



**SOW for the Supply of Electrical
Feedthroughs**

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Statement of Work

For the Supply of Electrical Feedthroughs

For RAL Space

Document Number:	AIV-STC2-SOW-1014
Issue:	1.1
Date:	15/08/2015
Classification:	Commercial in Confidence

Document Prepared By:	Giles Case	Signature and Date	

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Change Record

Issue	Date	Section(s) Affected	Description of Change
1.0	17/07/2015	All	First issue
1.1	15/8/2015	All	Minor corrections prior to formal issue

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1 INTRODUCTION

The Rutherford Appleton Laboratory (RAL) is the largest of the Science and Technology Facilities Council's laboratories. RAL, whose main function is to support the advancement of science, is situated 15 miles south of Oxford, in the UK.

The RAL Space Department is seeking to procure electrical connectors for integration to electrical harnessing for the shroud panels of its second Space Test Chamber (STC-2).

2 SCOPE

This document describes the activities to be executed and the deliverables required by STFC-RAL in relation to the supply of electrical feedthroughs for the STC-2 vacuum chamber.

2.1 Applicable Documents

The list of documents in Table 2-1 are applicable to this document.

Table 2-1 – Applicable Documents

Item Number	Document Title	Document Number

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3 WORK TO BE PERFORMED

The Contractor shall be fully responsible for:

- The work related to the manufacture, assembly, testing, and shipping of the connectors to STFC-RAL
- The preparation of the documentation necessary for the work
- Provision of all tools, test equipment, etc., necessary for the work

Lack of mention of any task or activity within this SOW does in no way absolve the Contractor from the responsibility for identification and performance of these tasks and activities where these are necessary to meet the requirements of the Contract.

3.1 Parts to be supplied

There are three connector types and two genders of these connectors alongside the pins and sockets associated with these connectors. Table 3-1 lists the parts to be supplied under this Statement of Work.

Table 3-1 Flange list

Description	Quantity
Flange Assembly AA_1	1
Flange Assembly AA_4	1
Flange Assembly AA_5	1



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3.2 Bidding Phase

Contractors wishing to bid for this work shall review this SOW and confirm, or otherwise,

- The suitability of the specified items for the intended operational conditions.
- Any alternate technologies that could be used to perform the same job and still meet the technical requirements laid out in this document.

Changes or alternate techniques should be offered as part of this tender response alongside the cost reduction available if there options were to be taken up.

3.3 Delivery

Delivery of the flanges and feedthroughs is required by the date given in Section 7 of this document.

3.4 Shipping

The Contractor shall be responsible for delivering the parts to STFC-RAL. The Contractor is responsible for ensuring that the parts are adequately protected during shipping so that no damage occurs.

4 FREE ISSUE MATERIALS

STFC will be free issuing materials to form part of the package of work. These are in the form of pre terminated wires that are to be used in the construction of the feedthrough assemblies that make up each flange. As timescales are short, if it is advantageous to the schedule it would be possible to supply some of the wires without termination and to terminate these at a later date. This schedule optimisation will be discussed with the winning bidder. Free issue wire assemblies will be cleaned to a level compliant with the end use of the flanges.

4.1 Free Issued Heater Wiring

- 53 Screened Twisted Quads terminated to a single 5W5 connector on one end of each cable. The other end is unterminated.

4.2 Free Issued Thermocouple Wiring

- 46 10-Pair Thermocouple cables for Shroud Zones terminated to a 25-way DSUB on one end of each cable. The other end is unterminated.
- 30 10-Pair Thermocouple cables for Payload terminated to a 25-way DSUB on one end of each cable. The other end is unterminated.
- 7 10-Pair Thermocouple cables for AUX channels terminated to a 9-way DSUB

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on one end of each cable. The other end is unterminated.

5 DELIVERABLES

- Certificates of Conformance (C of C) for supplied parts
- All complete flange assemblies as specified in Table 3-1

6 SPECIFICATION

- All flange and feedthrough assemblies should be visibly clean and suitable for use in a contamination sensitive high vacuum environment.
- All flange and feedthrough assemblies should be handled using powder free gloves and measures should be put into place to ensure there is no cross contamination between the working area, tools and the clean flange assemblies.
- Lubricants should not be used in the assembly of the flanges or feedthroughs except in the case of o-rings where it is permissible to use a small amount of YVAC-3 grease
- No silicone based products are to be used.
- Completed assemblies to be helium leak tight to $<1\text{E-}8$ mbar//s

6.1 Flange AA_1

- Designation: Shroud Heaters
- Type: Stainless steel 16.5inch conflat (CF) flange
- Number of wires: 53 Screened Twisted Quads
- Number of spare wires: 5 Screened Twisted Quads (TBC. dependant on available space in flange)
- Number of feedthroughs: TBC by supplier

6.2 Flange AA_4

- Designation: Shroud Thermocouples
- Type: Stainless steel 16.5inch conflat (CF) flange
- Number of wires: 53 T-Type 10-Pair Thermocouple Cables
- Number of feedthroughs: TBC by supplier

6.3 Flange AA_5

- Designation: Payload Thermocouples
- Type: Stainless steel 16.5inch conflat (CF) flange
- Number of wires: 30 T-Type 10-Pair Thermocouple Cables
- Number of spare wires: 5 T-Type 10-Pair Thermocouple Cables (TBC. dependant on available space in flange)



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- Number of feedthroughs: TBC by supplier

7 SCHEDULE

All items are required to be delivered to STFC-RAL by the end of October 2015.

The Contractor shall indicate in his bid submission whether this date is achievable, and if not, what is the earliest he feels the full complement of parts can be delivered. The Contractor should explain why he feels more time is necessary.

If the October 2015 date is not achievable then a phased delivery should be considered to allow priority items to be delivered and fitted earliest.

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8 ANNEX A – SCREENED TWISTED QUAD CABLE DETAILS

Technical Information Sheet

Sheet 2

Giles Case
RALSpace
STFC Rutherford Appleton Laboratory
Harwell - Didcot - OX11 0QX



REF: RERB/JB/file 18 AWG shielded Quad Quotation 12638

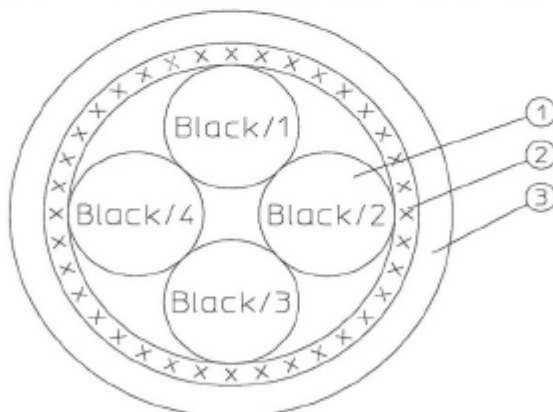
27-05-15

CABLE DRAWING		Habia Cable	
Article Number/Doc Number 700052786	Revision No 00	Status Released	Phase Proposal for Production
Description K 1819 TPC STK 4		Habia Inspection Plan (HIP) HIP-G-402	Page 1 of 1
Customer Product Number		Created by W.Guan	Approved by W.Guan
Customer Product Description		Creation Date 2013-12-19	Approval Date 2013-12-20

Technical Data	Values at +20° C	Unit
Conductor Resistance	Max 21,1	Ω/km
Insulation Resistance	Min 1500	MΩ x km
Test Voltage	2	KV DC
Voltage Rating	600	V AC
Weight	Approx 75	g / m
Temperature Rating	-65/+180	°C

RoHS Compliant
All dimensions in mm, unless otherwise stated.

Pos	Description	Dimension	Overall Diameter	Remarks
1.	Tin plated copper conductor	18 AWG	1,20	19 strands
2.	Insulation of FPI 205, black and numbered		1,75	
3.	Braided screen of tin plated copper wire	Wire Ø: 0,13	4,8	min 85% coverage
	Jacket of FPI 205, black	Thickness 0,35	Nom 5,5	



Provisional: Updated with core colours to follow.

Connecting minds
Tekdata cryoconnectTM
reaching into the cold



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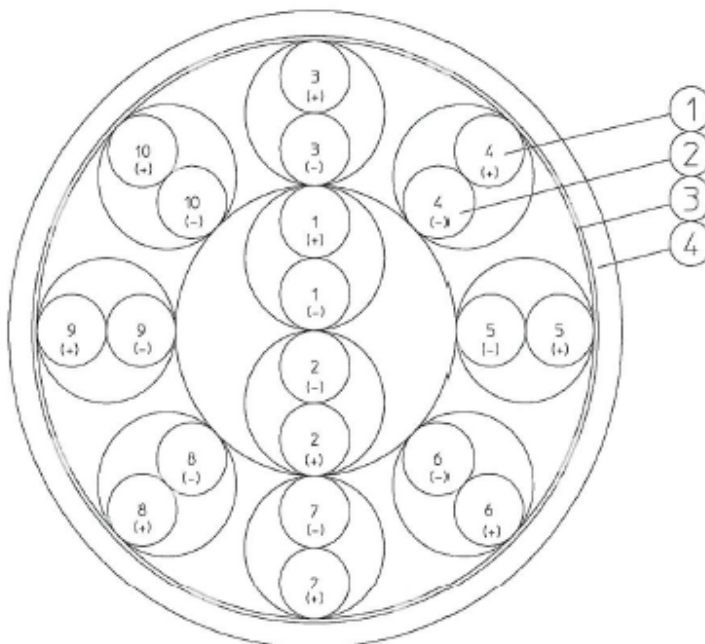
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9 ANNEX B – 10-PAIR THERMOCOUPLE CABLE DETAILS

CABLE DRAWING		Habia Cable	
Article Number/Doc Number 700060937	Revision No 01	Status Released	Phase Proposal for Production
Description THL 6Y T0,22(10x2)FJ/19/1		Habia Inspection Plan (HIP) HIP-G-402	Page 1 of 1
Customer Product Number		Created by C. Vestey	Approved by C. Vestey
Customer Product Description		Creation Date 2015-03-18	Approval Date 2015-03-18

Technical Data		Values at +20° C		Unit
Conductor Resistance		Cu: 80 CuNi: 2230		Ω/km
Insulation Resistance		>1500		MΩ x km
Test Voltage		3		KV DC
Voltage Rating		300		V AC
Weight		100		g / m
Temperature Rating		(thermocouple conductors: -25/+100°C) -200/+200		°C
RoHS Compliant.				
All dimensions in mm, unless otherwise stated.				
Pos	Description	Dimension	Overall Diameter	Remarks
1.	Cu conductor (+) Insulation of FEP, brown and numbered	A= 0.22mm²	0.60 1.10	7x0.20
2.	Cu-Ni conductor (-) Insulation of FEP, white and numbered	A= 0.22mm²	0.60 1.10	7x0.20
3.	Wrapped PTFE tape binder		7.9	
4.	Jacket of FEP, brown	T = 0.45	8.8 ± 0.4	

Code colours acc to IEC 60584.3: 1989



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10 ANNEX C – HEATER CABLE LENGTHS

5W5 connector (sockets)	Cable Bundle Label	Wire Number	Wire Type	Vac Length (m)	Feedthrough Plate Number	Air length (m)	Wire Type	Wire	Pin	48 way connector (Pins) Label															
1	Zone 1	1	Vacuum Rated FEP 20AWG STQ	15.6	AA_1	7.7	20AWG STQ	1	1	H1															
2		2						2																	
3		3						3																	
4		4						4																	
5		Screen						Screen	*pulled out seperatly																
1	Zone 2	1	Vacuum Rated FEP 20AWG STQ	15.9			AA_1	7.7	20AWG STQ		1	5	H1												
2		2									6														
3		3									7														
4		4									8														
5		Screen									Screen	*pulled out seperatly													
1	Zone 3	1	Vacuum Rated FEP 20AWG STQ	18.8					AA_1		7.7	20AWG STQ		1	9	H1									
2		2												10											
3		3												11											
4		4												12											
5		Screen												Screen	*pulled out seperatly										
1	Zone 4	1	Vacuum Rated FEP 20AWG STQ	18.8								AA_1		7.7	20AWG STQ		1	13	H1						
2		2															14								
3		3															15								
4		4															16								
5		Screen															Screen	*pulled out seperatly							
1	Zone 5	1	Vacuum Rated FEP 20AWG STQ	18.4											AA_1		7.7	20AWG STQ		1	17	H1			
2		2																		18					
3		3																		19					
4		4																		20					
5		Screen																		Screen	*pulled out seperatly				
1	Zone 6	1	Vacuum Rated FEP 20AWG STQ	15.8														AA_1		7.7	20AWG STQ		1	21	H1
2		2																					22		
3		3																					23		
4		4																					24		
5		Screen																					Screen	*pulled out seperatly	
1	Zone 7	1	Vacuum	15.6																	AA_1		7.7	20AWG STQ	



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2		2	Rated FEP 20AWG STQ					2	26		
3		3						27			
4		4						28			
5		Screen						*pulled out seperatly			
1	Zone 8	1	Vacuum Rated FEP 20AWG STQ	15.6				20AWG STQ	1		29
2		2							30		
3		3							31		
4		4							32		
5		Screen							*pulled out seperatly		
1	Zone 9	1	Vacuum Rated FEP 20AWG STQ	15.9				20AWG STQ	1		33
2		2					34				
3		3					35				
4		4					36				
5		Screen					*pulled out seperatly				
1	Zone 10	1	Vacuum RatedFE P 20AWG STQ	11.2			20AWG STQ	1	1		
2		2			2						
3		3			3						
4		4			4						
5		Screen			*pulled out seperatly						
1	Zone 11	1	Vacuum Rated FEP 20AWG STQ	10.1	20AWG STQ	1	5				
2		2				6					
3		3				7					
4		4				8					
5		Screen				*pulled out seperatly					
1	Zone 12	1	Vacuum Rated FEP 20AWG STQ	8.9	20AWG STQ	1	9				
2		2				10					
3		3				11					
4		4				12					
5		Screen				*pulled out seperatly					
1	Zone 13	1	Vacuum Rated FEP 20AWG STQ	7.8	20AWG STQ	1	13				
2		2				14					
3		3				15					
4		4				16					
5		Screen				*pulled out seperatly					
1	Zone 14	1	Vacuum	6.6	20AWG STQ	1	17				

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2		2	Rated FEP 20AWG STQ				2	18	
3		3					3	19	
4		4					4	20	
5		Screen					Screen	*pulled out seperatly	
1		1					1	21	
2		2					2	22	
3	Zone 15	3	Vacuum Rated FEP 20AWG STQ	5.4		20AWG STQ	3	23	
4		4					4	24	
5		Screen					Screen	*pulled out seperatly	
1		1					1	25	
2		2					2	26	
3	Zone 16	3	Vacuum Rated FEP 20AWG STQ	4.3		20AWG STQ	3	27	
4		4					4	28	
5		Screen					Screen	*pulled out seperatly	
1		1					1	1	
2		2					2	2	
3	Zone 17	3	Vacuum RatedFE P 20AWG STQ	3.1		20AWG STQ	3	3	
4		4					4	4	
5		Screen					Screen	*pulled out seperatly	
1		1					1	5	
2		2					2	6	
3	Zone 18	3	Vacuum Rated FEP 20AWG STQ	2.3		20AWG STQ	3	7	
4		4					4	8	
5		Screen					Screen	*pulled out seperatly	
1		1					1	9	
2		2					2	10	
3	Zone 19	3	Vacuum Rated FEP 20AWG STQ	3.5		20AWG STQ	3	11	
4		4					4	12	
5		Screen					Screen	*pulled out seperatly	
1		1					1	13	
2		2					2	14	
3	Zone 20	3	Vacuum Rated FEP 20AWG STQ	4.7		20AWG STQ	3	15	
4		4					4	16	
5		Screen					Screen	*pulled out seperatly	
1	Zone 21	1	Vacuum	5.8		20AWG STQ	1	17	



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2		2	Rated FEP 20AWG STQ				2	18	
3		3					3	19	
4		4					4	20	
5		Screen					Screen	*pulled out seperatly	
1		1					1	21	
2		2					2	22	
3	Zone 22	3	Vacuum Rated FEP 20AWG STQ	7.0		20AWG STQ	3	23	
4		4					4	24	
5		Screen					Screen	*pulled out seperatly	
1		1					1	25	
2		2					2	26	
3	Zone 23	3	Vacuum Rated FEP 20AWG STQ	7.9		20AWG STQ	3	27	
4		4					4	28	
5		Screen					Screen	*pulled out seperatly	
1		1					1	1	
2		2					2	2	
3	Zone 24	3	Vacuum RatedFE P 20AWG STQ	10.5		20AWG STQ	3	3	
4		4					4	4	
5		Screen					Screen	*pulled out seperatly	
1		1					1	5	
2		2					2	6	
3	Zone 25	3	Vacuum Rated FEP 20AWG STQ	9.4		20AWG STQ	3	7	
4		4					4	8	
5		Screen					Screen	*pulled out seperatly	
1		1					1	9	
2		2					2	10	
3	Zone 26	3	Vacuum Rated FEP 20AWG STQ	8.2		20AWG STQ	3	11	
4		4					4	12	
5		Screen					Screen	*pulled out seperatly	
1		1					1	13	
2		2					2	14	
3	Zone 27	3	Vacuum Rated FEP 20AWG STQ	7.1		20AWG STQ	3	15	
4		4					4	16	
5		Screen					Screen	*pulled out seperatly	
1	Zone 28	1	Vacuum	5.9		20AWG STQ	1	17	

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2		2	Rated FEP 20AWG STQ				2	18	
3		3					3	19	
4		4					4	20	
5		Screen					Screen	*pulled out seperatly	
1		1					1	21	
2		2					2	22	
3	Zone 29	3	Vacuum Rated FEP 20AWG STQ	4.7			3	23	
4		4					4	24	
5		Screen					Screen	*pulled out seperatly	
1		1					1	25	
2		2					2	26	
3	Zone 30	3	Vacuum Rated FEP 20AWG STQ	3.6			3	27	
4		4					4	28	
5		Screen					Screen	*pulled out seperatly	
1		1					1	1	
2		2					2	2	
3	Zone 31	3	Vacuum RatedFE P 20AWG STQ	2.4			3	3	
4		4					4	4	
5		Screen					Screen	*pulled out seperatly	
1		1					1	5	
2		2					2	6	
3	Zone 32	3	Vacuum Rated FEP 20AWG STQ	1.7			3	7	
4		4					4	8	
5		Screen					Screen	*pulled out seperatly	
1		1					1	9	
2		2					2	10	
3	Zone 33	3	Vacuum Rated FEP 20AWG STQ	2.8			3	11	
4		4					4	12	
5		Screen					Screen	*pulled out seperatly	
1		1					1	13	
2		2					2	14	
3	Zone 34	3	Vacuum Rated FEP 20AWG STQ	4.0			3	15	
4		4					4	16	
5		Screen					Screen	*pulled out seperatly	
1	Zone 35	1	Vacuum	5.2			20AWG STQ	1	17



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2		2	Rated FEP 20AWG STQ				2	18	
3		3					3	19	
4		4					4	20	
5		Screen					Screen	*pulled out seperatly	
1		1					1	21	
2		2					2	22	
3	Zone 36	3	Vacuum Rated FEP 20AWG STQ	6.3		20AWG STQ	3	23	
4		4					4	24	
5		Screen					Screen	*pulled out seperatly	
1		1					1	25	
2		2					2	26	
3	Zone 37	3	Vacuum Rated FEP 20AWG STQ	7.2		20AWG STQ	3	27	
4		4					4	28	
5		Screen					Screen	*pulled out seperatly	
1		1					1	1	
2		2					2	2	
3	Zone 38	3	Vacuum RatedFE P 20AWG STQ	14.1		20AWG STQ	3	3	
4		4					4	4	
5		Screen					Screen	*pulled out seperatly	
1		1					1	5	
2		2					2	6	
3	Zone 39	3	Vacuum Rated FEP 20AWG STQ	14.5		20AWG STQ	3	7	
4		4					4	8	
5		Screen					Screen	*pulled out seperatly	
1		1					1	9	
2		2					2	10	
3	Zone 40	3	Vacuum Rated FEP 20AWG STQ	17.4		20AWG STQ	3	11	
4		4					4	12	
5		Screen					Screen	*pulled out seperatly	
1		1					1	13	
2		2					2	14	
3	Zone 41	3	Vacuum Rated FEP 20AWG STQ	16.9		20AWG STQ	3	15	
4		4					4	16	
5		Screen					Screen	*pulled out seperatly	
1	Zone 42	1	Vacuum	17.0		20AWG STQ	1	17	

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3		3						19			
4		4						20			
5		Screen						*pulled out seperatly			
1	Zone 43	1	Vacuum Rated FEP 20AWG STQ	14.5				20AWG STQ	1		21
2		2							22		
3		3							23		
4		4							24		
5		Screen							*pulled out seperatly		
1	Zone 44	1	Vacuum Rated FEP 20AWG STQ	14.5				20AWG STQ	1		25
2		2							26		
3		3							27		
4		4							28		
5		Screen							*pulled out seperatly		
1	Zone 45	1	Vacuum Rated FEP 20AWG STQ	14.1				20AWG STQ	1		29
2		2							30		
3		3							31		
4		4							32		
5		Screen							*pulled out seperatly		
1	Zone 46	1	Vacuum Rated FEP 20AWG STQ	14.5				20AWG STQ	1		33
2		2			34						
3		3			35						
4		4			36						
5		Screen			*pulled out seperatly						
1	AUX 1	1	Vacuum RatedFEP P 20AWG STQ	10.0	AA_1	5.5	20AWG STQ	1	1	H7	
2		2						2			
3		3						3			
4		4						4			
5		Screen						*pulled out seperatly			
1	AUX 2	1	Vacuum Rated FEP 20AWG STQ	10.0	20AWG STQ	1	5				
2		2				6					
3		3				7					
4		4				8					
5		Screen				*pulled out seperatly					
1	AUX 3	1	Vacuum	10.0		20AWG STQ	1	9			



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2		2	Rated FEP 20AWG STQ									2	10
3		3										3	11
4		4										4	12
5		Screen										Screen	*pulled out seperatly
1	AUX 4	1	Vacuum Rated FEP 20AWG STQ	10.0								1	13
2		2										2	14
3		3										3	15
4		4										4	16
5		Screen										Screen	*pulled out seperatly
1	AUX 5	1	Vacuum Rated FEP 20AWG STQ	10.0								1	17
2		2										2	18
3		3										3	19
4		4										4	20
5		Screen										Screen	*pulled out seperatly
1	AUX 6	1	Vacuum Rated FEP 20AWG STQ	10.0								1	21
2		2										2	22
3		3										3	23
4		4										4	24
5		Screen										Screen	*pulled out seperatly
1	AUX 7	1	Vacuum Rated FEP 20AWG STQ	10.0								1	25
2		2										2	26
3		3										3	27
4		4										4	28
5		Screen										Screen	*pulled out seperatly

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11 ANNEX D – SHROUD THERMOCOUPLE CABLE LENGTHS

DSUB connector (sockets) Label	socket	Wire	Wire Type	Vac Length (m)	Feedthrough Port Number	Air length (m)	Wire Type	Wire	Label
Zone 1	1	+	T-TC	11.6	AA_4	8	T-TC	+	Z1-1
	2	-						-	
	3	+						+	Z1-2
	4	-						-	
	5	+						+	Z1-3
	6	-						-	
	7	+						+	Z1-4
	8	-						-	
	9	+						+	Z1-5
	10	-						-	
	11	+						+	Z1-6
	12	-						-	
	13	+						+	Z1-7
	14	-						-	
	15	+						+	Z1-8
	16	-						-	
	17	+						+	Z1-9
	18	-						-	
	19	+						+	Z1-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 2	1	+	T-TC	11.9	AA_4	8	T-TC	+	Z2-1
	2	-						-	
	3	+						+	Z2-2
	4	-						-	
	5	+						+	Z2-3
	6	-						-	



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	7	+						+	Z2-4
	8	-						-	
	9	+						+	Z2-5
	10	-						-	
	11	+						+	Z2-6
	12	-						-	
	13	+						+	Z2-7
	14	-						-	
	15	+						+	Z2-8
	16	-						-	
	17	+						+	Z2-9
	18	-						-	
	19	+						+	Z2-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 3	1	+	T-TC	14.8	AA_4	8	T-TC	+	Z3-1
	2	-						-	
	3	+						+	Z3-2
	4	-						-	
	5	+						+	Z3-3
	6	-						-	
	7	+						+	Z3-4
	8	-						-	
	9	+						+	Z3-5
	10	-						-	
	11	+						+	Z3-6
	12	-						-	
	13	+						+	Z3-7
	14	-						-	
	15	+						+	Z3-8
	16	-						-	
	17	+						+	Z3-9
	18	-						-	

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	19	+						+	Z3-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 4	1	+	T-TC	14.8	AA_4	8	T-TC	+	Z4-1
	2	-						-	
	3	+						+	Z4-2
	4	-						-	
	5	+						+	Z4-3
	6	-						-	
	7	+						+	Z4-4
	8	-						-	
	9	+						+	Z4-5
	10	-						-	
	11	+						+	Z4-6
	12	-						-	
	13	+						+	Z4-7
	14	-						-	
	15	+						+	Z4-8
	16	-						-	
	17	+						+	Z4-9
	18	-						-	
	19	+						+	Z4-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 5	1	+	T-TC	14.4	AA_4	8	T-TC	+	Z5-1
	2	-						-	
	3	+						+	Z5-2
	4	-						-	
	5	+						+	Z5-3



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	6	-						-	
	7	+						+	Z5-4
	8	-						-	
	9	+						+	Z5-5
	10	-						-	
	11	+						+	Z5-6
	12	-						-	
	13	+						+	Z5-7
	14	-						-	
	15	+							
	16	-							
	17	+							
	18	-							
	19	+							
	20	-							
	21								
	22								
	23								
	24								
	25								
Zone 6	1	+	T-TC	11.9	AA_4	8	T-TC	+	Z6-1
	2	-						-	
	3	+						+	Z6-2
	4	-						-	
	5	+						+	Z6-3
	6	-						-	
	7	+						+	Z6-4
	8	-						-	
	9	+						+	Z6-5
	10	-						-	
	11	+						+	Z6-6
	12	-						-	
	13	+						+	Z6-7
	14	-						-	
	15	+						+	Z6-8
	16	-						-	
	17	+						+	Z6-9

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	18	-						-	
	19	+						+	Z6-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 7	1	+	T-TC	11.6	AA_4	8	T-TC	+	Z7-1
	2	-						-	
	3	+						+	Z7-2
	4	-						-	
	5	+						+	Z7-3
	6	-						-	
	7	+						+	Z7-4
	8	-						-	
	9	+						+	Z7-5
	10	-						-	
	11	+						+	Z7-6
	12	-						-	
	13	+						+	Z7-7
	14	-						-	
	15	+							
	16	-							
	17	+							
	18	-							
	19	+							
	20	-							
	21								
	22								
	23								
	24								
	25								
Zone 8	1	+	T-TC	11.6	AA_4	8	T-TC	+	Z8-1
	2	-						-	
	3	+						+	Z8-2
	4	-						-	



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	5	+						+	Z8-3
	6	-						-	
	7	+						+	Z8-4
	8	-						-	
	9	+						+	Z8-5
	10	-						-	
	11	+						+	Z8-6
	12	-						-	
	13	+						+	Z8-7
	14	-						-	
	15	+						+	Z8-8
	16	-						-	
	17	+						+	Z8-9
	18	-						-	
	19	+						+	Z8-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 9	1	+	T-TC	11.9	AA_4	8	T-TC	+	Z9-1
	2	-						-	
	3	+						+	Z9-2
	4	-						-	
	5	+						+	Z9-3
	6	-						-	
	7	+						+	Z9-4
	8	-						-	
	9	+						+	Z9-5
	10	-						-	
	11	+						+	Z9-6
	12	-						-	
	13	+						+	Z9-7
	14	-						-	
	15	+							
	16	-							

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	17	+							
	18	-							
	19	+							
	20	-							
	21								
	22								
	23								
	24								
	25								
Zone 10	1	+	T-TC	11.2	AA_4	8	T-TC	+	Z10-1
	2	-						-	
	3	+						+	Z10-2
	4	-						-	
	5	+						+	Z10-3
	6	-						-	
	7	+						+	Z10-4
	8	-						-	
	9	+						+	Z10-5
	10	-						-	
	11	+						+	Z10-6
	12	-						-	
	13	+						+	Z10-7
	14	-						-	
	15	+						+	Z10-8
	16	-						-	
	17	+						+	Z10-9
	18	-						-	
	19	+						+	Z10-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 11	1	+	T-TC	10.1	AA_4	8	T-TC	+	Z11-1
	2	-						-	
	3	+						+	Z11-2



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	4	-						-	
	5	+						+	Z11-3
	6	-						-	
	7	+						+	Z11-4
	8	-						-	
	9	+						+	Z11-5
	10	-						-	
	11	+						+	Z11-6
	12	-						-	
	13	+						+	Z11-7
	14	-						-	
	15	+						+	Z11-8
	16	-						-	
	17	+						+	Z11-9
	18	-						-	
	19	+						+	Z11-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 12	1	+	T-TC	8.9	AA_4	8	T-TC	+	Z12-1
	2	-						-	
	3	+						+	Z12-2
	4	-						-	
	5	+						+	Z12-3
	6	-						-	
	7	+						+	Z12-4
	8	-						-	
	9	+						+	Z12-5
	10	-						-	
	11	+						+	Z12-6
	12	-						-	
	13	+						+	Z12-7
	14	-						-	
	15	+						+	Z12-8

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	16	-						-	
	17	+						+	Z12-9
	18	-						-	
	19	+						+	Z12-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 13	1	+	T-TC	7.8	AA_4	8	T-TC	+	Z13-1
	2	-						-	
	3	+						+	Z13-2
	4	-						-	
	5	+						+	Z13-3
	6	-						-	
	7	+						+	Z13-4
	8	-						-	
	9	+						+	Z13-5
	10	-						-	
	11	+						+	Z13-6
	12	-						-	
	13	+						+	Z13-7
	14	-						-	
	15	+						+	Z13-8
	16	-						-	
	17	+						+	Z13-9
	18	-						-	
	19	+						+	Z13-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 14	1	+	T-TC	6.6	AA_4	8	T-TC	+	Z14-1
	2	-						-	

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	3	+						+	Z14-2
	4	-						-	
	5	+						+	Z14-3
	6	-						-	
	7	+						+	Z14-4
	8	-						-	
	9	+						+	Z14-5
	10	-						-	
	11	+						+	Z14-6
	12	-						-	
	13	+						+	Z14-7
	14	-						-	
	15	+						+	Z14-8
	16	-						-	
	17	+						+	Z14-9
	18	-						-	
	19	+						+	Z14-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 15	1	+	T-TC	5.4	AA_4	8	T-TC	+	Z15-1
	2	-						-	
	3	+						+	Z15-2
	4	-						-	
	5	+						+	Z15-3
	6	-						-	
	7	+						+	Z15-4
	8	-						-	
	9	+						+	Z15-5
	10	-						-	
	11	+						+	Z15-6
	12	-						-	
	13	+						+	Z15-7
	14	-						-	

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	15	+						+	Z15-8
	16	-						-	
	17	+						+	Z15-9
	18	-						-	
	19	+						+	Z15-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 16	1	+	T-TC	4.3	AA_4	8	T-TC	+	Z16-1
	2	-						-	
	3	+						+	Z16-2
	4	-						-	
	5	+						+	Z16-3
	6	-						-	
	7	+						+	Z16-4
	8	-						-	
	9	+						+	Z16-5
	10	-						-	
	11	+						+	Z16-6
	12	-						-	
	13	+						+	Z16-7
	14	-						-	
	15	+						+	Z16-8
	16	-						-	
	17	+						+	Z16-9
	18	-						-	
	19	+						+	Z16-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 17	1	+	T-TC	3.1	AA_4	8	T-TC	+	Z17-1



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	2	-						-	
	3	+						+	Z17-2
	4	-						-	
	5	+						+	Z17-3
	6	-						-	
	7	+						+	Z17-4
	8	-						-	
	9	+						+	Z17-5
	10	-						-	
	11	+						+	Z17-6
	12	-						-	
	13	+						+	Z17-7
	14	-						-	
	15	+						+	Z17-8
	16	-						-	
	17	+						+	Z17-9
	18	-						-	
	19	+						+	Z17-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 18	1	+	T-TC	2.3	AA_4	8	T-TC	+	Z18-1
	2	-						-	
	3	+						+	Z18-2
	4	-						-	
	5	+						+	Z18-3
	6	-						-	
	7	+						+	Z18-4
	8	-						-	
	9	+						+	Z18-5
	10	-						-	
	11	+						+	Z18-6
	12	-						-	
	13	+						+	Z18-7

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	14	-						-	
	15	+						+	Z18-8
	16	-						-	
	17	+						+	Z18-9
	18	-						-	
	19	+						+	Z18-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 19	1	+	T-TC	3.5	AA_4	8	T-TC	+	Z19-1
	2	-						-	
	3	+						+	Z19-2
	4	-						-	
	5	+						+	Z19-3
	6	-						-	
	7	+						+	Z19-4
	8	-						-	
	9	+						+	Z19-5
	10	-						-	
	11	+						+	Z19-6
	12	-						-	
	13	+						+	Z19-7
	14	-						-	
	15	+						+	Z19-8
	16	-						-	
	17	+						+	Z19-9
	18	-						-	
	19	+						+	Z19-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								



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Zone 20	1	+	T-TC	4.7	AA_4	8	T-TC	+	Z20-1
	2	-						-	
	3	+						+	Z20-2
	4	-						-	
	5	+						+	Z20-3
	6	-						-	
	7	+						+	Z20-4
	8	-						-	
	9	+						+	Z20-5
	10	-						-	
	11	+						+	Z20-6
	12	-						-	
	13	+						+	Z20-7
	14	-						-	
	15	+						+	Z20-8
	16	-						-	
	17	+						+	Z20-9
	18	-						-	
	19	+						+	Z20-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 21	1	+	T-TC	5.8	AA_4	8	T-TC	+	Z21-1
	2	-						-	
	3	+						+	Z21-2
	4	-						-	
	5	+						+	Z21-3
	6	-						-	
	7	+						+	Z21-4
	8	-						-	
	9	+						+	Z21-5
	10	-						-	
	11	+						+	Z21-6
	12	-						-	

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	13	+					+	Z21-7
	14	-					-	
	15	+					+	Z21-8
	16	-					-	
	17	+					+	Z21-9
	18	-					-	
	19	+					+	Z21-10
	20	-					-	
	21							
	22							
	23							
	24							
	25							
Zone 22	1	+	T-TC	7.0	AA_4	8	+	Z22-1
	2	-					-	
	3	+					+	Z22-2
	4	-					-	
	5	+					+	Z22-3
	6	-					-	
	7	+					+	Z22-4
	8	-					-	
	9	+					+	Z22-5
	10	-					-	
	11	+					+	Z22-6
	12	-					-	
	13	+					+	Z22-7
	14	-					-	
	15	+					+	Z22-8
	16	-					-	
	17	+					+	Z22-9
	18	-					-	
	19	+					+	Z22-10
	20	-					-	
	21							
	22							
	23							
	24							



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	25								
Zone 23	1	+	T-TC	7.9	AA_4	8	T-TC	+	Z23-1
	2	-						-	
	3	+						+	Z23-2
	4	-						-	
	5	+						+	Z23-3
	6	-						-	
	7	+						+	Z23-4
	8	-						-	
	9	+						+	Z23-5
	10	-						-	
	11	+						+	Z23-6
	12	-						-	
	13	+						+	Z23-7
	14	-						-	
	15	+						+	Z23-8
	16	-						-	
	17	+						+	Z23-9
	18	-						-	
	19	+						+	Z23-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 24	1	+	T-TC	6.6	AA_4	8	T-TC	+	Z24-1
	2	-						-	
	3	+						+	Z24-2
	4	-						-	
	5	+						+	Z24-3
	6	-						-	
	7	+						+	Z24-4
	8	-						-	
	9	+						+	Z24-5
	10	-						-	
	11	+						+	Z24-6

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	12	-					-	
	13	+					+	Z24-7
	14	-					-	
	15	+					+	Z24-8
	16	-					-	
	17	+					+	Z24-9
	18	-					-	
	19	+					+	Z24-10
	20	-					-	
	21							
	22							
	23							
	24							
	25							
Zone 25	1	+	T-TC	5.5	AA_4	8	+	Z25-1
	2	-					-	
	3	+					+	Z25-2
	4	-					-	
	5	+					+	Z25-3
	6	-					-	
	7	+					+	Z25-4
	8	-					-	
	9	+					+	Z25-5
	10	-					-	
	11	+					+	Z25-6
	12	-					-	
	13	+					+	Z25-7
	14	-					-	
	15	+					+	Z25-8
	16	-					-	
	17	+					+	Z25-9
	18	-					-	
	19	+					+	Z25-10
	20	-					-	
	21							
	22							
	23							



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	24								
	25								
Zone 26	1	+	T-TC	4.3	AA_4	8	T-TC	+	Z26-1
	2	-						-	
	3	+						+	Z26-2
	4	-						-	
	5	+						+	Z26-3
	6	-						-	
	7	+						+	Z26-4
	8	-						-	
	9	+						+	Z26-5
	10	-						-	
	11	+						+	Z26-6
	12	-						-	
	13	+						+	Z26-7
	14	-						-	
	15	+						+	Z26-8
	16	-						-	
	17	+						+	Z26-9
	18	-						-	
	19	+						+	Z26-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 27	1	+	T-TC	3.2	AA_4	8	T-TC	+	Z27-1
	2	-						-	
	3	+						+	Z27-2
	4	-						-	
	5	+						+	Z27-3
	6	-						-	
	7	+						+	Z27-4
	8	-						-	
	9	+						+	Z27-5
	10	-						-	

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	11	+						+	Z27-6
	12	-						-	
	13	+						+	Z27-7
	14	-						-	
	15	+						+	Z27-8
	16	-						-	
	17	+						+	Z27-9
	18	-						-	
	19	+						+	Z27-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 28	1	+	T-TC	2.0	AA_4	8	T-TC	+	Z28-1
	2	-						-	
	3	+						+	Z28-2
	4	-						-	
	5	+						+	Z28-3
	6	-						-	
	7	+						+	Z28-4
	8	-						-	
	9	+						+	Z28-5
	10	-						-	
	11	+						+	Z28-6
	12	-						-	
	13	+						+	Z28-7
	14	-						-	
	15	+						+	Z28-8
	16	-						-	
	17	+						+	Z28-9
	18	-						-	
	19	+						+	Z28-10
	20	-						-	
	21								
	22								



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	23								
	24								
	25								
Zone 29	1	+	T-TC	2.1	AA_4	8	T-TC	+	Z29-1
	2	-						-	
	3	+						+	Z29-2
	4	-						-	
	5	+						+	Z29-3
	6	-						-	
	7	+						+	Z29-4
	8	-						-	
	9	+						+	Z29-5
	10	-						-	
	11	+						+	Z29-6
	12	-						-	
	13	+						+	Z29-7
	14	-						-	
	15	+						+	Z29-8
	16	-						-	
	17	+						+	Z29-9
	18	-						-	
	19	+						+	Z29-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 30	1	+	T-TC	3.2	AA_4	8	T-TC	+	Z30-1
	2	-						-	
	3	+						+	Z30-2
	4	-						-	
	5	+						+	Z30-3
	6	-						-	
	7	+						+	Z30-4
	8	-						-	
	9	+						+	Z30-5

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	10	-						-	
	11	+						+	Z30-6
	12	-						-	
	13	+						+	Z30-7
	14	-						-	
	15	+						+	Z30-8
	16	-						-	
	17	+						+	Z30-9
	18	-						-	
	19	+						+	Z30-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 31	1	+	T-TC	4.4	AA_4	8	T-TC	+	Z31-1
	2	-						-	
	3	+						+	Z31-2
	4	-						-	
	5	+						+	Z31-3
	6	-						-	
	7	+						+	Z31-4
	8	-						-	
	9	+						+	Z31-5
	10	-						-	
	11	+						+	Z31-6
	12	-						-	
	13	+						+	Z31-7
	14	-						-	
	15	+						+	Z31-8
	16	-						-	
	17	+						+	Z31-9
	18	-						-	
	19	+						+	Z31-10
	20	-						-	
	21								



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	22								
	23								
	24								
	25								
Zone 32	1	+	T-TC	5.6	AA_4	8	T-TC	+	Z32-1
	2	-						-	
	3	+						+	Z32-2
	4	-						-	
	5	+						+	Z32-3
	6	-						-	
	7	+						+	Z32-4
	8	-						-	
	9	+						+	Z32-5
	10	-						-	
	11	+						+	Z32-6
	12	-						-	
	13	+						+	Z32-7
	14	-						-	
	15	+						+	Z32-8
	16	-						-	
	17	+						+	Z32-9
	18	-						-	
	19	+						+	Z32-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 33	1	+	T-TC	6.8	AA_4	8	T-TC	+	Z33-1
	2	-						-	
	3	+						+	Z33-2
	4	-						-	
	5	+						+	Z33-3
	6	-						-	
	7	+						+	Z33-4
	8	-						-	

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	9	+						+	Z33-5
	10	-						-	
	11	+						+	Z33-6
	12	-						-	
	13	+						+	Z33-7
	14	-						-	
	15	+						+	Z33-8
	16	-						-	
	17	+						+	Z33-9
	18	-						-	
	19	+						+	Z33-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 34	1	+	T-TC	7.9	AA_4	8	T-TC	+	Z34-1
	2	-						-	
	3	+						+	Z34-2
	4	-						-	
	5	+						+	Z34-3
	6	-						-	
	7	+						+	Z34-4
	8	-						-	
	9	+						+	Z34-5
	10	-						-	
	11	+						+	Z34-6
	12	-						-	
	13	+						+	Z34-7
	14	-						-	
	15	+						+	Z34-8
	16	-						-	
	17	+						+	Z34-9
	18	-						-	
	19	+						+	Z34-10
	20	-						-	



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	21								
	22								
	23								
	24								
	25								
Zone 35	1	+	T-TC	9.1	AA_4	8	T-TC	+	Z35-1
	2	-						-	
	3	+						+	Z35-2
	4	-						-	
	5	+						+	Z35-3
	6	-						-	
	7	+						+	Z35-4
	8	-						-	
	9	+						+	Z35-5
	10	-						-	
	11	+						+	Z35-6
	12	-						-	
	13	+						+	Z35-7
	14	-						-	
	15	+						+	Z35-8
	16	-						-	
	17	+						+	Z35-9
	18	-						-	
	19	+						+	Z35-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 36	1	+	T-TC	10.2	AA_4	8	T-TC	+	Z36-1
	2	-						-	
	3	+						+	Z36-2
	4	-						-	
	5	+						+	Z36-3
	6	-						-	
	7	+						+	Z36-4

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	8	-						-	
	9	+						+	Z36-5
	10	-						-	
	11	+						+	Z36-6
	12	-						-	
	13	+						+	Z36-7
	14	-						-	
	15	+						+	Z36-8
	16	-						-	
	17	+						+	Z36-9
	18	-						-	
	19	+						+	Z36-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 37	1	+	T-TC	11.1	AA_4	8	T-TC	+	Z37-1
	2	-						-	
	3	+						+	Z37-2
	4	-						-	
	5	+						+	Z37-3
	6	-						-	
	7	+						+	Z37-4
	8	-						-	
	9	+						+	Z37-5
	10	-						-	
	11	+						+	Z37-6
	12	-						-	
	13	+						+	Z37-7
	14	-						-	
	15	+						+	Z37-8
	16	-						-	
	17	+						+	Z37-9
	18	-						-	
	19	+						+	Z37-10



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	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 38	1	+	T-TC	10.2	AA_4	8	T-TC	+	Z38-1
	2	-						-	
	3	+						+	Z38-2
	4	-						-	
	5	+						+	Z38-3
	6	-						-	
	7	+						+	Z38-4
	8	-						-	
	9	+						+	Z38-5
	10	-						-	
	11	+						+	Z38-6
	12	-						-	
	13	+						+	Z38-7
	14	-						-	
	15	+						+	Z38-8
	16	-						-	
	17	+						+	Z38-9
	18	-						-	
	19	+						+	Z38-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 39	1	+	T-TC	10.5	AA_4	8	T-TC	+	Z39-1
	2	-						-	
	3	+						+	Z39-2
	4	-						-	
	5	+						+	Z39-3
	6	-						-	

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	7	+						+	Z39-4
	8	-						-	
	9	+						+	Z39-5
	10	-						-	
	11	+						+	Z39-6
	12	-						-	
	13	+						+	Z39-7
	14	-						-	
	15	+						+	Z39-8
	16	-						-	
	17	+						+	Z39-9
	18	-						-	
	19	+						+	Z39-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 40	1	+	T-TC	13.5	AA_4	8	T-TC	+	Z40-1
	2	-						-	
	3	+						+	Z40-2
	4	-						-	
	5	+						+	Z40-3
	6	-						-	
	7	+						+	Z40-4
	8	-						-	
	9	+						+	Z40-5
	10	-						-	
	11	+						+	Z40-6
	12	-						-	
	13	+						+	Z40-7
	14	-						-	
	15	+							
	16	-							
	17	+							
	18	-							

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	19	+							
	20	-							
	21								
	22								
	23								
	24								
	25								
Zone 41	1	+	T-TC	13.0	AA_4	8	T-TC	+	Z41-1
	2	-						-	
	3	+						+	Z41-2
	4	-						-	
	5	+						+	Z41-3
	6	-						-	
	7	+						+	Z41-4
	8	-						-	
	9	+						+	Z41-5
	10	-						-	
	11	+						+	Z41-6
	12	-						-	
	13	+						+	Z41-7
	14	-						-	
	15	+						+	Z41-8
	16	-						-	
	17	+						+	Z41-9
	18	-						-	
	19	+						+	Z41-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 42	1	+	T-TC	13.1	AA_4	8	T-TC	+	Z42-1
	2	-						-	
	3	+						+	Z42-2
	4	-						-	
	5	+						+	Z42-3

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	6	-						-	
	7	+						+	Z42-4
	8	-						-	
	9	+						+	Z42-5
	10	-						-	
	11	+						+	Z42-6
	12	-						-	
	13	+						+	Z42-7
	14	-						-	
	15	+							
	16	-							
	17	+							
	18	-							
	19	+							
	20	-							
	21								
	22								
	23								
	24								
	25								
Zone 43	1	+	T-TC	10.5	AA_4	8	T-TC	+	Z43-1
	2	-						-	
	3	+						+	Z43-2
	4	-						-	
	5	+						+	Z43-3
	6	-						-	
	7	+						+	Z43-4
	8	-						-	
	9	+						+	Z43-5
	10	-						-	
	11	+						+	Z43-6
	12	-						-	
	13	+						+	Z43-7
	14	-						-	
	15	+						+	Z43-8
	16	-						-	
	17	+						+	Z43-9



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	18	-						-	
	19	+						+	Z43-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 44	1	+	T-TC	10.5	AA_4	8	T-TC	+	Z44-1
	2	-						-	
	3	+						+	Z44-2
	4	-						-	
	5	+						+	Z44-3
	6	-						-	
	7	+						+	Z44-4
	8	-						-	
	9	+						+	Z44-5
	10	-						-	
	11	+						+	Z44-6
	12	-						-	
	13	+						+	Z44-7
	14	-						-	
	15	+							
	16	-							
	17	+							
	18	-							
	19	+							
	20	-							
	21								
	22								
	23								
	24								
	25								
Zone 45	1	+	T-TC	10.2	AA_4	8	T-TC	+	Z45-1
	2	-						-	
	3	+						+	Z45-2
	4	-						-	

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	5	+						+	Z45-3
	6	-						-	
	7	+						+	Z45-4
	8	-						-	
	9	+						+	Z45-5
	10	-						-	
	11	+						+	Z45-6
	12	-						-	
	13	+						+	Z45-7
	14	-						-	
	15	+						+	Z45-8
	16	-						-	
	17	+						+	Z45-9
	18	-						-	
	19	+						+	Z45-10
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Zone 46	1	+	T-TC	10.5	AA_4	8	T-TC	+	Z46-1
	2	-						-	
	3	+						+	Z46-2
	4	-						-	
	5	+						+	Z46-3
	6	-						-	
	7	+						+	Z46-4
	8	-						-	
	9	+						+	Z46-5
	10	-						-	
	11	+						+	Z46-6
	12	-						-	
	13	+						+	Z46-7
	14	-						-	
	15	+							



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	16	-							
	17	+							
	18	-							
	19	+							
	20	-							
	21								
	22								
	23								
	24								
	25								
AUX 1	1	+	T-TC	10.0	AA_4	8	T-TC	+	AUX1-1
	2	-						-	
	3	+						+	AUX1-2
	4	-						-	
	5	+						+	AUX1-3
	6	-						-	
	7	+						+	AUX1-4
	8	-						-	
	9								
AUX 2	1	+	T-TC	10.0	AA_4	8	T-TC	+	AUX2-1
	2	-						-	
	3	+						+	AUX2-2
	4	-						-	
	5	+						+	AUX2-3
	6	-						-	
	7	+						+	AUX2-4
	8	-						-	
	9								
AUX 3	1	+	T-TC	10.0	AA_4	8	T-TC	+	AUX3-1
	2	-						-	
	3	+						+	AUX3-2
	4	-						-	
	5	+						+	AUX3-3
	6	-						-	
	7	+						+	AUX3-4
	8	-						-	
	9								

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AUX 4	1	+	T-TC	10.0	AA_4	8	T-TC	+	AUX4-1
	2	-						-	
	3	+						+	AUX4-2
	4	-						-	
	5	+						+	AUX4-3
	6	-						-	
	7	+						+	AUX4-4
	8	-						-	
	9								
AUX 5	1	+	T-TC	10.0	AA_4	8	T-TC	+	AUX5-1
	2	-						-	
	3	+						+	AUX5-2
	4	-						-	
	5	+						+	AUX5-3
	6	-						-	
	7	+						+	AUX5-4
	8	-						-	
	9								
AUX 6	1	+	T-TC	10.0	AA_4	8	T-TC	+	AUX6-1
	2	-						-	
	3	+						+	AUX6-2
	4	-						-	
	5	+						+	AUX6-3
	6	-						-	
	7	+						+	AUX6-4
	8	-						-	
	9								
AUX 7	1	+	T-TC	10.0	AA_4	8	T-TC	+	AUX7-1
	2	-						-	
	3	+						+	AUX7-2
	4	-						-	
	5	+						+	AUX7-3
	6	-						-	
	7	+						+	AUX7-4
	8	-						-	
	9								



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12 ANNEX E – PAYLOAD THERMOCOUPLE CABLE LENGTH

25 DSUB connector (sockets) Label	socket No.	Wire	Wire Type	Vac Length (m)	Feedthrough Plate Number	Air length (m)	Wire Type	Wire	Label
Payload 001 to 010	1	+	T-TC 10 Pair	10	AA_5	10	T-TC 10 pair	+	PL-001
	2	-						-	
	3	+						+	PL-002
	4	-						-	
	5	+						+	PL-003
	6	-						-	
	7	+						+	PL-004
	8	-						-	
	9	+						+	PL-005
	10	-						-	
	11	+						+	PL-006
	12	-						-	
	13	+						+	PL-007
	14	-						-	
	15	+						+	PL-008
	16	-						-	
	17	+						+	PL-009
	18	-						-	
	19	+						+	PL-010
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 011 to 020	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-011
	2	-						-	
	3	+						+	PL-012
	4	-						-	
	5	+						+	PL-013
	6	-						-	

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	7	+						+	PL-014
	8	-						-	
	9	+						+	PL-015
	10	-						-	
	11	+						+	PL-016
	12	-						-	
	13	+						+	PL-017
	14	-						-	
	15	+						+	PL-018
	16	-						-	
	17	+						+	PL-019
	18	-						-	
	19							+	PL-020
	20							-	
	21								
	22								
	23								
	24								
	25								
Payload 012 to 030	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-021
	2	-						-	
	3	+						+	PL-022
	4	-						-	
	5	+						+	PL-023
	6	-						-	
	7	+						+	PL-024
	8	-						-	
	9	+						+	PL-025
	10	-						-	
	11	+						+	PL-026
	12	-						-	
	13	+						+	PL-027
	14	-						-	
	15	+						+	PL-028
	16	-						-	
	17	+						+	PL-029



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	18	-						-	
	19	+						+	PL-030
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 031 to 040	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-031
	2	-						-	
	3	+						+	PL-032
	4	-						-	
	5	+						+	PL-033
	6	-						-	
	7	+						+	PL-034
	8	-						-	
	9	+						+	PL-035
	10	-						-	
	11	+						+	PL-036
	12	-						-	
	13	+						+	PL-037
	14	-						-	
	15	+						+	PL-038
	16	-						-	
	17	+						+	PL-039
	18	-						-	
	19	+						+	PL-040
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 041 to 050	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-041
	2	-						-	
	3	+						+	PL-042

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	4	-						-	
	5	+						+	PL-043
	6	-						-	
	7	+						+	PL-044
	8	-						-	
	9	+						+	PL-045
	10	-						-	
	11	+						+	PL-046
	12	-						-	
	13	+						+	PL-047
	14	-						-	
	15	+						+	PL-048
	16	-						-	
	17	+						+	PL-049
	18	-						-	
	19	+						+	PL-050
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 051 to 060	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-051
	2	-						-	
	3	+						+	PL-052
	4	-						-	
	5	+						+	PL-053
	6	-						-	
	7	+						+	PL-054
	8	-						-	
	9	+						+	PL-055
	10	-						-	
	11	+						+	PL-056
	12	-						-	
	13	+						+	PL-057
	14	-						-	



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	15	+						+	PL-058
	16	-						-	
	17	+						+	PL-059
	18	-						-	
	19	+						+	PL-060
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 061 to 070	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-061
	2	-						-	
	3	+						+	PL-062
	4	-						-	
	5	+						+	PL-063
	6	-						-	
	7	+						+	PL-064
	8	-						-	
	9	+						+	PL-065
	10	-						-	
	11	+						+	PL-066
	12	-						-	
	13	+						+	PL-067
	14	-						-	
	15	+						+	PL-068
	16	-						-	
	17	+						+	PL-069
	18	-						-	
	19	+						+	PL-070
	20	-						-	
	21								
	22								
	23								
	24								
	25								

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Payload 071 to 080	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-071
	2	-						-	
	3	+						+	PL-072
	4	-						-	
	5	+						+	PL-073
	6	-						-	
	7	+						+	PL-074
	8	-						-	
	9	+						+	PL-075
	10	-						-	
	11	+						+	PL-076
	12	-						-	
	13	+						+	PL-077
	14	-						-	
	15	+						+	PL-078
	16	-						-	
	17	+						+	PL-079
	18	-						-	
	19	+						+	PL-080
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 081 to 090	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-081
	2	-						-	
	3	+						+	PL-082
	4	-						-	
	5	+						+	PL-083
	6	-						-	
	7	+						+	PL-084
	8	-						-	
	9	+						+	PL-085
	10	-						-	
	11	+						+	PL-086

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	12	-						-	
	13	+						+	PL-087
	14	-						-	
	15	+						+	PL-088
	16	-						-	
	17	+						+	PL-089
	18	-						-	
	19	+						+	PL-090
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 091 to 100	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-091
	2	-						-	
	3	+						+	PL-092
	4	-						-	
	5	+						+	PL-093
	6	-						-	
	7	+						+	PL-094
	8	-						-	
	9	+						+	PL-095
	10	-						-	
	11	+						+	PL-096
	12	-						-	
	13	+						+	PL-097
	14	-						-	
	15	+						+	PL-098
	16	-						-	
	17	+						+	PL-099
	18	-						-	
	19	+						+	PL-100
	20	-						-	
	21								
	22								

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	23								
	24								
	25								
Payload 101 to 110	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-101
	2	-						-	
	3	+						+	PL-102
	4	-						-	
	5	+						+	PL-103
	6	-						-	
	7	+						+	PL-104
	8	-						-	
	9	+						+	PL-105
	10	-						-	
	11	+						+	PL-106
	12	-						-	
	13	+						+	PL-107
	14	-						-	
	15	+						+	PL-108
	16	-						-	
	17	+						+	PL-109
	18	-						-	
	19	+						+	PL-110
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 111 to 120	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-111
	2	-						-	
	3	+						+	PL-112
	4	-						-	
	5	+						+	PL-113
	6	-						-	
	7	+						+	PL-114
	8	-						-	

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	9	+						+	PL-115
	10	-						-	
	11	+						+	PL-116
	12	-						-	
	13	+						+	PL-117
	14	-						-	
	15	+						+	PL-118
	16	-						-	
	17	+						+	PL-119
	18	-						-	
	19	+						+	PL-120
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 121 to 130	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-121
	2	-						-	
	3	+						+	PL-122
	4	-						-	
	5	+						+	PL-123
	6	-						-	
	7	+						+	PL-124
	8	-						-	
	9	+						+	PL-125
	10	-						-	
	11	+						+	PL-126
	12	-						-	
	13	+						+	PL-127
	14	-						-	
	15	+						+	PL-128
	16	-						-	
	17	+						+	PL-129
	18	-						-	
	19	+						+	PL-130

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	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 131 to 140	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-131
	2	-						-	
	3	+						+	PL-132
	4	-						-	
	5	+						+	PL-133
	6	-						-	
	7	+						+	PL-134
	8	-						-	
	9	+						+	PL-135
	10	-						-	
	11	+						+	PL-136
	12	-						-	
	13	+						+	PL-137
	14	-						-	
	15	+						+	PL-138
	16	-						-	
	17	+						+	PL-139
	18	-						-	
	19	+						+	PL-140
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 141 to 150	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-141
	2	-						-	
	3	+						+	PL-142
	4	-						-	
	5	+						+	PL-143

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	6	-						-	
	7	+						+	PL-144
	8	-						-	
	9	+						+	PL-145
	10	-						-	
	11	+						+	PL-146
	12	-						-	
	13	+						+	PL-147
	14	-						-	
	15	+						+	PL-148
	16	-						-	
	17	+						+	PL-149
	18	-						-	
	19	+						+	PL-150
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 151 to 160	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-151
	2	-						-	
	3	+						+	PL-152
	4	-						-	
	5	+						+	PL-153
	6	-						-	
	7	+						+	PL-154
	8	-						-	
	9	+						+	PL-155
	10	-						-	
	11	+						+	PL-156
	12	-						-	
	13	+						+	PL-157
	14	-						-	
	15	+						+	PL-158
	16	-						-	

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	17	+						+	PL-159
	18	-						-	
	19	+						+	PL-160
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 161 to 170	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-161
	2	-						-	
	3	+						+	PL-162
	4	-						-	
	5	+						+	PL-163
	6	-						-	
	7	+						+	PL-164
	8	-						-	
	9	+						+	PL-165
	10	-						-	
	11	+						+	PL-166
	12	-						-	
	13	+						+	PL-167
	14	-						-	
	15	+						+	PL-168
	16	-						-	
	17	+						+	PL-169
	18	-						-	
	19	+						+	PL-170
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 171 to 180	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-171
	2	-						-	

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	3	+						+	PL-172
	4	-						-	
	5	+						+	PL-173
	6	-						-	
	7	+						+	PL-174
	8	-						-	
	9	+						+	PL-175
	10	-						-	
	11	+						+	PL-176
	12	-						-	
	13	+						+	PL-177
	14	-						-	
	15	+						+	PL-178
	16	-						-	
	17	+						+	PL-179
	18	-						-	
	19	+						+	PL-180
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 181 to 190	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-181
	2	-						-	
	3	+						+	PL-182
	4	-						-	
	5	+						+	PL-183
	6	-						-	
	7	+						+	PL-184
	8	-						-	
	9	+						+	PL-185
	10	-						-	
	11	+						+	PL-186
	12	-						-	
	13	+						+	PL-187

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	14	-						-	
	15	+						+	PL-188
	16	-						-	
	17	+						+	PL-189
	18	-						-	
	19	+						+	PL-190
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 191 to 200	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-191
	2	-						-	
	3	+						+	PL-192
	4	-						-	
	5	+						+	PL-193
	6	-						-	
	7	+						+	PL-194
	8	-						-	
	9	+						+	PL-195
	10	-						-	
	11	+						+	PL-196
	12	-						-	
	13	+						+	PL-197
	14	-						-	
	15	+						+	PL-198
	16	-						-	
	17	+						+	PL-199
	18	-						-	
	19	+						+	PL-200
	20	-						-	
	21								
	22								
	23								
	24								

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	25								
Payload 201 to 210	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-201
	2	-						-	
	3	+						+	PL-202
	4	-						-	
	5	+						+	PL-203
	6	-						-	
	7	+						+	PL-204
	8	-						-	
	9	+						+	PL-205
	10	-						-	
	11	+						+	PL-206
	12	-						-	
	13	+						+	PL-207
	14	-						-	
	15	+						+	PL-208
	16	-						-	
	17	+						+	PL-209
	18	-						-	
	19	+						+	PL-210
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 211 to 220	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-211
	2	-						-	
	3	+						+	PL-212
	4	-						-	
	5	+						+	PL-213
	6	-						-	
	7	+						+	PL-214
	8	-						-	
	9	+						+	PL-215
	10	-						-	

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	11	+					+	PL-216
	12	-					-	
	13	+					+	PL-217
	14	-					-	
	15	+					+	PL-218
	16	-					-	
	17	+					+	PL-219
	18	-					-	
	19	+					+	PL-220
	20	-					-	
	21							
	22							
	23							
	24							
	25							
Payload 221 to 230	1	+	T-TC10 Pair	10	AA_5	10	+	PL-221
	2	-					-	
	3	+					+	PL-222
	4	-					-	
	5	+					+	PL-223
	6	-					-	
	7	+					+	PL-224
	8	-					-	
	9	+					+	PL-225
	10	-					-	
	11	+					+	PL-226
	12	-					-	
	13	+					+	PL-227
	14	-					-	
	15	+					+	PL-228
	16	-					-	
	17	+					+	PL-229
	18	-					-	
	19	+					+	PL-230
	20	-					-	
	21							



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	22								
	23								
	24								
	25								
Payload 231 to 240	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-231
	2	-						-	
	3	+						+	PL-232
	4	-						-	
	5	+						+	PL-233
	6	-						-	
	7	+						+	PL-234
	8	-						-	
	9	+						+	PL-235
	10	-						-	
	11	+						+	PL-236
	12	-						-	
	13	+						+	PL-237
	14	-						-	
	15	+						+	PL-238
	16	-						-	
	17	+						+	PL-239
	18	-						-	
	19	+						+	PL-240
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 241 to 250	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-241
	2	-						-	
	3	+						+	PL-242
	4	-						-	
	5	+						+	PL-243
	6	-						-	
	7	+						+	PL-244

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	8	-						-	
	9	+						+	PL-245
	10	-						-	
	11	+						+	PL-246
	12	-						-	
	13	+						+	PL-247
	14	-						-	
	15	+						+	PL-248
	16	-						-	
	17	+						+	PL-249
	18	-						-	
	19	+						+	PL-250
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 251 to 260	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-251
	2	-						-	
	3	+						+	PL-252
	4	-						-	
	5	+						+	PL-253
	6	-						-	
	7	+						+	PL-254
	8	-						-	
	9	+						+	PL-255
	10	-						-	
	11	+						+	PL-256
	12	-						-	
	13	+						+	PL-257
	14	-						-	
	15	+						+	PL-258
	16	-						-	
	17	+						+	PL-259
	18	-						-	



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	19	+						+	PL-260
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 261 to 270	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-261
	2	-						-	
	3	+						+	PL-262
	4	-						-	
	5	+						+	PL-263
	6	-						-	
	7	+						+	PL-264
	8	-						-	
	9	+						+	PL-265
	10	-						-	
	11	+						+	PL-266
	12	-						-	
	13	+						+	PL-267
	14	-						-	
	15	+						+	PL-268
	16	-						-	
	17	+						+	PL-269
	18	-						-	
	19	+						+	PL-270
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 271 to 280	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-271
	2	-						-	
	3	+						+	PL-272
	4	-						-	

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	5	+						+	PL-273
	6	-						-	
	7	+						+	PL-274
	8	-						-	
	9	+						+	PL-275
	10	-						-	
	11	+						+	PL-276
	12	-						-	
	13	+						+	PL-277
	14	-						-	
	15	+						+	PL-278
	16	-						-	
	17	+						+	PL-279
	18	-						-	
	19	+						+	PL-280
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 281 to 290	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-281
	2	-						-	
	3	+						+	PL-282
	4	-						-	
	5	+						+	PL-283
	6	-						-	
	7	+						+	PL-284
	8	-						-	
	9	+						+	PL-285
	10	-						-	
	11	+						+	PL-286
	12	-						-	
	13	+						+	PL-287
	14	-						-	
	15	+						+	PL-288

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	16	-						-	
	17	+						+	PL-289
	18	-						-	
	19	+						+	PL-290
	20	-						-	
	21								
	22								
	23								
	24								
	25								
Payload 291 to 300	1	+	T-TC10 Pair	10	AA_5	10	T-TC10 pair	+	PL-291
	2	-						-	
	3	+						+	PL-292
	4	-						-	
	5	+						+	PL-293
	6	-						-	
	7	+						+	PL-294
	8	-						-	
	9	+						+	PL-295
	10	-						-	
	11	+						+	PL-296
	12	-						-	
	13	+						+	PL-297
	14	-						-	
	15	+						+	PL-298
	16	-						-	
	17	+						+	PL-299
	18	-						-	
	19	+						+	PL-300
	20	-						-	
	21								
	22								
	23								
	24								
	25								



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13 ANNEX F – PORT LOCATIONS



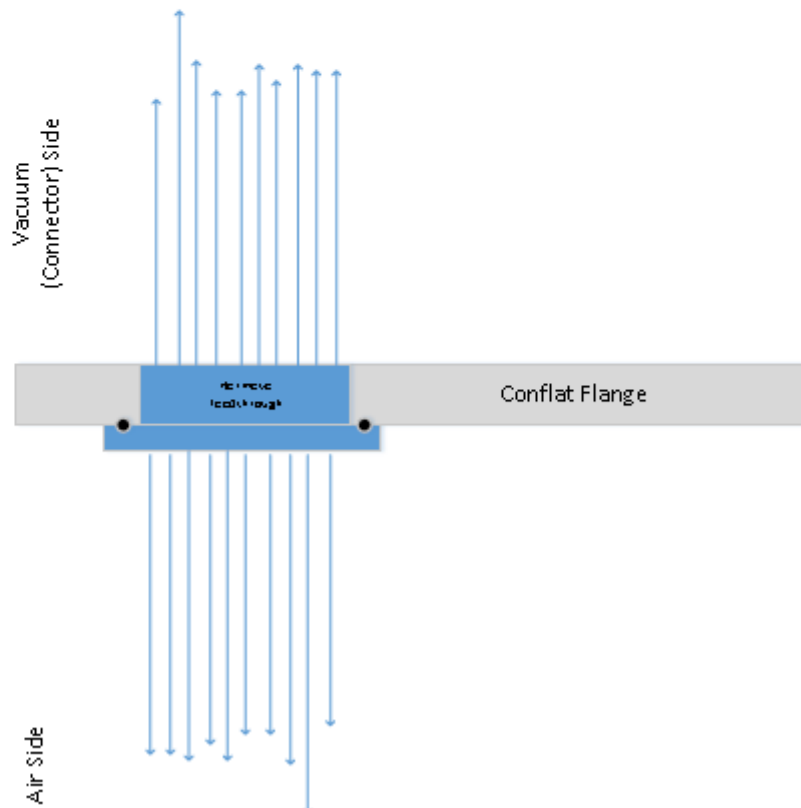
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14 ANNEX G – CONCEPTUAL LAYOUT FOR FLANGE AA_1

Flange AA_1 Shroud Heaters

Hermetically sealed cable feedthrough, removable for maintenance. O-ring sealed to flange. Feedthrough must be removable for maintenance purposes and the flange orifice large enough to pass the required number of cables and terminated connection through without modification.



All cables are Screened Twisted Quads (STQ)
Hermetic sealings should be on the conductor, not jacket

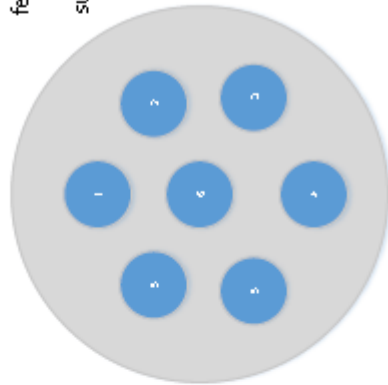
Screen must pass through feedthrough halftough this can be at a common point for each feedthrough as it is just a Pt connection. It should not be electrically connected to the feedthrough shell in any way.

Total of 38 STQs on Flange AA_1

Feedthrough to be helium leak tight to 1×10^{-8} mbar/0s

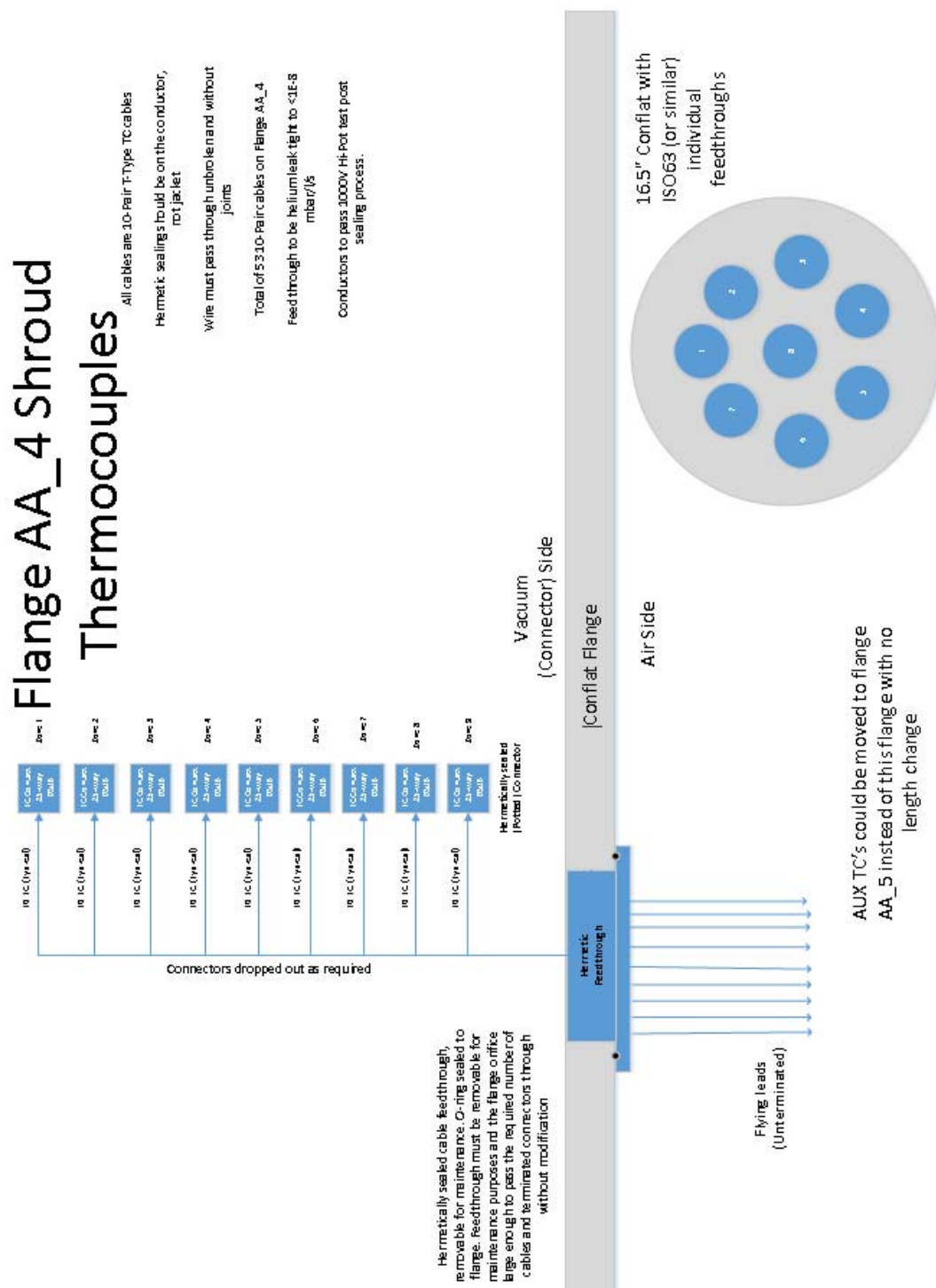
Conductors to pass 1000V Hi-Pot test post sealing process.

16.5" Conflat with ISO63 individual feedthroughs (or similar to suit suppliers design)



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15 ANNEX H – CONCEPTUAL LAYOUT FOR FLANGE AA 4



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16 ANNEX I – CONCEPTUAL LAYOUT FOR FLANGE AA_5

