

Online Training Event 2020
Exercise 1 – Thermal gradient

Ladle

Hot Face

Diameter	1200mm
Circumference	3770mm
Temperature	1550°C
cte	$13 \times 10^{-6} / ^\circ\text{C}$

Expansion	73mm
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Backup

Diameter	1550mm
Circumference	4870mm
Temperature	1275°C
cte	$5.2 \times 10^{-6} / ^\circ\text{C}$

Expansion	32mm
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Shell

Diameter	1710mm
Circumference	5370mm
Temperature	320°C
cte	$12 \times 10^{-6} / ^\circ\text{C}$

Expansion	21mm
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Nett Expansion

Backup	11mm
Hot Face	52mm

Ladle

- Cannot have gaps in hot face – metal penetration
- Expansion in hot face is too much for no specific allowance
- Compressible layer behind hot face (if behind backup, larger movement would open gaps in backup)
 - Dry Vibratable Refractory
 - Allowance is only 30-50% of expansion as lining must be tight
 - Need to know compression of dry-vibe. Minimum thickness to properly install dry vive may be greater than expansion
- Back-up Lining
 - Smaller expansion movement. If l
 - Possibly use 'Creep' of Mortar only
 - Possible use small compressible layer, eg CF Felt (less common)
- VERTICAL EXPANSION
 - Allowance needed or retaining bolts damaged

Oxidiser

Hot Face

Diameter	3020mm
Height	8000mm
Circumference	9490mm
Temperature	1100°C
cte	$4.8 \times 10^{-6} / ^\circ\text{C}$

Expansion - Vert	42mm
Expansion – Circ	50mm

Insulation

Diameter	3370mm
Circumference	10590mm
Height	8000mm
Temperature	820°C
cte	$5.2 \times 10^{-6} / ^\circ\text{C}$

Expansion - Vert	34mm
Expansion – Circ	45mm

Shell

Diameter	3500mm
Circumference	11000mm
Height	8000mm
Temperature	200°C
cte	$12 \times 10^{-6} / ^\circ\text{C}$

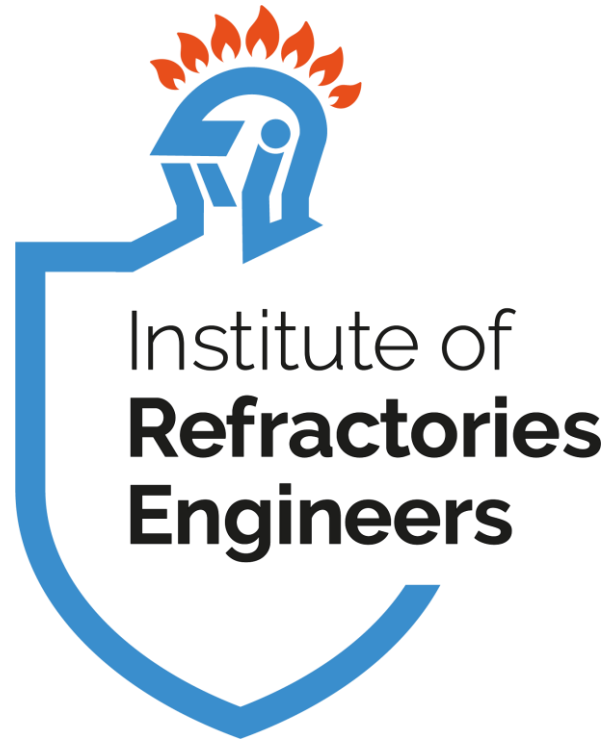
Expansion - Vert	19mm
Expansion – Circ	26mm

Nett Expansion

Backup - Vert	15mm
Backup - Circ	19mm
Hot Face - Vert	23mm
Hot Face - Circ	24mm

Oxidiser

- Hot Face
 - Circuferential Expansion
 - Gaps in hot face could close up during warm up
 - Can use combustibile pack
 - Compressible layer between insulation and hot face, eg CF
 - Vertical Expansion
 - Large gap at top , and large distance
 - Install brick shelves to reduce size of gaps and movement
 - CF blanket as compressible material below each shelf
- Insulation
 - Circumferential Expansion – No specific allowance normal insulation – low stiffness means large forces not developed
 - Vertical – use same as hot face



Thank you

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