

## Heath input considerations for the 50 cards chimneys (completely filled for 3 views)

Calculations updated in November 2020, following original calculations by Franco made for the 3x1x1 and NP02 (see plots and formulae)

accounting for:

- 1) Cryostat feedthrough pipe (2 mm) , 480 mm internal diameter
- 2) Chimney pipe (2 mm)
- 3) All flat cables from warm flanges (heath conduction from warm flange and joule effect for LV power supply currents)
- 4) Extraction blades materials
- 5) Electronics 18mW/channel, conservative measured NP02 consumptions not disentangled from distribution system, disentangled (11mW/channel) 64\*50 channels

Pipe 1	5,440952	W
Pipe 2	5,655453	W
Cables	15,81972	W
Cards	57,6	W
Blades	2,335442	W
Tot	86,85157	W

The total computed heath input is 87W (64W)/chimney; 66% (55%) from the electronics  
This calculation is for 50 cards/chimney (3 views)

# Pipes

## Pipe1

## Pipe2

Pipe1			Pipe2		
Cross section tube			External pipe		
D	480 mm		D	499 mm	
T	4 mm		T	4 mm	
A	3029,659 mm <sup>2</sup>		A	3149,086 mm <sup>2</sup>	

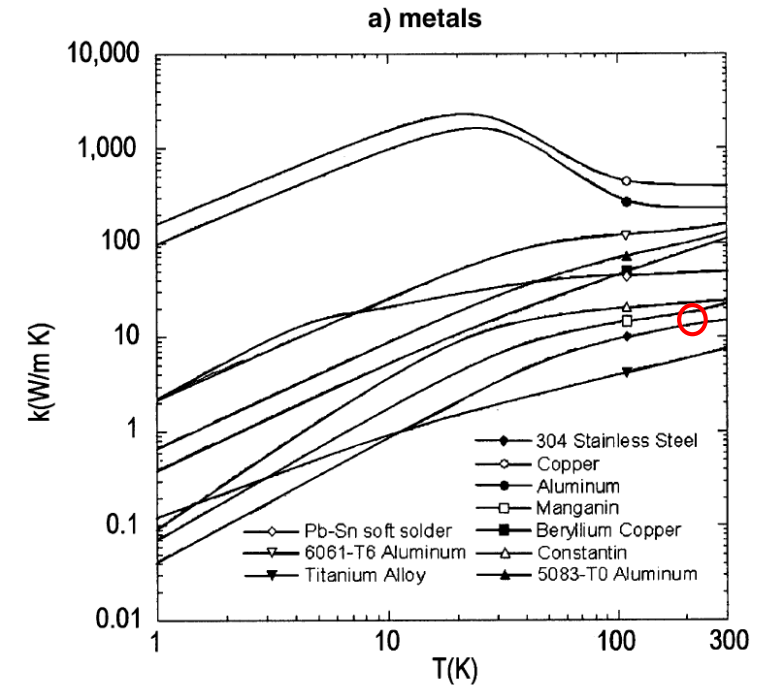
2mm tickness

4mm=difference external-inner diameters

a(SS)	3029,66 mm <sup>2</sup>		3149,1 mm <sup>2</sup>	
L	1,754 m		1,754 m	
DeltaT	210 K		210 K	
lambda	15 W/(m*K)		15 W/(m*K)	
W	5,440952		5,655453	

$$W = \langle \lambda_{SS} \rangle \cdot \frac{a(SS)}{L_{SS}} \cdot \Delta T$$

# Stainless Steel



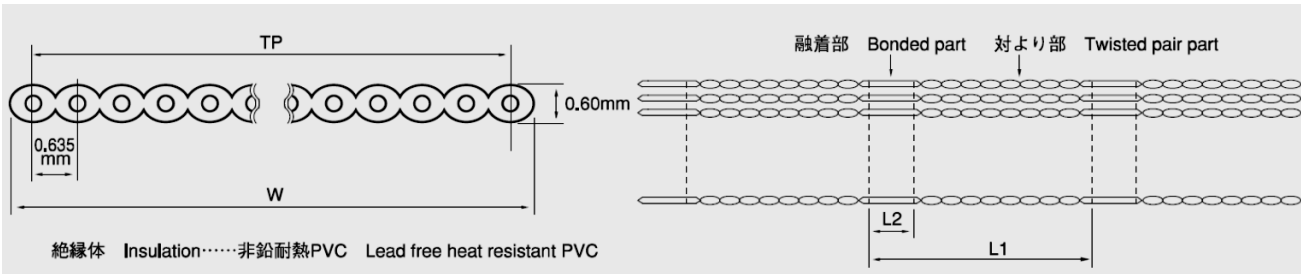
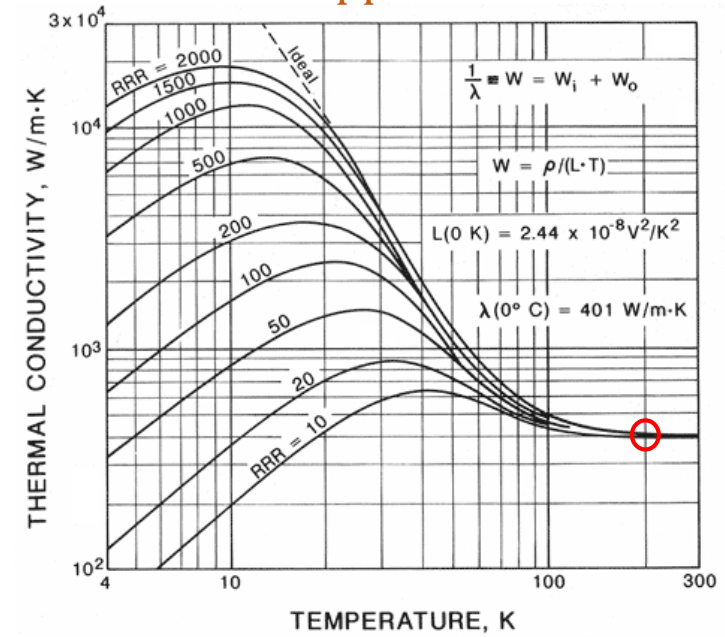
# Cables

Twisted pairs flat cables: (34 pairs + 40 pairs) = 74x2 AWG 30 conductors, 0.635mm pitch

Cables 80+68 pins		a	0,0509 mm <sup>2</sup>
N pins	148	Number conductors	7400
N cards	50	L cable	2 m
Nconductors	7400	delta_T	210 K
		lambda	400 W/(m*K)
		W	15,81972 W

$$W = \lambda \cdot \frac{a \cdot N_c}{L_{cable}} \cdot \Delta T$$

# Copper



# Blades

Blades		
a(FR4)	30010	mm2
L	1,754	m
DeltaT	210	K
lambda	0,65	W/(m*K)
W	2,335442	

50x2 blades

$$W = \langle \lambda_{FR4} \rangle \cdot \frac{a(FR-4)}{L_{FR4}} \cdot \Delta T$$

## FR-4

