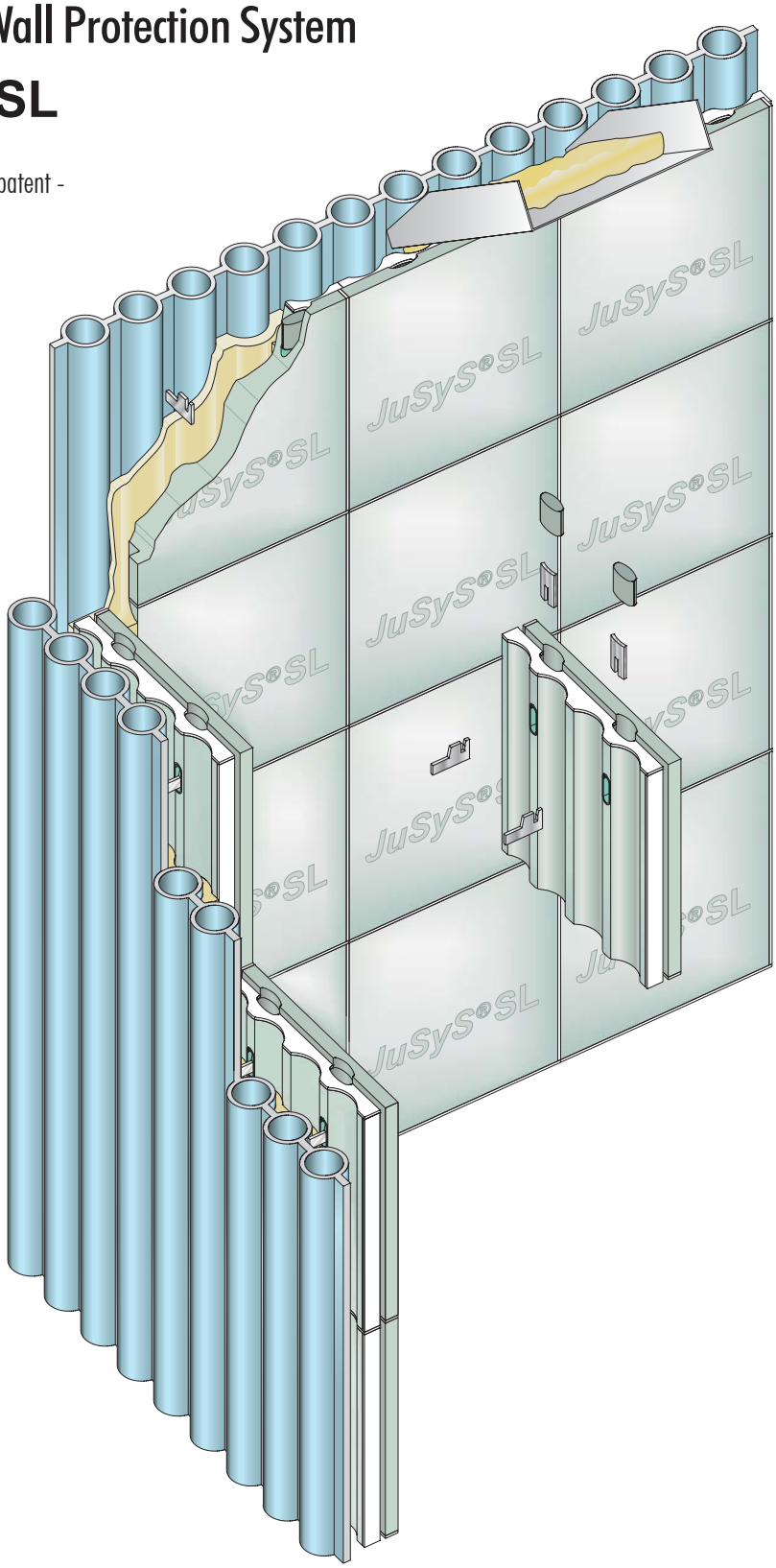
J+G REFRACTORIES

JuSyS®SL

Refractory Linings
for Waste Combined Heat & Power Plants and Bio Mass Boilers

with Tube Wall Protection System
JuSyS®SL

- protected by letters patent -



Issue 28.08.08

JuSyS®SL

Technology and Function

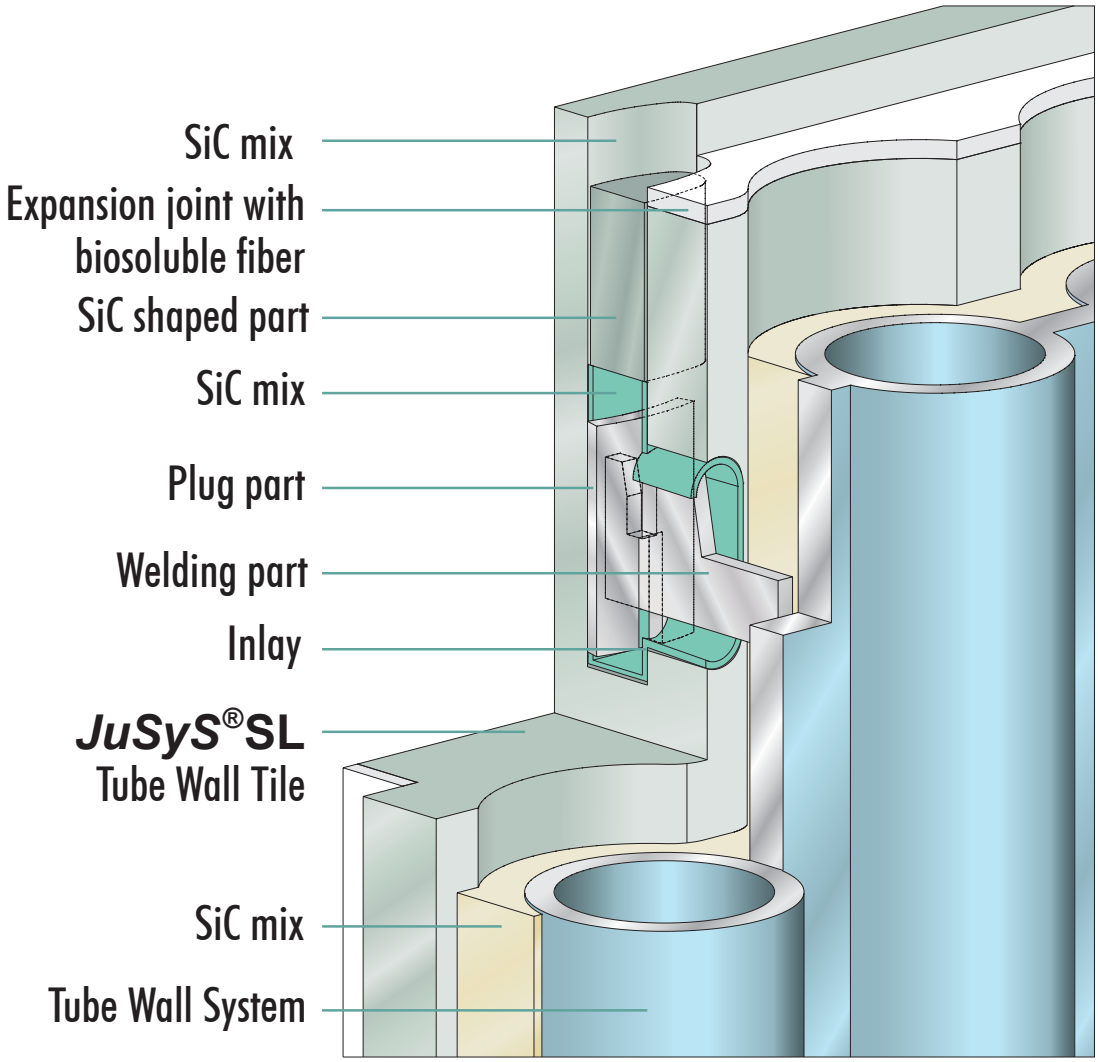
The rear-filled ***JuSyS*®SL** Tube Wall Protection System is developed from and added to our current Tube Wall Protection Systems proven over many years, as e.g. *JuSyS*® Standard and *JuSyS*®Air.

***JuSyS*®SL** consists of tube wall tiles made of SiC nitride which are stressless held on the tube wall system by heat resistant metallic retainers in connection with castable. Due to the stressless constructed retainer, no power transmission takes place by the movement of the tube wall and/or the different expansion of the refractory system to the tube wall. A defined gap arising from the evaporation of an especially formed poly propylene (PP) inlay effects the reduction of power and tension during operation. The retainers are covered by the tile and completely wrapped with castable as additional corrosion protection. The uninterrupted volume of the ***JuSyS*®SL** tile is unsusceptible to cracks, even in case of thermal shocks.

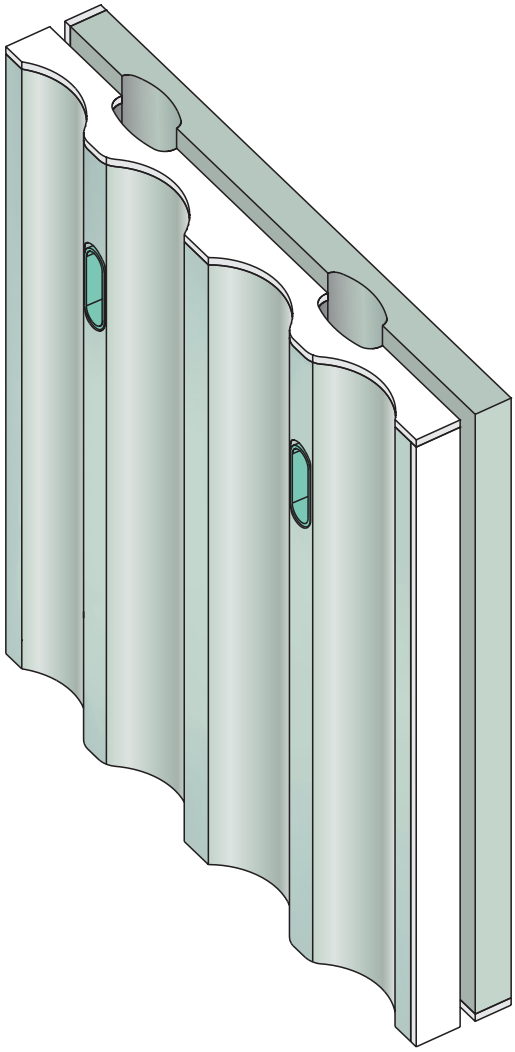
***JuSyS*®SL** provides decisive advantages:

- Reduction of power between tube wall and refractory system via the inlay
- Less cracks by the use of tiles with uninterrupted volume
- Best corrosion protection by staggered tile joints, covered arrangement of the steel retainers and their envelopment with JUFLOW mixes of low porosity
- Expansion and working joints which are adapted to the process technology and installed according to the thermal/mechanical stress in ***JuSyS*®SL** segments
- Variable distance between tube wall and ***JuSyS*®SL** tile, important in case of existing residual studding as well as uneven boiler tube wall
- No additional pressure test necessary, as the steel parts are not welded on the pressure part
- Depending on the process technology variable heat tranfers by rear casting with mixes of different thermal conductivity from the JUFLOW line (SiC or Al_2O_3 based)
- Short shut-downs by quick mounting and dismounting of the tube wall tiles
- High rentability of the initial equipment and/or the later installation

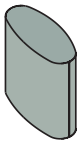
Detail JuSyS®SL
Function and Construction of the suspension



Detail Tube Wall Tile

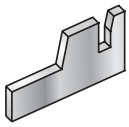


Detail retainer and accessories



SiC shaped part

Plug part / retainer
SHRW-25



Welding part
SHRW-28

JuSyS®SL

Tile installation

Picture top left
Mounting of the welding parts on the tube wall by means of a stud welder

Picture top right
Inserting the plug parts / retainers into the suspended tube wall tile

Picture left
Suspending of the tube wall tiles in the prepared tube wall

Picture left
Inserting the plug parts / retainers into the installed tube wall tile

Tile installation

Picture top left and right
Inserting the tube wall tiles

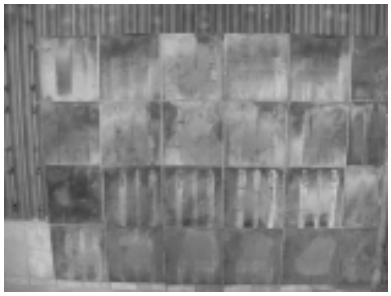
Picture left
Applying SiC mastic to the oval recess to envelop the steel parts

Picture left
Inserting the in SiC mastic dipped SiC shaped parts as upper closing of the recess

Tile installation

Picture left
Rear-casting of the tube wall tiles with SiC-mix by means of a feeding sheet metal

Picture left
Ready-installed tube wall tile system



Pictures above
Ready-installed tube wall tile system

Heat transfer

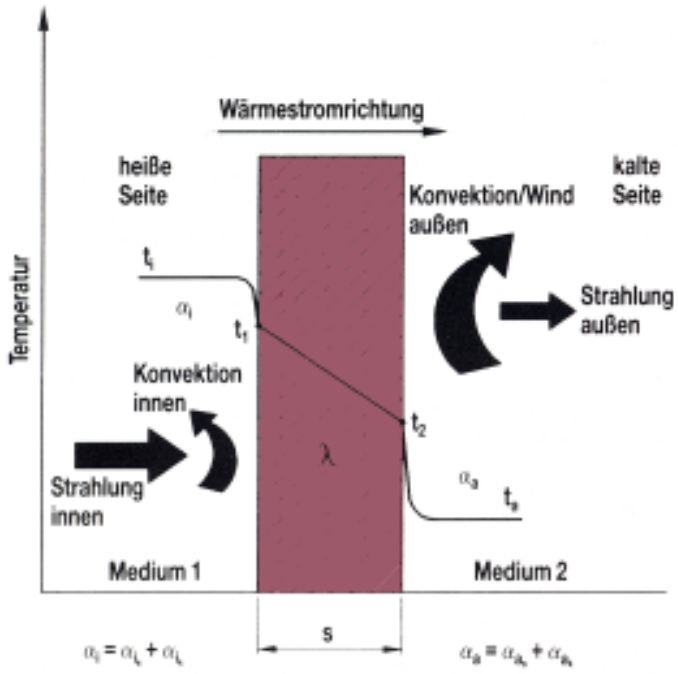
The following heat flow calculations for the ***JuSyS®SL*** tube wall tile system apply to the new condition of the refractory lining without any surface contamination as well as to the operating condition of the refractory lining with surface contamination.

The calculations are based on the following parameters:

Combustion Chamber Temperature:	T_{inner}	=	1.000 °C
Tube medium temperature:	T_{outer}	=	257 °C (depending on the boiler pressure stage)
Heat transfer coefficient:	α_{inner}	=	100/200 W/m²K
Heat transfer coefficient:	α_{outer}	=	10.000 W/m²K
Surface contamination:		=	5 mm slag /coating
Rear-castable of the tile system:		=	6/10 mm SiC-mix

The outcome of this is the following heat flow density in W/m² wall surface:

Dicke Hintergießmasse	without contamination		with contamination	
	100 W/m²K	200 W/m²K	100 W/m²K	200 W/m²K
6 mm	**61.000 W/m²**	**103.000 W/m²**	**20.300 W/m²**	**23.800 W/m²**
10 mm	**58.500 W/m²**	**95.700 W/m²**	**20.000 W/m²**	**23.400 W/m²**



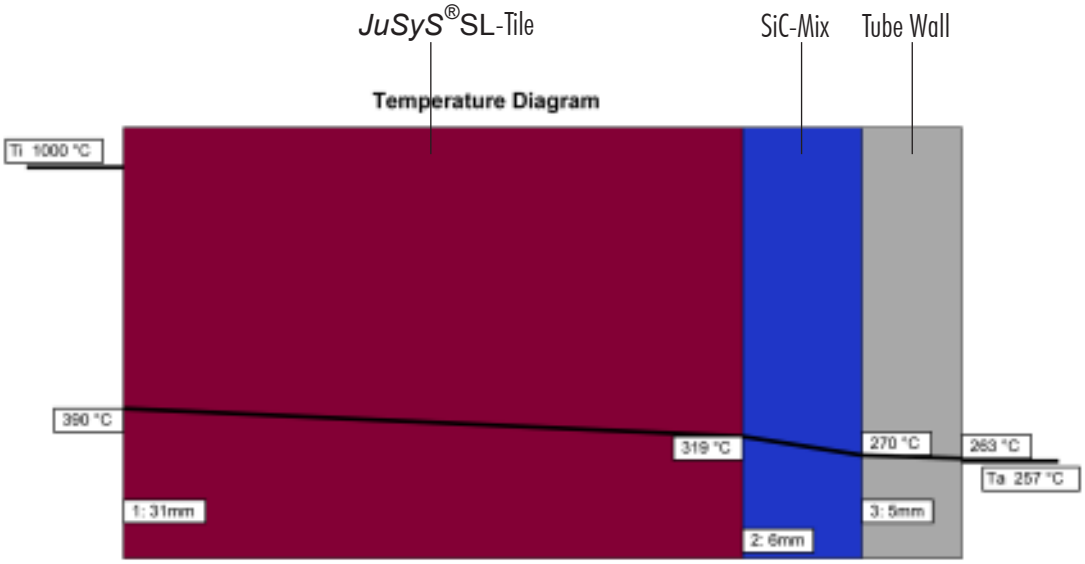
JuSyS®SL

Heat Transfer Calculation - without contamination-

Client	**: Tube Wall Tile System JuSyS SL**
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile without Surface Contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	390	263	°C (Calculated)
Heat Transfer Coefficient	100	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	60956	60956	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +SI107C	SiC brick		31	26,300	390,4	354,5
2: +SM115B	SiC mix		6	7,600	318,6	294,5
3: +ST0425	steel		5	41,331	270,5	266,8
			42		263,1	



Inserted thermal conductivity data represent average values without tolerances of dimensions and fabrication technique. Calculated data can, therefore, not be used as guarantee data. Heat bridges such as metallic anchors, joints or similar devices or deposits at the brickwork (fouling factor) and/or influence through surrounding walls resp. areas have not been taken into consideration in this calculation.

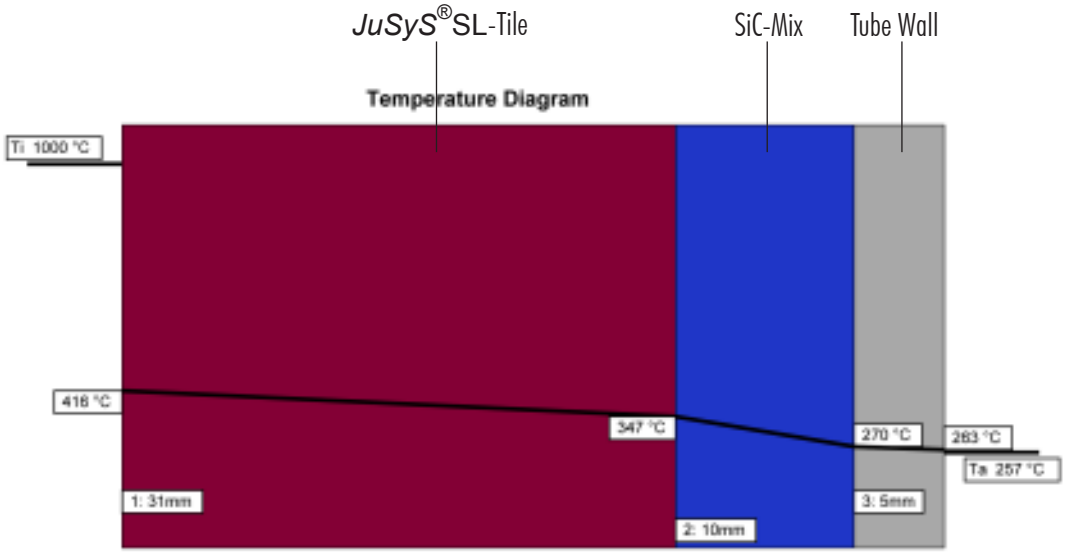
JuSyS®SL

Heat Transfer Calculation - without contamination-

Client	**: Tube Wall Tile System JuSyS SL**
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile without Surface Contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	416	263	°C (Calculated)
Heat Transfer Coefficient	100	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	58426	58426	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +SI107C	SiC brick		31	26,300	415,7	381,2
2: +SM115B	SiC mix		10	7,600	346,8	308,3
3: +ST0425	steel		5	41,341	269,9	266,4
			46		262,8	



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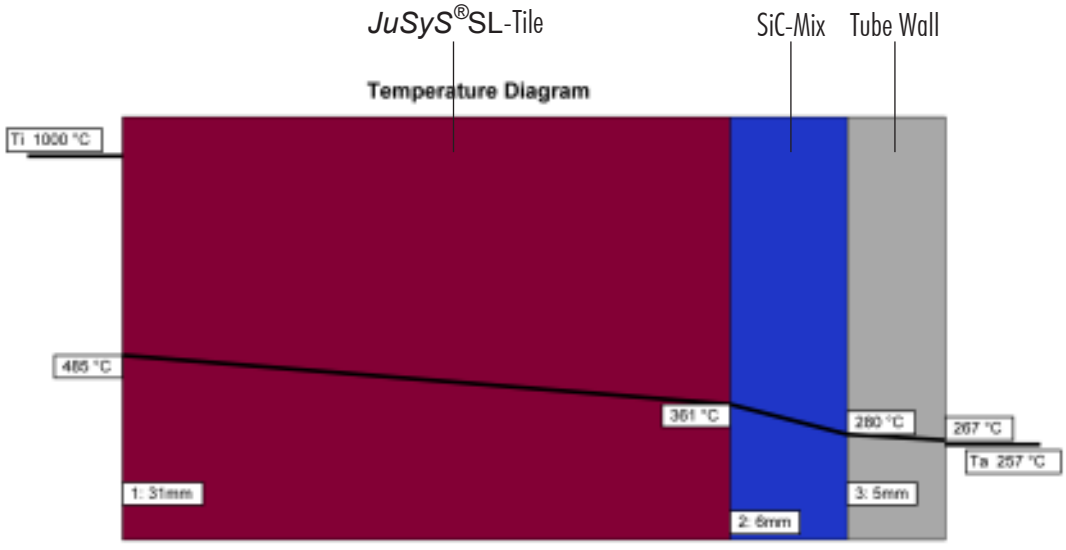
JuSyS®SL

Heat Transfer Calculation - without contamination -

Client	**: Tube Wall Tile System JuSyS SL**
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile without Surface Contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	485	267	°C (Calculated)
Heat Transfer Coefficient	200	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	102994	102994	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +SI107C	SiC brick		31	25,892	485,0	422,4
2: +SM115B	SiC mix		6	7,600	361,1	320,5
3: +ST0425	steel		5	41,161	279,8	273,5
			42		267,3	



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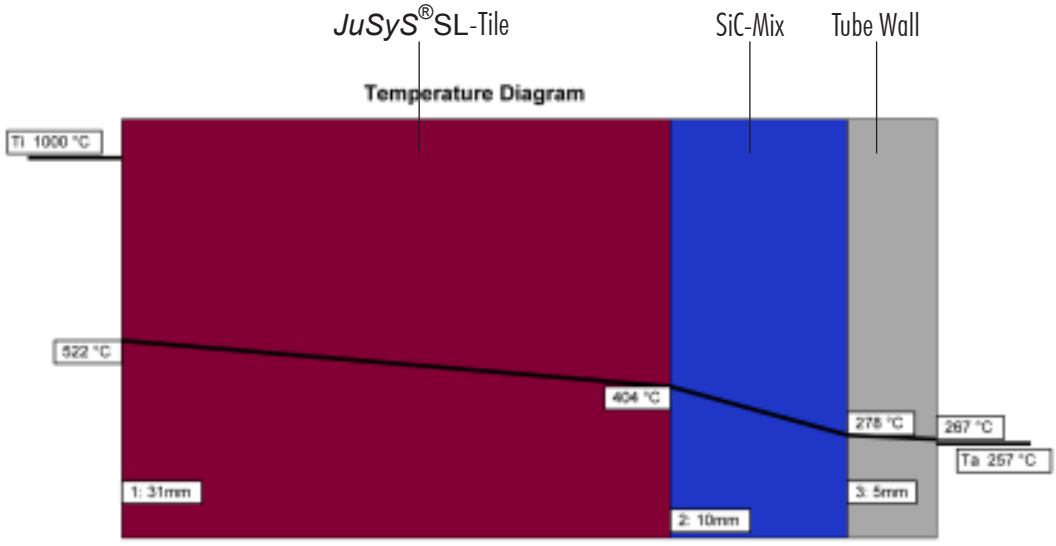
JuSyS® SL

Heat Transfer Calculation - without contamination -

Client	**: Tube Wall Tile System JuSyS SL**
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile without Surface Contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	522	267	°C (Calculated)
Heat Transfer Coefficient	200	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	95627	95627	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +SI107C	SiC brick		31	25,167	521,9	462,1
2: +SM115B	SiC mix		10	7,600	404,0	341,1
3: +ST0425	steel		5	41,191	278,2	272,4
			46		266,6	



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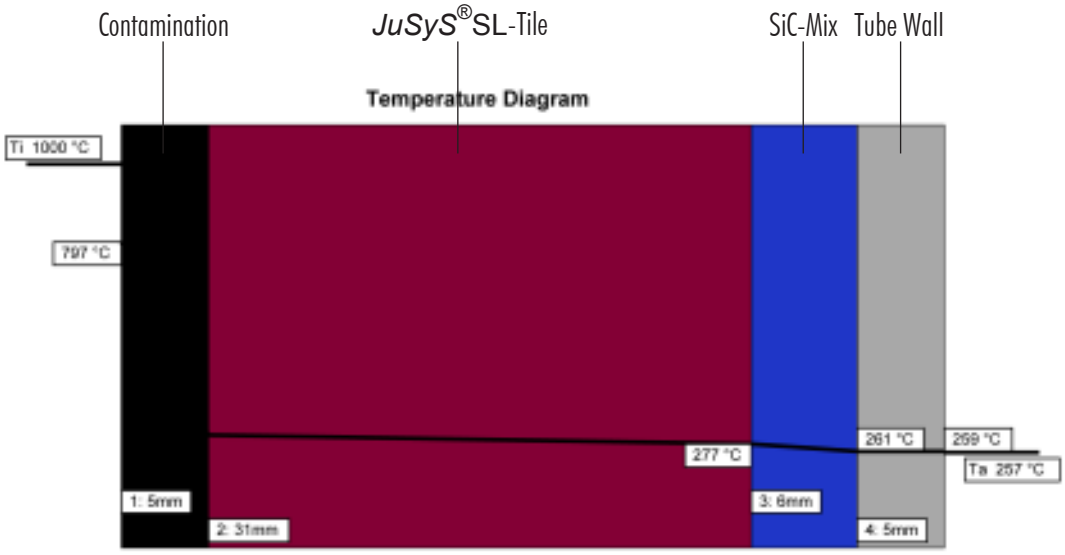
JuSyS®SL

Heat Transfer Calculation - with contamination -

Client	**: Tube Wall Tile System JuSyS SL**
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile with surface contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	797	259	°C (Calculated)
Heat Transfer Coefficient	100	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	20286	20286	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +MK597A	contamination		5	0,204	797,1	554,7
2: +SI107C	SiC brick		31	26,300	301,4	289,4
3: +SM115B	SiC mix		6	7,600	277,5	269,5
4: +ST0425	steel		5	41,494	261,5	260,3
			47		259,0	



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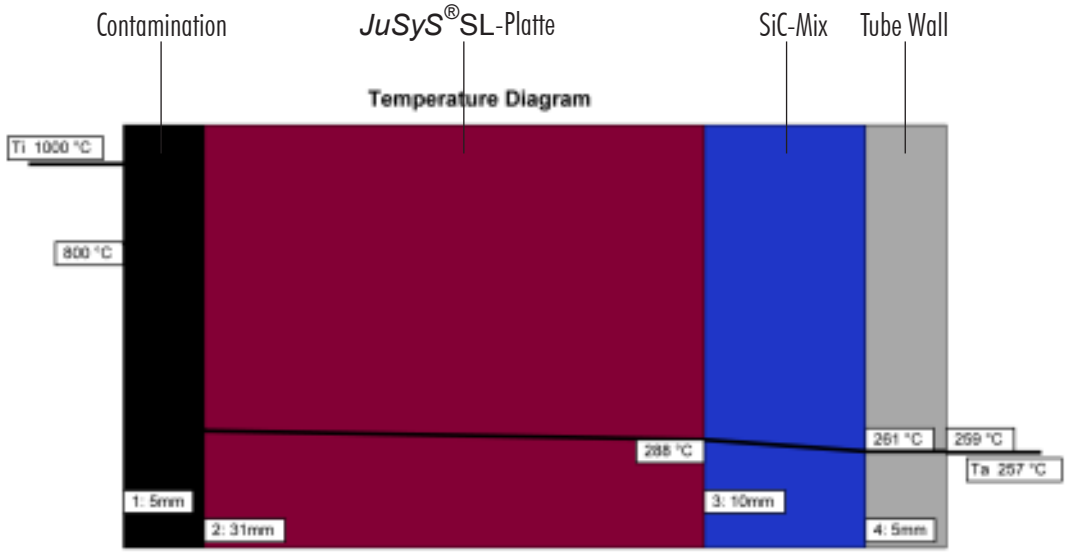
JuSyS®SL

Heat Transfer Calculation - with contamination -

Client	**: Tube Wall Tile System JuSyS SL**
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile with surface contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	800	259	°C (Calculated)
Heat Transfer Coefficient	100	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	20019	20019	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +MK597A	contamination		5	0,204	799,8	561,0
2: +SI107C	SiC brick		31	26,300	311,4	299,6
3: +SM115B	SiC mix		10	7,600	287,8	274,6
4: +ST0425	steel		5	41,495	261,4	260,2
			51		259,0	



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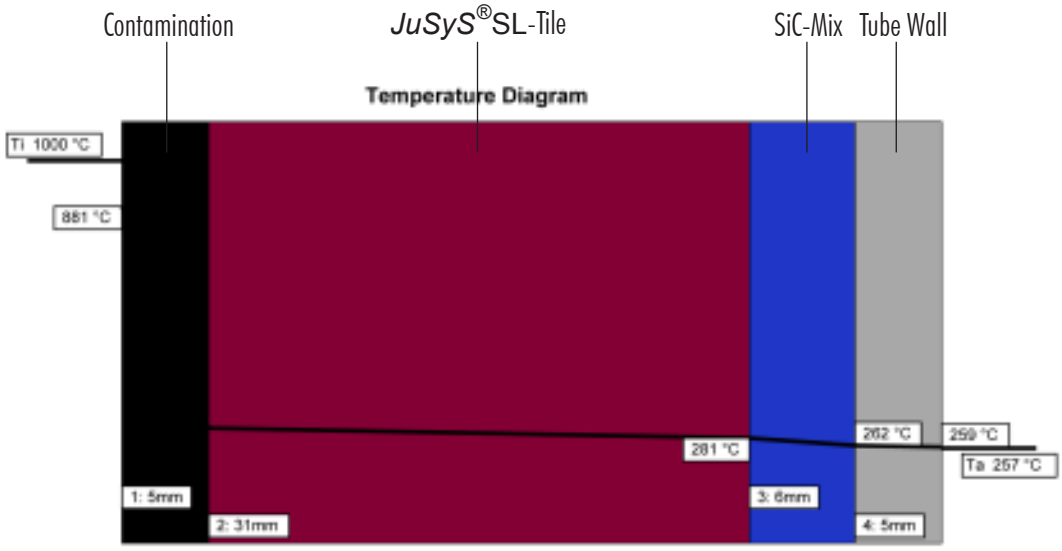
Heat Transfer Calculation - with contamination -

Client	**: Tube Wall Tile System JuSyS SL**
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile with surface contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	881	259	°C (Calculated)
Heat Transfer Coefficient	200	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	23741	23741	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +MK597A	contamination		5	0,207	881,3	602,7
2: +SI107C	SiC brick		31	26,300	309,0	295,0
3: +SM115B	SiC mix		6	7,600	281,0	271,6
4: +ST0425	steel		5	41,480	262,2	260,8
			47		259,4	



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Heat Transfer Calculation - with contamination -

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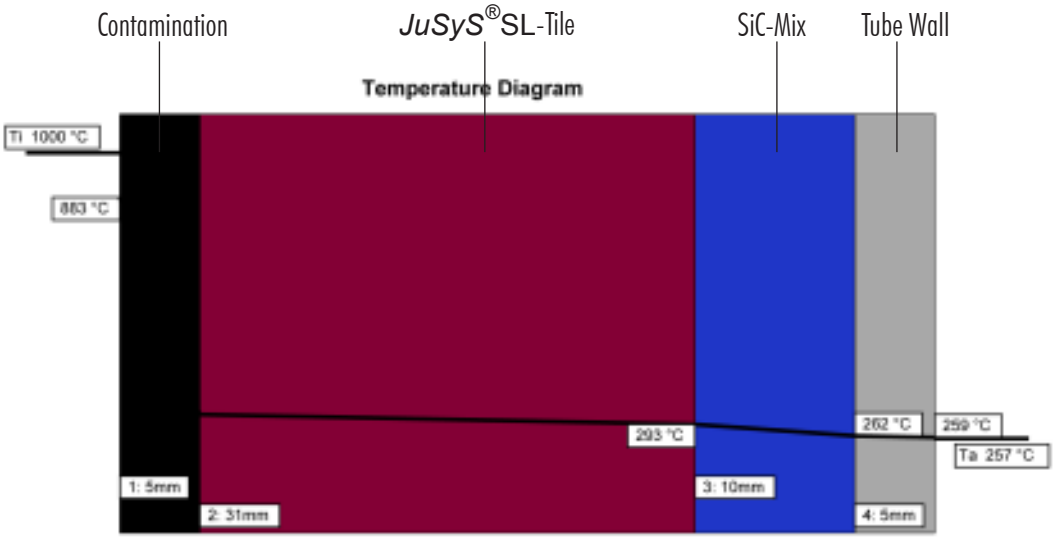
Project	**: rear-filled with SiC**
Component / Part	**: Tube Wall Tile with Surface Contamination**
Calculation Model	**: Plane vertical Wall**

Ambient Conditions	**Inner**	**Outer**	**Unit**
Ambient Temperature	1000	257	°C (Input)
Wall Temperature	883	259	°C (Calculated)
Heat Transfer Coefficient	200	9999,9	W/(m²K)
Calculation Model	manual	manual	--
Air Speed			m/s
Radiation Coefficient			--
Sun Radiation			W/m²
Diameter			mm
Heat Flow Density through Wall	23377	23377	W/m²

Wall Construction		**Cond. Factor**	**Thickn.**	**Cond.**	**Temperature of Layers**	
Material			**mm**	**W/(mK)**	**Face °C**	**Mean °C**
1: +MK597A	contamination		5	0,207	883,1	609,2
2: +SI107C	SiC brick		31	26,300	320,5	306,7
3: +SM115B	SiC mix		10	7,600	292,9	277,5
4: +ST0425	steel		5	41,481	262,2	260,7
			51		259,3	



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JuSyS®SL

Technisches Datenblatt / Fiche de données techniques

Rev. Hp / 30.11.2004

JUBRICK SI 107 C

Allgemeine Eigenschaften / Propriétés générales

ROHSTOFFBASIS **Base de matières premières**		Siliciumcarbid carbure de silicium
BINDUNGSART: **Type de liaison**		keramisch-nitridisch céramique-nitrure
ROHDICHTE **Densité apparente** DIN EN 993-1		2,72 g/cm³ +/-0,07 g/cm³
CHEMISCHE ANALYSE: **Composition chimique** RFA	SiC Si_3N_4+Si_2ON_2	72,00 - 78,00 % 18,00 - 26,00 %
MAX. ANWENDUNGSTEMP.: **Temp. maximum de service**		1150 °C
POROSITÄT (OFFEN): **Porosité (ouverte)** EN 993-1		15,0 %

Physikalische Eigenschaften / Propriétés

	IRREV. LÄNGENÄNDERG. Mod. de la long. lin. (irrév.)	REV. THERM. DEHNUNG Mod. de la long. lin. (rév.)	KALTDRUCKFESTIGKEIT Rés. à l' écras. à froid	WÄRMELEITFÄHIGKEIT Conductibilite therm.
		DIN 51045	DIN EN 993-5	EN 993-15
			120,0 - 160,0 MPa	
400 °C		0,18 %		26,300 W/mK
600 °C		0,27 %		
800 °C		0,37 %		19,000 W/mK
1000 °C		0,46 %		17,400 W/mK
1200 °C				16,900 W/mK

Weitere Eigenschaften / Autres propriétés

TEMPERATURWECHSELBEST.: **Résist. aux chocs thermiques**	Wasser / Eau: > 30 x

JuSyS®SL

Technisches Datenblatt / Fiche de données techniques

Rev. Hp / 31.08.2006

JUFLOW SM 115 B

Allgemeine Eigenschaften / Propriétés générales

ROHSTOFFBASIS **Base de matières premières**		Siliciumcarbid carbure de silicium	**VERARBEITUNG** **Mise en oeuvre**	selbstfließend auto-coulable
BINDUNGSART: **Type de liaison**		hydraulisch-chemisch hydraulique-chimique	**KÖRNUNG:** **Granulométrie**	0 - 3,0 mm
			MATERIALBEDARF: **Besoin en matériaux**	2,60 t/m³
CHEMISCHE ANALYSE: **Composition chimique**	SiC	58,00 %	**WASSERZUSATZ:** **Addition d' eau**	7,3 - 8,0 l / 100 kg
	Al_2O_3	26,00 %		
	SiO_2	13,00 %	**ANLIEFERUNGSZUSTAND:** **Etat à la livraison**	trocken sec
	Fe_2O_3	0,20 %		
	CaO	1,50 %		
MAX. ANWENDUNGSTEMP.: **Temp. maximum de service**		1400 °C	**HALTBARKEIT:** **Solidité**	6 Monate / mois

Physikalische Eigenschaften / Propriétés

	IRREV. LÄNGENÄNDERG. Mod. de la long. lin. (irrév.)	REV. THERM. DEHNUNG Mod. de la long. lin. (rév.)	KALTDRUCKFESTIGKEIT Rés. à l' écras. à froid PRE/R 27	WÄRMELEITFÄHIGKEIT Conductibilite therm. EN 993-15
110 °C			70,0 MPa	
400 °C				7,200 W/mK
500 °C			70,0 MPa	
600 °C				5,800 W/mK
800 °C		0,40 %	100,0 MPa	5,000 W/mK
1100 °C	-0,25 %		100,0 MPa	
1350 °C			100,0 MPa	

Weitere Eigenschaften / Autres propriétés

ABRIEBFESTIGKEIT: **Résistance r l'abrasion**	815 °C	8,8 cm³

ASTM C 704

References

JuSyS®SL 

The rear-casted Tube Wall Protection System ***JuSyS®* SL** has already been successfully installed in a large number of plants since the year 2004. In numerous furnaces throughout Germany and in other European countries we accomplished a surface of more than 5.000 m^2 of installed tube wall tiles to best customer satisfaction.

We will gladly give your more detailed information upon request.

Just talk to us or write us.

Jünger + Gräter GmbH
Robert-Bosch-Strasse 1, 68723 Schwetzingen
Phone +49 (0) 6202 944-0, Fax +49 (0) 6202 944-194
info@jg-refractories.com