboratory and report number are available on request.

APPENDIX A2

Complete Cryogenic Technical Data

Cryogenic material comparison and the full CIM series.

Property	Cellular glass	PIR	PU	Nanoporous silica-based
Density, kg/m³	100 – 180	50 – 100	50 – 100	110 – 140
λ at –160 ° C, W/(m·K)	0.036	0.019 – 0.025	0.022 – 0.025 (–110 ° C)	0.010
Vapour transmission, g/(Pa·s·m²)	≤ 0.5 × 10 [^] -8	≤ 6.2 × 10 ^{^-7}	≤ 5.8 × 10 ^{^-7}	≤ 1.3 × 10 [^] -8
Insulation thickness required	Thick	Thick	Thick	Thin
Fire classification	A1	B1	B1	A1
Installation	Brittle, difficult	Large volume	Large volume	Flexible, easy
Minimum service temperature, ° C	–196	–196	–110	–196
Service life, years	5 – 8	5 – 8	5 – 8	15

CIM SERIES — FULL DATA SET

Service temperature	≥ –196 ° C	Hydrophobicity	99.0 %
λ at 0 ° C	≤ 0.024 W/(m·K)	λ at –160 ° C	≤ 0.010 W/(m·K) — series value for the CIM range
Service temperature range	–196 ° C to +80 ° C	Density	110 – 140 kg/m³
Tensile strength	≥ 100 kPa	Vapour transmission	≤ 1.3 × 10 [^] -8 g/(m·s·Pa)

Complete Acoustic Technical Data

Products, system build-up, frequency design method and the design standard chosen for petrochemical work.

PRODUCTS

CAS-AX	Absorbing felt, 10 mm nominal per layer
CAS-AP	Blocking felt, 12 mm nominal per layer
CAS-AP-IIA	Blocking grade — data on request

System build-up used in the case studies: 5 × 10 mm CAS-AX + 2 × 12 mm CAS-AP (50 mm + 24 mm), plus protective cladding.

DESIGN STANDARD SELECTED

SH/T 3146-2004 (current)
GB/T 31013

SH/T 3146 (new version, submitted for approval)

Published early; no systematic rules for acoustic wrap structures.
Recommended structure gives negative insertion loss at low frequency; test method references overseas standards with no domestic testing capability; requires thick steel cladding; limited to circular ducts under 1,000 mm.
First systematic design code for petrochemical acoustic wrap; better suited to site construction; submitted to the Ministry of Industry and Information Technology.

FREQUENCY DESIGN METHOD

Sound is made up of several frequency bands, and reduction cannot be achieved simply by adding thickness.

Mid and high frequencies: short wavelength, strongly directional — absorbing material converts the mechanical energy into low-level frictional heat and reduces reflection.

Low frequencies: long wavelength, high penetration — a high-density blocking layer raises the acoustic impedance and stops transmission.

Complete Acoustic Measurement Data

All recorded measurement positions from the delivered acoustic projects. Values in dB(A).

Zhongke (Guangdong) Refining & Chemical — hydrogen upgrading

unit POSITION	BEFORE	AFTER
PSA desorption-gas compressor C-301B, inspection position	118.0	85.5
PSA lubricating-oil pump A, inspection position	104.6	83.5
PSA desorption-gas compressor C-301A, inspection position	115.4	84.6

Qilu Petrochemical — CCUS project

POSITION	BEFORE	AFTER
Propylene compressor	100.4	84.5
Separator outlet gate valve	103.0	85.0
Reducer gate valve	95.6	84.9
Compressor outlet piping	96.4	84.1

DATA REQUIRED — the Shenghong Refining acoustic case is held as an image only; figures will be added once the record is transcribed.

Acoustic Safety & Chemical Compatibility

Safety comparison against common acoustic materials, and how compatibility is assessed.

Item	Bitumen-based	Rubber board	PU	PVC board	Shuowu CAS felt
Service temperature	80 ° C	100 ° C	100 ° C	80 ° C	250 ° C
Surface layer combustion class	—	—	—	—	A1
Overall combustion class	E	C	D	B2	B1 – A2
Toxic-gas rating	High (benzene, formaldehyde)	Medium (some halogen, plasticiser)	Medium (isocyanate residue)	High (chloride)	ZA1

HOW COMPATIBILITY AND THERMAL IMPACT ARE HANDLED

Process media

Compatibility is reviewed against the actual process media and operating conditions of each project. No blanket statement is made.

Thermal impact

Acoustic treatment can change heat dissipation. The build-up is chosen to suit the service conditions and is fit for intended

Material composition

Free of bitumen, benzene, formaldehyde and halogens; no harmful gas released at high temperature.

DATA REQUIRED — the Shuowu acoustic-safety response letter will be added as the documented basis of this appendix.

Heat-Loss Limits: Previous and Current GB/T 4272

The current national standard allows less heat loss at every temperature — which is why many existing systems no longer comply.

Temperature	Previous limit, W/m²	Current limit, W/m²	Difference	Reduction
50 ° C	52	39	13	25 %
100 ° C	84	56	28	33 %
150 ° C	104	71	33	32 %
200 ° C	126	86	40	32 %
250 ° C	147	101	46	31 %
300 ° C	167	116	51	31 %
350 ° C	188	131	57	30 %
400 ° C	204	145	59	29 %
450 ° C	220	160	60	27 %

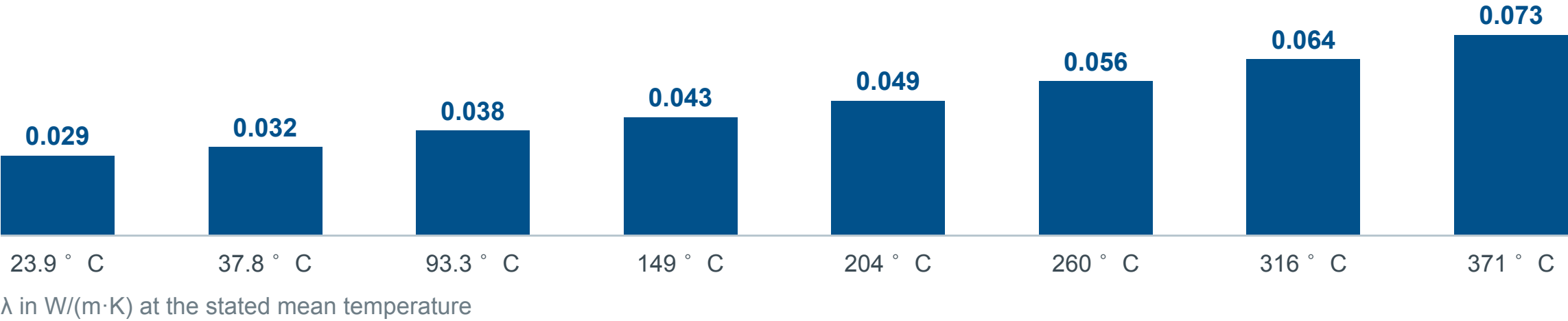
Temperature	Previous limit, W/m²	Current limit, W/m²	Difference	Reduction
500 ° C	236	174	62	26 %
550 ° C	251	190	61	24 %
600 ° C	266	209	57	21 %
650 ° C	283	229	54	19 %
700 ° C	—	249	—	—
750 ° C	—	268	—	—
800 ° C	—	286	—	—
850 ° C	—	303	—	—

The reduction ranges from 19 % to 33 % between 50 ° C and 650 ° C; above 650 ° C the previous standard gave no limit.

International Reference Data

Equivalent data for comparison with commonly referenced international specifications.

ASTM C1728 TYPE V — THERMAL CONDUCTIVITY BY MEAN TEMPERATURE



OTHER EQUIVALENT PROPERTIES

Compressive strength	≥ 20.7 kPa	Fire performance	A1
Max. service temperature	649 ° C	Density	120–180 kg/m³
Water absorption (2 h immersion)	≤ 8 % as received; ≤ 16 % after 24 h pre-heating at 316 ° C		

Thermal Case Conditions — Full Record

The operating conditions and raw readings behind the main-deck thermal cases.

BASF-YPC medium-pressure steam line

- 20 in pipe · 260 ° C · 1,217 m · 10 m elevation
- Rock wool 120 mm — 2020-03: inlet 261 ° C, outlet 228 ° C
- CAS 60 mm — 2020-03: inlet 261 ° C, outlet 245 ° C
- 2022-09: 263 to 249 ° C · 2023-11: 263 to 246 ° C
- 2025-04: 265 to 250 ° C · 2026-04: 267.1 to 250.5 ° C

Ultra-high-pressure steam network

- Insulation replaced on the same network at the same plant load
- Ambient 15.5 ° C, wind 6 m/s, original insulation 200 mm
- Sections: 14 in / 18 in / 20 in / 12 in / 16 in
- Turbine inlet pressure 11.2 to 11.5 MPa, ethylene output 88 t/h unchanged
- Steam 356 to 326 t/h, main inlet valve 89 % to 83 %

All values are taken from the project measurement records. Where a value was calculated rather than measured, the main deck states it as a calculation.

Cryogenic Case Conditions — Full Record

All retrofit positions, including the case where the Shuowu build-up was thicker than the original.

Retrofit positions — ethylene plant cold box and filters

- 1 · Second-floor small cold box PA-601/N3 — -63°C — cellular glass 130 mm
- 2 · FE-60015 impulse line — -42°C — cellular glass 100 mm
- 3 · Ground cold box PA-301/N21 — -163°C — cellular glass 200 mm
- 4 · Third-floor filter STR-30024 — -143°C — cellular glass 180 mm

Piping retrofit — -63°C , DN 426

- Removed 130 mm cellular glass, installed 110 mm CAS
- Calculated surface temperature 28.1°C , measured 28.4°C
- Surface cold loss -15.5 W/m^2 calculated, -14.7 W/m^2 measured
- Linear cold loss -32.4 W/m calculated, -30.8 W/m measured

Filter retrofit — -143°C , DN 325

- Removed 180 mm cellular glass, installed 190 mm CAS
- Calculated surface temperature 28.3°C , measured 26.8°C
- Surface cold loss -13.8 W/m^2 calculated, -10.6 W/m^2 measured
- Linear cold loss -30.6 W/m calculated, -22.8 W/m measured

Not every retrofit gets thinner: on the -143°C filter the Shuowu build-up went from 180 mm to 190 mm to meet the duty. Thickness is calculated, not assumed.

Engineering Calculations & Cost Breakdown

How the main-deck numbers were produced. Comparison basis: equal cold loss and compliance with GB/T 4272.

1,000 M CRYOGENIC LINE — COST BREAKDOWN

Item	Nanoporous	Cellular glass
Pipe diameter	460 mm	460 mm
Length	1,000 m	1,000 m
Medium temperature	−100 ° C	−100 ° C
Cold loss	−52.0 W/m	−52.3 W/m
Insulation thickness	120 mm	270 mm
Insulation volume	229.6 m³	650.3 m³
Insulation unit price	15,000 CNY/m³	3,500 CNY/m³
Insulation total	3,444,000 CNY	2,276,050 CNY
Installation unit price	2,000 CNY/m³	3,000 CNY/m³
Installation total	459,200 CNY	1,950,900 CNY
Cladding area / price	2,749 m² / 120 CNY/m²	3,928 m² / 120 CNY/m²
Vapour barrier area / price	3,299 m² / 55 CNY/m²	4,714 m² / 55 CNY/m²
Total installed cost	4,233,080 CNY	4,698,310 CNY
Investment ratio	90.1 %	100.0 %

Basis

1,000 m · 545 ° C · DN 219 — calculated from measured data

Conventional 160 mm

54.9 ° C surface · 462.25 W/m² · 798,768 W · 708 t/month

CAS 110 mm

30.9 ° C surface · 203.96 W/m² · 288,399 W · 256 t/month

Result

50 mm less thickness · 64 % less heat loss · 452 t/month less steam loss

Benefit stated in the record

About 1.41 million CNY per year; the extra investment is recovered within one year

NORMALIZED STEAM SAVING — HP STEAM RETROFIT

4.53 t/h · 3,261.6 t/month

Normalized for operating conditions. The full normalization method is being prepared and will be added to this page.

Equipment & Applications

Delivered across the following equipment and process units.

HIGH-TEMPERATURE STEAM & PIPING

- Turbine main steam, 545 ° C
- Long-distance steam pipeline, 7 km, 426 ° C
- Directly-buried steam pipeline, 12 km, 330 ° C
- Reactor, 420 ° C
- 1 Mt/y ethylene plant turbine compressor

REFINING & CHEMICAL UNITS

- Hydrocracking unit
- Propane dehydrogenation unit
- Sulphur recovery unit
- Aromatics unit

- Coking unit
- C2 refining unit
- CCUS carbon-capture equipment
- 100,000 m³ crude oil storage tank

NEW MATERIALS, STORAGE & ACOUSTIC

- Polysilicon reduction furnace
- Polysilicon hydrochlorination furnace
- Alumina evaporation station
- Digestion autoclave
- Offshore terminal crude pipeline
- Equipment and piping acoustic treatment

Equipment list compiled from delivered projects. Temperatures shown are the design conditions of the respective projects. Complete reference information is available upon request, subject to project confidentiality requirements.

Testing, Certificates, Patents & Policy

The documentary backing behind the figures used in this presentation.

Test records

Thermal conductivity; fire classification; hydrophobicity and water absorption; tensile strength; cryogenic conductivity and vapour transmission; ion content and chemical resistance

Quality systems

ISO 9001 · ISO 14001 · ISO 45001 · work-safety standardisation

Standards

3 group standards as editor-in-chief; 4 national and industry standards as contributing drafter

Third-party testing

SGS acid, alkali and salt immersion — 2,160 h; ROHS and VOC testing

Patents

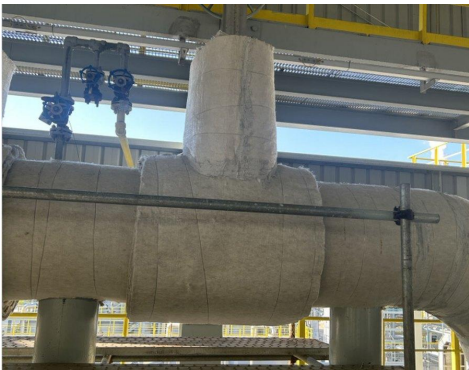
26 patents granted, of which 15 invention patents and 1 PCT international filing — patent numbers to be added (DATA REQUIRED)

Policy support

Industrial energy-efficiency action plan; retrofit guidelines for high-energy-consumption sectors; national energy-saving technology catalogue; petrochemical carbon-peaking plan

Acoustic Configurations, Noise Sources and Frequency-Dependent Reduction

How the reduction is achieved: source type, configuration and frequency.



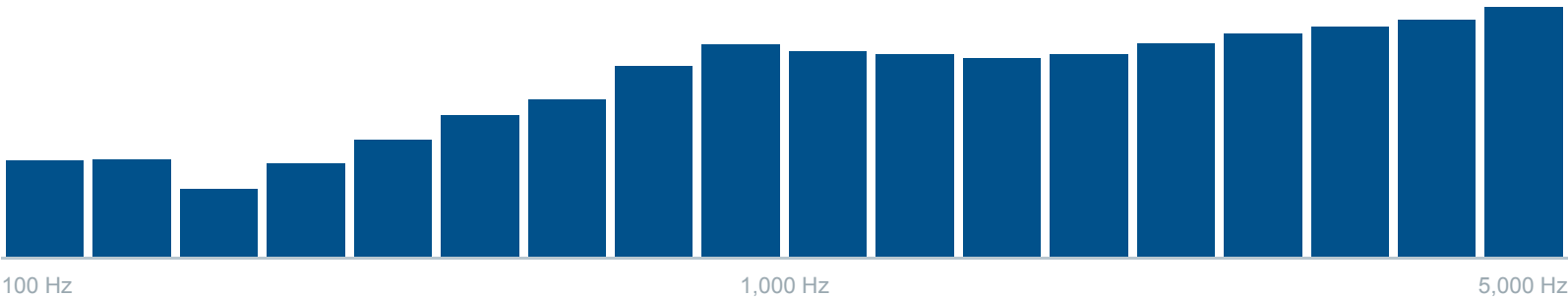
Acoustic enclosure around a working area

Acoustic enclosure case

A power-plant working area measured 101 dB. After the CAS acoustic wall was installed, about 70 dB outside the enclosure.

101 dB to about 70 dB

SOUND REDUCTION BY FREQUENCY · dB



NOISE SOURCES

WHAT DECIDES THE RESULT

- MECHANICAL** — compressors, pumps, motors — radiated casing noise; mass and damping decide the result
- FLOW & AERODYNAMIC** — valves, vents, high-velocity piping — broadband jet noise; absorption decides the result
- STRUCTURAL** — support-transmitted vibration — low-frequency energy; the support detail decides the result

The reduction is frequency-dependent, which is why the build-up is designed from the source spectrum rather than from a fixed thickness.

Eighteen frequency bands measured on the acoustic enclosure. Complete table and the wrapped-system cases are given in Appendix A4.