REPORT

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Reference
7P02170-Rev. A

Calculation

HS Hansen A/S
Bredgade 4
DK-6949 LEM ST
Denmark

Calculation of thermal transmittance according to EN 10077-2:2012

(3 appendices)

Revision A: the section G40A is added to appendix 3.

Work requested

The client supplied drawings of windows for calculation of its total U-value. Appendix 3 shows the design of the constructions.

Product name:	Millennium
Product type:	Operable window (Turn-tilt fitting)
Product category:	Aluminium frames with thermal break
Glass options:	Multiple, see table 1 , appendix 1
Spacer:	TGI
Daylight size:	1.23 x 1.48 m^2
Producer of window:	HS Hansen A/S

Calculation and test methods

Calculations of the profile sections was performed using the THERM 6.3 program. Material data and boundary conditions are shown in appendix 1.

Calculation results

Name	Spacer	Glass combination	Size (B x H)	U_w (W/(m^2K))
G24	TGI-18	4-18Ar-PT+	1.23 x 1.48 m^2	1.5
G24A	TGI-15	4PL-15Ar-4PC-15Ar-4PL	1.23 x 1.48 m^2	1.1
G30	TGI-20	6-20Ar-PT+	1.23 x 1.48 m^2	1.5
G30A	TGI-18	4PL-18Ar-4PC-18Ar-4PL	1.23 x 1.48 m^2	0.97
G40	TGI-15	4PL-15Ar-4PC-15Ar-4PL	1.23 x 1.48 m^2	1.0
G40A	TGI-20	6PL-20Ar-6PC-20Ar-6PL	1.23 x 1.48 m^2	0.91
G40W	TGI-20	6PL-20Ar-6PC-20Ar-6PL	1.23 x 1.48 m^2	0.98

The calculations are described more in detail in appendix 2.

Note that the U-values, as calculated and stated in this report, only apply for operable window with turn-tilt fitting which is having the same construction details as given by the drawings in this report. Window must be clearly marked. Glazing system details and the spacer must confirm with the description in this report. Also, the frame and sash design must confirm with drawings that are given in this report.

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Building Technology - Building Physics and Indoor Environment

Performed by

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Reason: I have reviewed this document
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Eva-Lotta Kurkinen

Appendices

1 Material data and boundary conditions
2 Calculation of thermal transmittance
3 Calculated sections

Appendix 1

Material data and boundary conditions

Table 1 Glazing unit

No#	Combination:	Gas:	Coating (position):	Corrected emissivity:	Spacer:	U_g W/(m^{2}K)
G24	D4-18	Argon (90%)	Planitherm Total+ (3)	0.060	TGI-18	1.2
G24A	T4-15	Argon (90%) / Argon (90%)	Planitherm LUX (2, 5)	0.082	TGI-15 / TGI-15	0.7
G30	D6-20	Argon (90%)	Planitherm Total+ (3)	0.060	TGI-20	1.2
G30A	T4-18	Argon (90%) / Argon (90%)	Planitherm LUX (2, 5)	0.082	TGI-18 / TGI-18	0.6
G40	T4-15	Argon (90%) / Argon (90%)	Planitherm LUX (2, 5)	0.082	TGI-15 / TGI-15	0.7
G40A	T6-20	Argon (90%) / Argon (90%)	Planitherm LUX (2, 5)	0.082	TGI-20 / TGI-20	0.6
G40W	T6-20	Argon (90%) / Argon (90%)	Planitherm LUX (2, 5)	0.082	TGI-20 / TGI-20	0.6

Table 2

Material	**Thermal conductivity, W/(m·K)**	**Source**
Aluminium	160	1
EPDM (TPE)	0.25	2
Glass	1.0	1
Silicon	0.35	2
Tape	0.08	2
Polyamide	0.30	2
TGI eq1	0.40	2
TGI eq2	0.30	2
Steel	50	1

Cavity (air)* Calculated according to SS-EN ISO 10077-2

* Non rectangular air cavities are transformed into equivalent rectangular air cavities in accordance with SS-EN ISO 10077-2 and the thermal conductivity is then calculated for this equivalent air cavity. The radiative surface heat transfer coefficient for surfaces within the air cavity is determined according to SS-EN ISO 6946 ;2007 (Annex B.4). The emissivity of surfaces are set according to the drawing from client which is attached in appendix 3.

1 = SS-EN ISO 10077-2
2 = according to producer

Appendix 1

The air temperature and surface resistance have been taken as ϑ_i = +20 °C and R_{si} = 0.13 m²K/W (0.20 m²K/W for inward corners) on the inside and ϑ_e = 0 °C and R_{se} = 0.04 m²K/W on the outside.

Calculation was carried out according to detailed section as shown in Annex 3. Adjacent sections (adiabatic) was placed 190 mm from the edge of the glass and along adjoining wall. Only fittings which have influence on the U-value is taken into account in the calculation.

Appendix 2

Calculation of thermal transmittance

Linear thermal transmittance

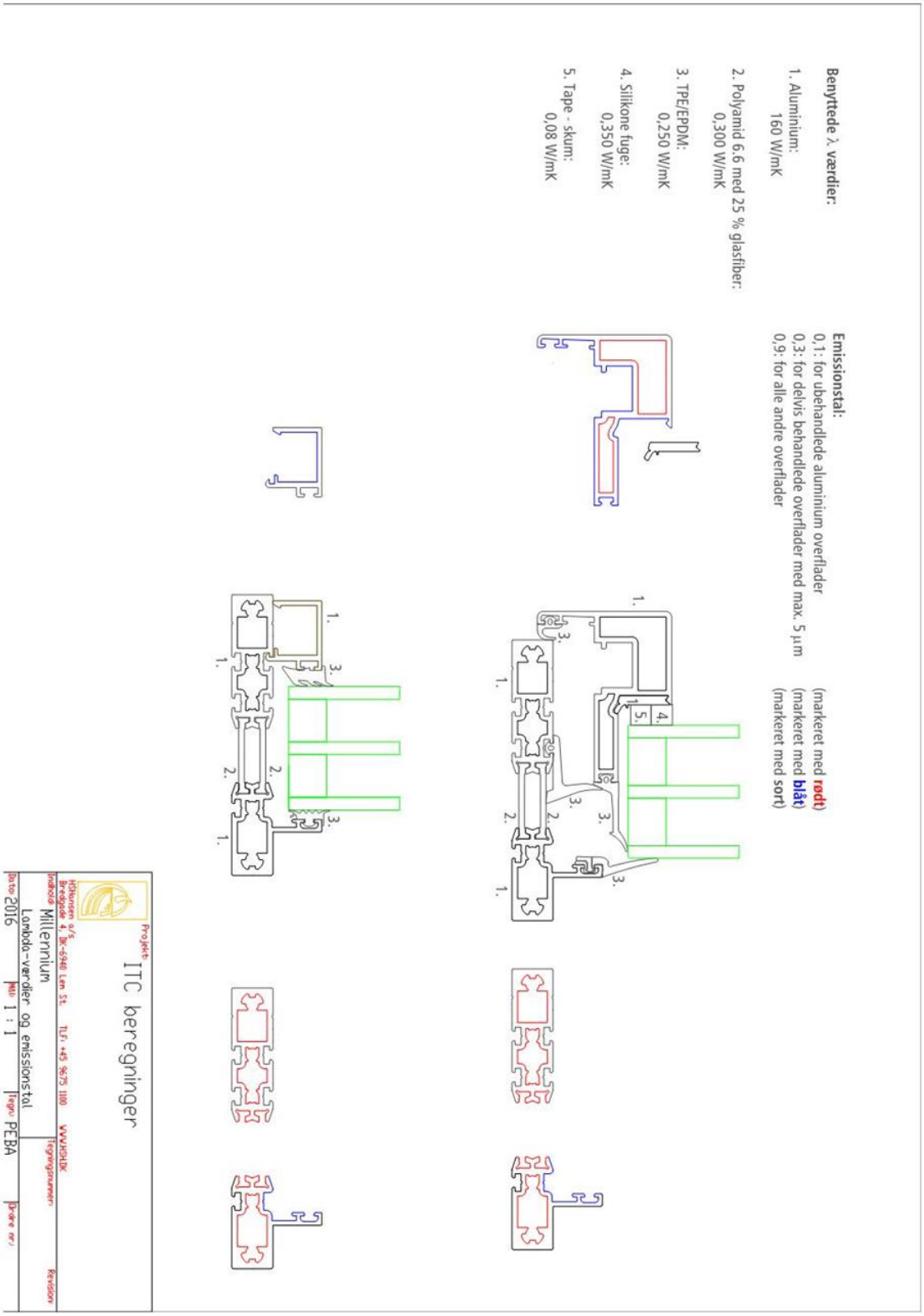
Table 3 Calculated ψ- och U-value for window with size 1.23 m x 1.48 m

Name	Spacer	**Frame height b_f, (m)**	**ψ-value, W/(mK)**	**U-value, W/(m²K)**	
		Side, top and Bottom	Side, top and Bottom	U_f Side, top and Bottom	U_w Window 1.23×1.48 m²
G24	TGI-18	0.0500	0.047	2.47	1.52
G24A	TGI-15	0.0505	0.045	2.51	1.08
G30	TGI-20	0.0500	0.047	2.21	1.48
G30A	TGI-18	0.0505	0.042	2.26	0.97
G40	TGI-15	0.0500	0.040	2.01	1.00
G40A	TGI-20	0.0505	0.041	1.93	0.91
G40W	TGI-20	0.0720	0.045	1.83	0.98

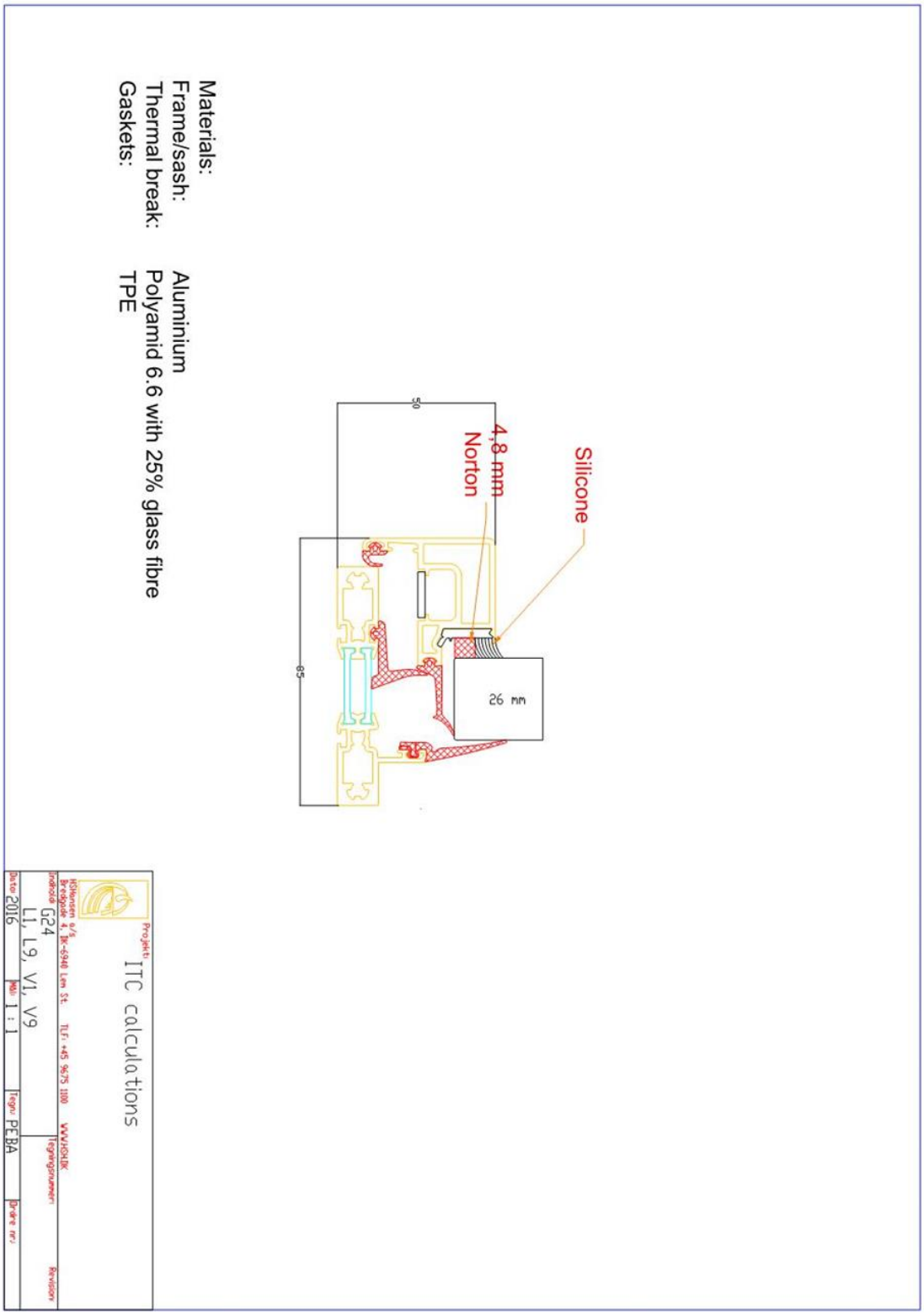
U-value for the windows are calculated using area weighting of U-value for each part and correction for edge losses near the glass edge according to SS-EN ISO 10077-1;2006 and -2: 2012.

Appendix 3

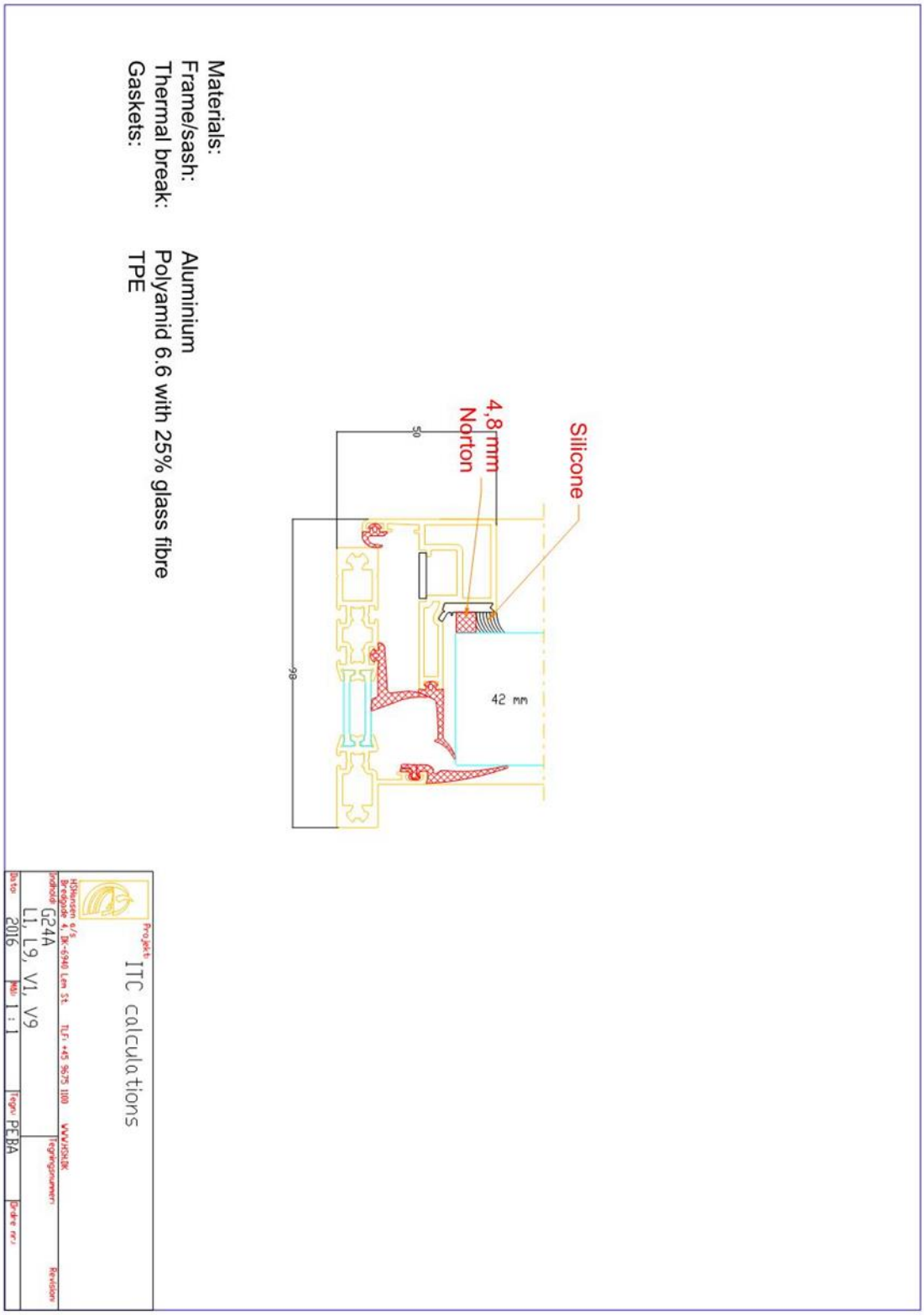
Calculated sections



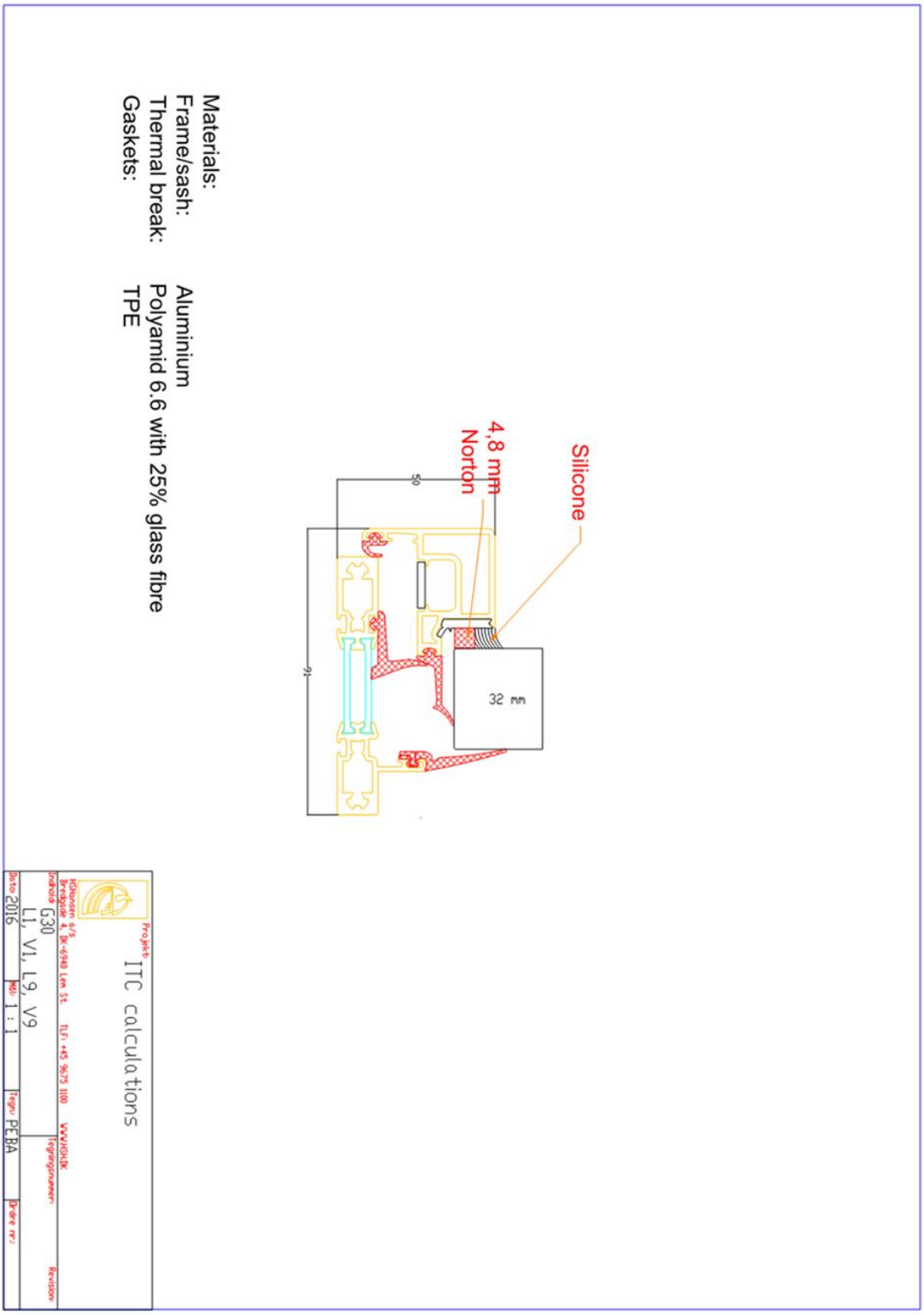
Appendix 3


Materials:
Frame/sash: Aluminium
Thermal break: Polyamid 6.6 with 25% glass fibre
Gaskets: TPE
50
4,8 mm
Norton
Silicone
65
26 mm
Projekt:
ITC calculations
G24
L1, L9, V1, V9
Dato: 2016
Målt: 1 : 1
Tegn: PEBA
Revision:

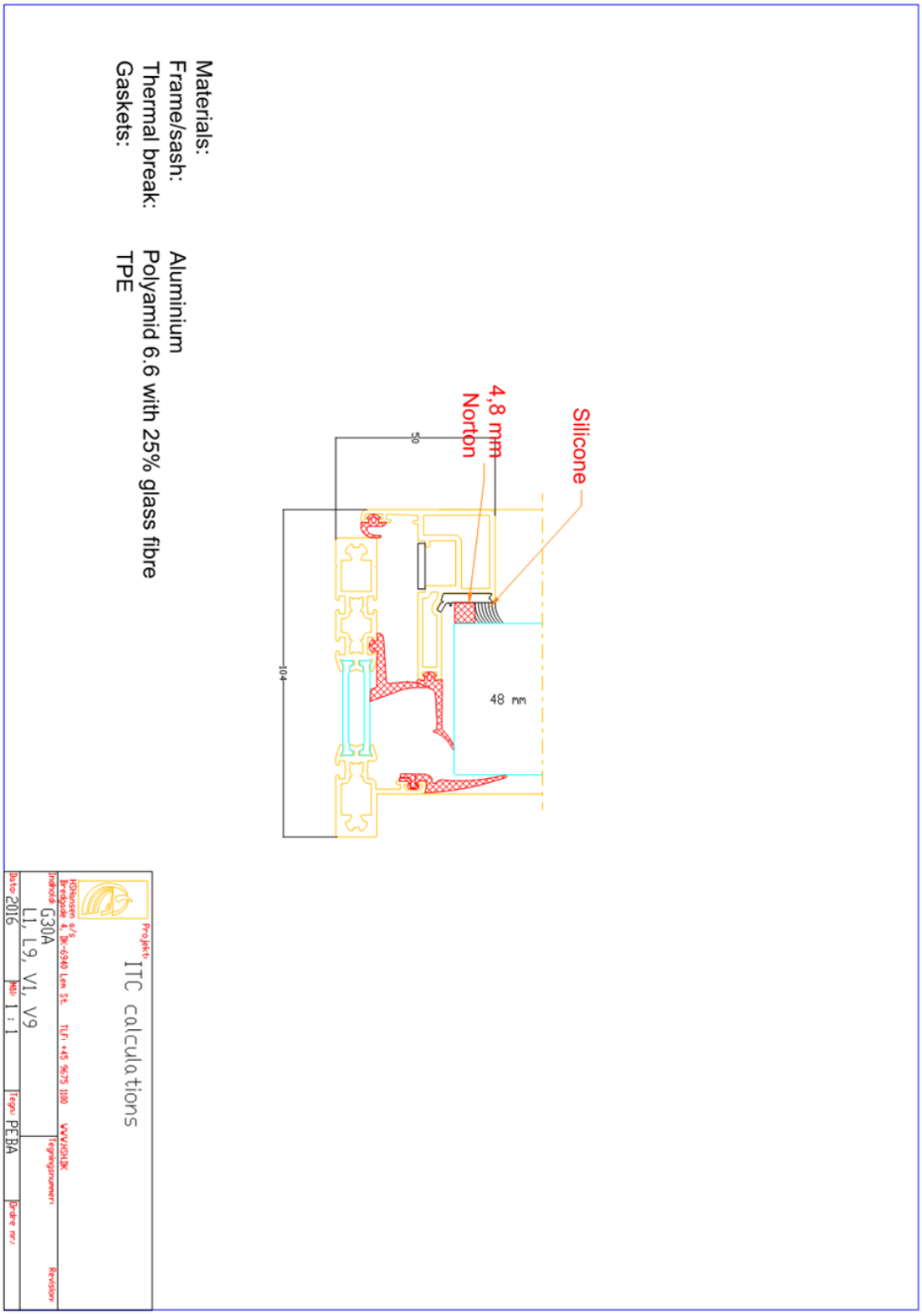
Appendix 3


Materials:
Frame/sash: Aluminium
Thermal break: Polyamid 6.6 with 25% glass fibre
Gaskets: TPE
4,8 mm
Norton
Silicone
50
98
42 mm
ITC calculations
G24A
L1, L9, V1, V9
2016
1 : 1
PEBA

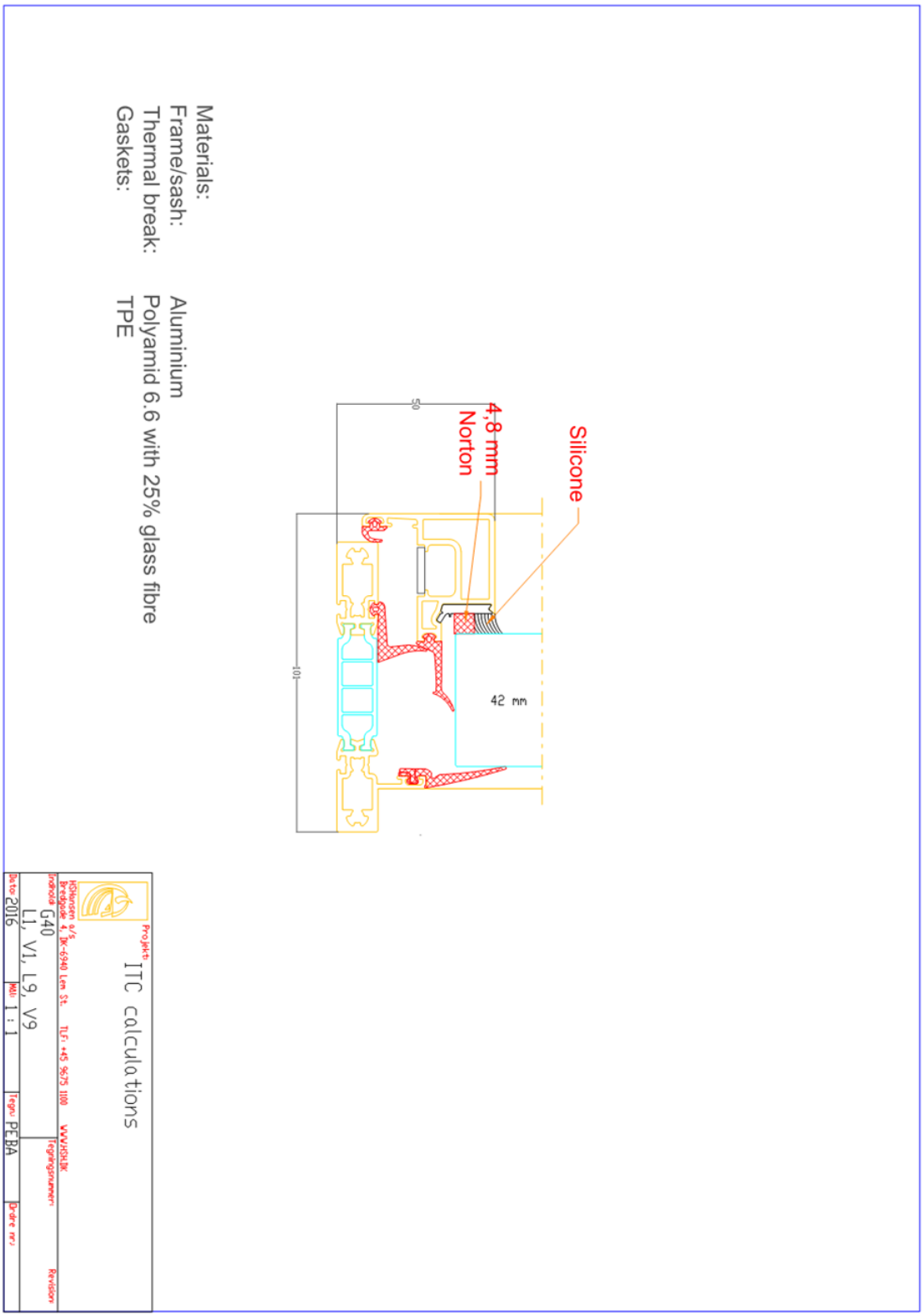
Appendix 3


Materials:
Frame/sash: Aluminium
Thermal break: Polyamid 6.6 with 25% glass fibre
Gaskets: TPE
4,8 mm
Norton
Silicone
50
91
32 mm
ITC calculations
G30
L1, V1, L9, V9
2016
1 : 1
PE BA

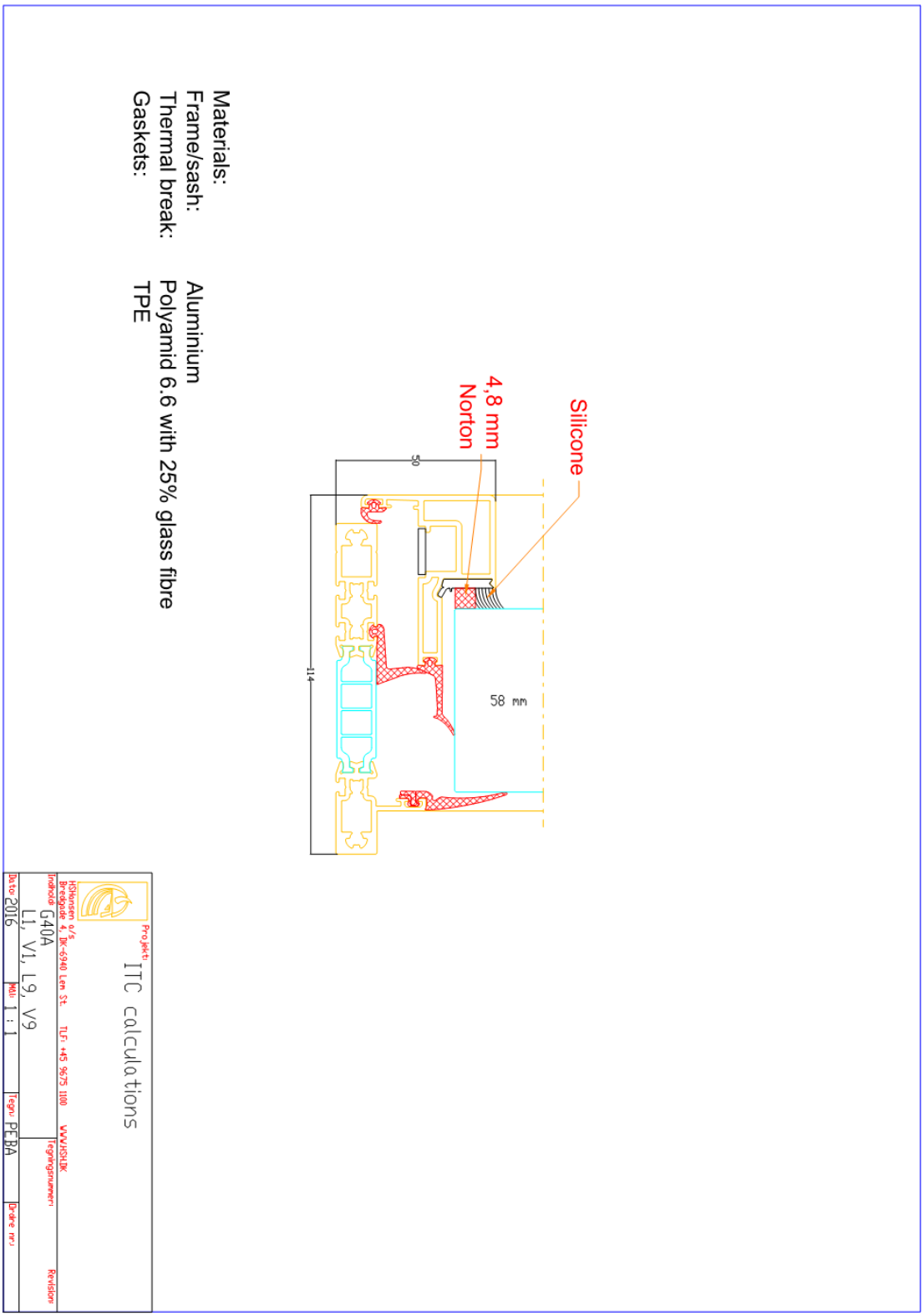
Appendix 3


Materials:
Frame/sash: Aluminium
Thermal break: Polyamid 6.6 with 25% glass fibre
Gaskets: TPE
4,8 mm
Norton
Silicone
50
104
48 mm
ITC calculations
G30A
L1, L9, V1, V9
2016
1 : 1
PE BA

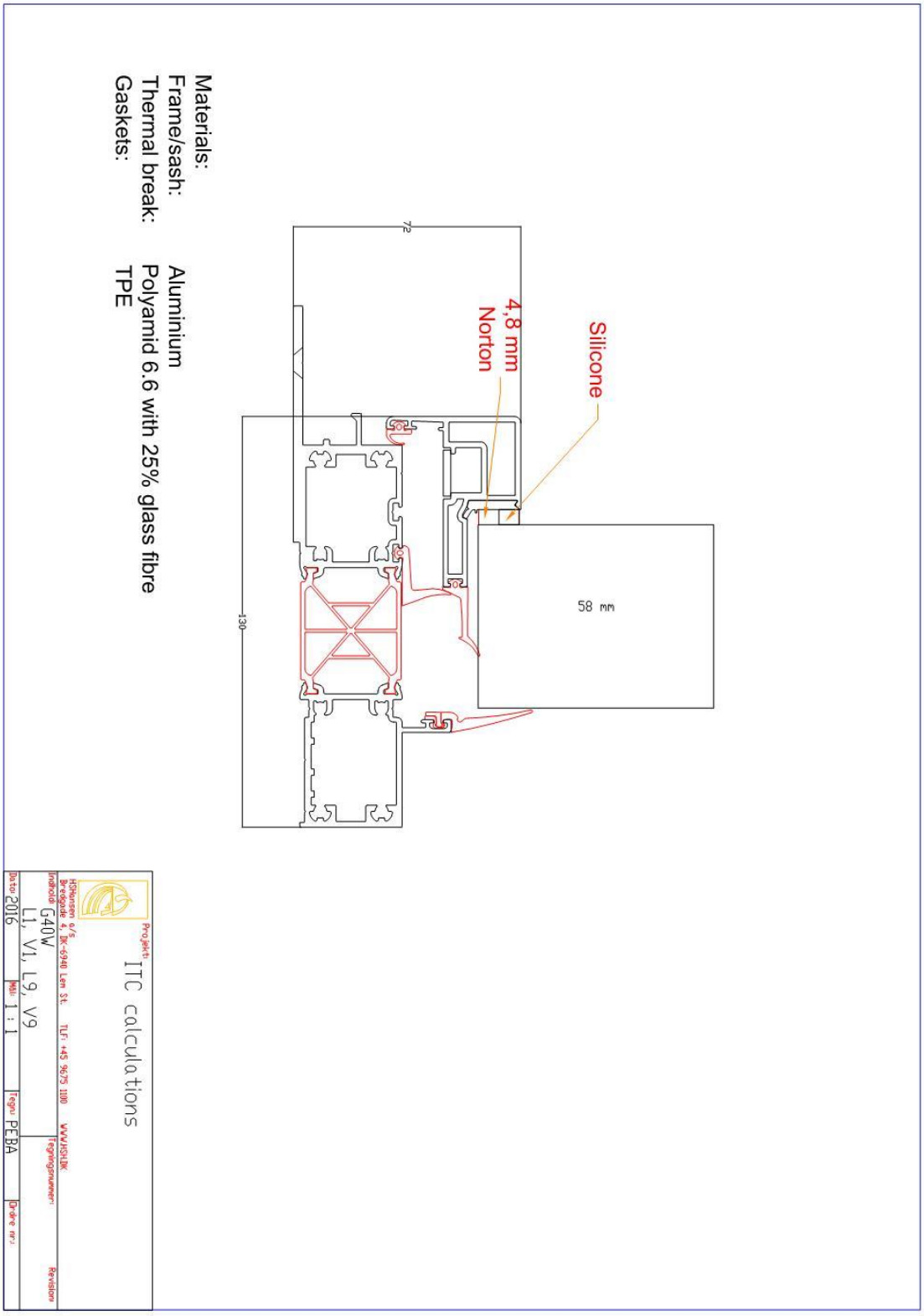
Appendix 3


Materials:
Frame/sash: Aluminium
Thermal break: Polyamid 6.6 with 25% glass fibre
Gaskets: TPE
4,8 mm
Norton
Silicone
42 mm
50
101
ITC calculations
G40
L1, V1, L9, V9
PEBA
2016
1 : 1

Appendix 3


Materials:
Frame/sash: Aluminium
Thermal break: Polyamid 6.6 with 25% glass fibre
Gaskets: TPE
4,8 mm
Norton
Silicone
50
114
58 mm
Projekt:
ITC calculations
HSHansen a/s
Bredgade 4, DK-6940 Lem St.
TLF: +45 9675 1100
WWW.HSH.DK
Indhold:
G40A
L1, V1, L9, V9
Dato:
2016
Mål:
1 : 1
Tegn:
PEBA
Tegningsnummer:
Revision
Ordre nr.:

Appendix 3


Materials:
Frame/sash: Aluminium
Thermal break: Polyamid 6.6 with 25% glass fibre
Gaskets: TPE
72
4,8 mm
Norton
Silicone
58 mm
130
ITC calculations
G40W
L1, V1, L9, V9
2016
1 : 1
PEBA