MTG Optical Ground System Equipment Transport and Storage Containers Specification

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Science & Technology Facilities Council

Change Record

Issue	Date	Section(s) Affected	Description of Change/Change Request Reference/Remarks
01D01	19/09/2017	All	Initial draft
	13/10/2017		Updated with requirement for externally accessible desiccant cartridge for the outside container
			Corrected to two He systems (not three)
			Added skate for phase separator system
			Added spreader frames to contents of TSC 1,3 and 4
01D02	24/10/2017	2	Requirements matrix moved to before requirements
		3	Changed each TSC to subheading
		3	Changed wording of notes
		4.3.2	R-16 humidity indicator requirement simplified
		0	R-24 lifting points for inner container requirement removed for TSC#2
		4.7	R-27 updated with legible distance
		6	Removed duplicate notes that are already in Section 3
		6	Added TSC# column and updated Spares
	13/11/2017	3	Lifting equipment (spreader frames) now contained in TSC#2
		4.5	R-20 – added "exposed" to requirement
	21/11/2017	1.1	Corrected the electronics and He flange to one combined flange
		2	Wire-rope isolator requirement removed for EGSE cabinet
		4.3.1	Rain-proof covers used in conjunction with water-resistant container now acceptable
	21/02/2018	1.3	Updated applicable documents
		All	Updated document reference numbers
	07/03/2018	6.5	Updated spares list
	08/03/2018	6	Spreader frames moved to TSC#2
01	15/03/2018	4.1.1	R-2 – Added "and support"
		5.1	R-29 – Added "in accordance to industry

			standard"
	16/03/2018	3	Updated description and image to include mounting platform
		0	R-24 updated to include mounting platform
	19/03/2018	1.1	Added "and associated equipment" Corrected to "Firm Fixed Price"
		2	n/a added to cells Green hashed cells changed to yellow for clarity
		3	Clarified bag to be zipseal Added nitrogen top-up requirement
		3.3	Changed wording of inner bags from "must be" to "can be" for clarity
		4	R-3.b 20 cycles, painted white externally R-3.d "box" and "cover" replaced with "base" and "lid" R-10 reworded and dimensions changed R-11 reworded R-15 updated shock indicator requirement R-21 "non-shedding" added R-22 "attachment slings" replaced with "tie-down straps" 0 expanded R-25 "rotating" replaced with "castor" R-28.i added
	20/03/2018	3	Figure 3-1 removed heat seal
		4	R-13 requirements divided for TSC#4 R-23 removed still forklift
	26/03/2018	All	Released
02D01	24/05/2018	6.5	Added envelope, delicate and in-foam/mounted columns
		3	Explicit detail added about dirty vs clean for outer/inner container, materials acceptable, what inner container is meant to consist of, and typical use of TSC. An indication as to the value/importance of each TSC's contents given.
		R-9	ISO 8 filtering not mandatory for outside container
		R-26	No shock-mounted wheels
		5.4	Dates updated

02D02	08/06/2018	3 4.1.2 4.5 5.3 6.1 6.2	Updated outside container requirement R-9 Updated filtering requirement R-20 Note added regarding use of timber Clarified CE marking required for full system and components "where applicable" Added image to show available mounting points of BB Clarified spreader frames are assembled
02	12/06/2018	3.2,6.2,6.5 6.5 All	Reduced to one spreader frame Updated pipework lengths Issued

Distribution List

Distribution	Company	Name
x	ESA	MTG Team
x	TAS-F	MTG Team
	OHB	MTG Team

TABLE OF CONTENTS

1 Introduction

1.1 Purpose

STFC is designing and building five blackbody targets for the calibration of two instruments on the ESA Meteosat Third Generation (MTG) imaging and sounding satellites. The two instruments are called 'IRS' (being developed by OHB in Germany) and 'FCI' (being developed by Thales-Alenia Space in France). The blackbody targets require very accurate thermal control, based on a liquid nitrogen jacket, a helium gas gap (where heat conduction through the gas is controlled by adjusting its pressure), and electric heaters. These, together with associated electronics, controls, tooling, flanges, harnesses, and cryogenic supply systems and their ancillary pipework, form the Optical Ground System Equipment (OGSE).

This contract is for the transport and storage containers (TSC) for TAS-F only, but it is likely the OHB containers will follow with similar requirements.

For TAS-F, this will consist of

- two blackbodies
- one phase-separator
- two Helium supply systems
- associated pipework for two blackbodies
- harnessing for two blackbodies
- one electronics/He flange
- one LN2 flange
- one EGSE
- a transformer
- two assembly frames
- three mounting/alignment frameworks.

The OGSEs will be transported from STFC to TAS-F where they will be intermittently in use and in storage over a 25 year timespan.

In bidding for this ITQ, the Bidder is asked to provide for the TAS-F calibration rig and associated equipment:

- **A Firm Fixed Price (FFP)**
- **A technical proposal showing the preliminary solution for each of the containers.**
- **A Schedule and Workflow plan, highlighting kick-off, design phases and reviews, and deliveries of containers.**

1.2 Scope

This document describes the requirements for the dual-purpose transport and storage containers in which all TAS-F components of the OGSE are housed.

1.3 Applicable Documents

The below documents are provided on
https://drive.google.com/open?id=17_J65p_IkWJSphN6cfZn-FlbRKuzNCKZ

AD #	Document #	Title
AD1	**KE-0269-503**	TAS-F VBB & DSBB Base Frame Assy Model
AD2	**KE-0269-1430**	TAS-F VBB & DSBB Ball Transfer Unit Model
AD3	**KE-0269-500**	Lower BB (DSBB) Assembly Model
AD4	**KE-0269-511**	Upper BB (VBB) Assembly Model
AD5	**KE-0269-536**	LN2 Assy Frame Model and Drawing
AD6	**KE-0269-537**	BBM Cavity Assy Frame Model and Drawing
AD7	**PPS10100**	Helium System Model
AD8	**PP S10 100**	Helium System Drawing
AD9	**PP S10 103**	Helium System (Simplified) Drawing
AD10	**MANUAL CMT20K-151-1_pages8-13**	Transformer Drawings
AD11	**KE-0269-1305**	Phase Separator Model
AD12	**KE-0269-1456**	Phase Separator Feedthrough Model
AD13	**P1-22103**	FLANGE ASSEMBLY FOR TAS-F CHAMBER Drawing (Phase Separator Feedthrough)
AD14	**P3-22107**	EXHAUST PIPE ASSEMBLY – TAS-F CHAMBER
AD15	**P1-22001**	Phase Separator Level Probe Assy. Drawing
AD16	**KE-0269-1100**	TASF TVAC DN500 MLTAIT553A_615 Assy

1.4 Reference Documents

The following documents, although not a part of this document, amplify or classify its contents. The below documents are provided on
https://drive.google.com/open?id=17_J65p_IkWJSphN6cfZn-FlbRKuzNCKZ

IR #	Document #	Title
RD1	MTG-STFC-IBLBO-DD-0001	MTG OGSE Lot 1 Design Document

2 Summary Entabulation of Requirements per TSC

Some simplifications for specific containers are preferred as not all requirements need be applied to all TSCs; the overview of requirements to the various deliverable TSCs are shown below:

- If a requirement is marked with an 'x' and green shading, then the particular requirement is applicable to that particular TSC; but if cell is marked "n/a" the TSC does not require that particular feature. In some cases, key words are used instead of x's for clarity.
  As above, but if the cell is shaded yellow, the particular requirement is a nice-to-have, and the Bidder is asked to advise on the cost/complication aspects.

REQUIREMENTS THAT ARE NOT LISTED HERE ARE APPLICABLE TO ALL CONTAINERS.

TSC		R-1				R-4	R-14	R-15	R-16	R-18	R-21	R-24
		ISO 5 vs ISO8 Inner bags	Rotating door	Lifting container body	Wire-rope isolators	Air-tight inner container	Pressure monitor	TAS-F Shock indicator vs logger	Temp & humidity monitor	Inner container non-outgassing	Inner container <180 ppm	Inner container lifting interfaces
BBs and frames	TSC#1	x	n/a	n/a	x	x	x	Logger	Logger	x	x	x
Tools, assembly frames, flanges, harnesses, pipework	TSC#2	x	n/a	n/a	n/a	x	n/a	n/a	n/a	x	x	n/a
He systems, Phase-separator, transformer	TSC#3	only for phase-separator	n/a	x	x	n/a	x	Indicator	Indicator	n/a	only for phase-separator	x
EGSE	TSC#4	n/a	x	n/a	n/a	n/a	x	Indicator	Indicator	n/a	n/a	x

3 Transport and Storage Container Description (R-1)

The OGSE will be transported and stored in bespoke transport/storage containers (TSC) suitable for both purposes.

These will be doubled-sealed containers, consisting of

- an **'outside container'**: a **protective dirty hard container** (constructed of whatever material the bidder deems appropriate given all other requirements)
  NOTES:
  - *Water-resistant (as opposed to waterproof, whereby water-resistance is defined as being able to withstand standing in light rain for a short period of time without penetration of the container – so non-permeable materials with limited fixing points) outer containers are preferred, as are options relying on soft covers to increase this resistance.*
  - *Shock resistance is to be limited to the inner container wire rope isolators; i.e. no shock mounting on castors.*

followed by

- an **'inner container'** which ultimately contains the OGSE: this 'inner container' non-negotiably consists of **a set of two nested air-tight, re-sealable bags**, such that
  - the first, an **outer bag: a metalised ISO 8** compatible moisture barrier bag
  - the second, an **inner bag: an ISO 5 clean** bag (note: multiple inner bags can be contained in one outer bag)

  in between which there is desiccant cartridge with a moisture warning indicator, and with the inner bag resting on a set of mounts/rails (ISO 5 compatible) which acts to both hold the bagged assembly in place and to provide lifting interfaces. These nested bags will be attached to a mounting platform that is mounted on a wire rope isolated shipping frame (see Figure 3-1).

  NOTES:
  Not all containers require mounting system with wire rope isolation, these are identified in Section 2.
  - *Both the outer and inner bags are to be zipper (not toothed, but zipseal-like) metalised bags.*

They will normally be filled with dry nitrogen (not supplied by the Bidder) with the ability of topping up with dry nitrogen when necessary.

The envisioned use of these TSC is that the outer container will be used to protect the items enclosed in the inner container during transport and long-term storage; these will probably be shipped once from the UK to Europe, where they will spend most of their 25 year lifetime in storage. When in use:

1. they will be taken out of storage, transported to the testing facility,
2. taken out of the dirty outer container outside of clean areas,
3. moved into the cleanroom antechamber in the inner container,
    - where the (dirty) outer bag of the inner container will be removed,
    - leaving only the clean inner bag of the inner container (and its contents) to be moved into the cleanroom.

Available drawings and CAD models are included as applicable documents (Section 1.3) as PDFs and STEP files; in the case that a CAD model is unavailable (e.g. COTS part), the xyz envelope and mass are given. Please refer to Section 6 for a list of components associated with each TSC. Interfaces will be provided at Kick off for mounted parts.

All of the components described in this specification (inner container/outer container, various monitoring/relief devices etc) are deliverable as part of this contract and provided to STFC by the Bidder. If components are not required to be delivered by the Bidder to STFC, they are explicitly marked so otherwise in this specification. Bidders are asked to make it clear if they do not intend to provide all such components, or if there are limitations to their proposed solutions.

In particular, if Bidders are not able to provide the inner container bags, STFC will consider bids without the bags themselves included, but will need to have this explicitly noted, highlighting whether the mounts/rails/desiccant will be provided, as well as necessary interface requirement of the Bidder explicitely listed, and with a statement from the Bidder confirming that they will fully liaise with STFC and a third-party bagging supplier. Preference will be given to Bidders who are able to provide the full inner container with bags included.

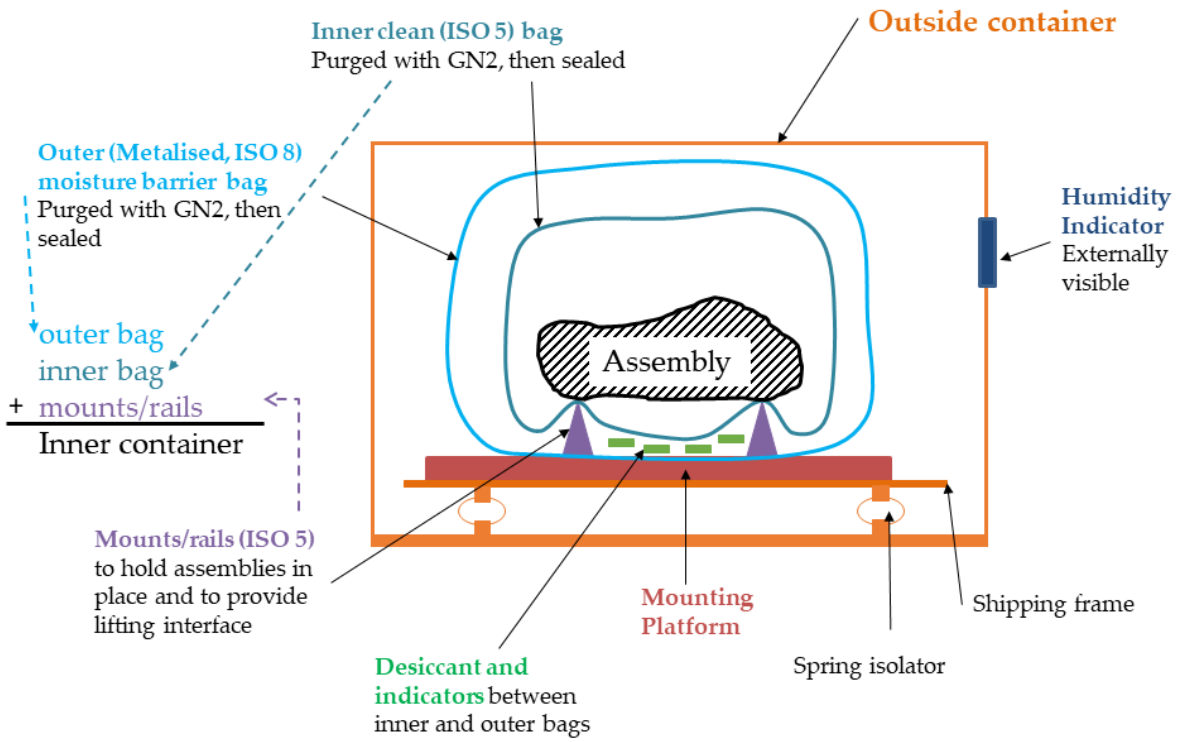

Figure 3-1 Transport/Storage Container (TSC)

In total, of these double-sealing TSCs, there will need to be:

3.1 TSC#1 Contents

A TSC holding all

- the assembled blackbodies (of which there are two, to be put in separate inner (ISO5) and separate outer (ISO8) bags, Please note that they each are to be provided with desiccant cartridges (each with a moisture warning indicator), and with each inner bag resting on a set of mounts/rails (ISO 5 compatible) which acts to both hold the bagged assembly in place and to provide lifting interfaces),
- protective covers,
- mounting/alignment framework for the blackbodies;

This is the primary and scientifically important/delicate equipment which is most important to protect.

3.2 TSC#2 Contents

A TSC holding all

- accessories and tools for the blackbodies;
- the disassembled assembly frames,
- any ancillary tooling required for assembly/disassembly such as lifting plates;
- one LN2 flange and one He/electrics flange,
- the associated harnesses (in-air and in-vacuum),
- the pipework (LN2 and He),
- and spare components;
- spreader frame and lifting equipment for blackbodies, He supply systems and transformer

This equipment is not delicate or expensive, and is the lowest spec container.

NOTE: Items in this TSC do not require mounting system with wire rope isolation, please advise on (simpler) storage arrangement, eg. drawers with cutouts for components in foam lining.

3.3 TSC#3 Contents

A TSC holding all

- two He supply systems,
- a phase-separator system,
- a transformer and its associated harnessing (please see Note 2 of TSC#4)

These are high-value but relatively highly-robust pieces of equipment – only the phase-separator will go in the cleanroom and all other items will remain in dirty conditions in use.

NOTE 1: The inner-bags for the phase-separator system must be ISO 5 compatible for cleanroom use. All other items in this T&SC (He systems, and transformer/harnessing) can have inner-bags that areISO 8 or better.

NOTE 2: It is preferable for this TSC, but not required, that the 'outer container' have a "top-hat" which can be lifted off of the container base for handling purposes. This is so we don't have to lift the big/heavy He supply systems + the big/heavy transformer quite so high and far as would need to be done if they were to have to be lifted from the top of a 'standard' outer box. That said, if this is inpracticable or much more expensive, it is not required, but rather a nice-to-have.

Figure 3-2: "Top-hat" container body which lifts off of container base.

3.4 TSC#4 Contents

A TSC holding all

- components of the EGSE, including the EGSE cabinet in its fully assembled state

This is high-value but relatively highly-robust piece of equipment (basically a computer rack) which will remain in dirty conditions in use.

NOTE 1: The inner containers (both outer and inner bags thereof) of this TSC must be ISO 8 or better, but ISO 5 is not required.

NOTE 2: If it is more convenient/cheaper for the transformer from TSC#3 to be placed in TSC#4, then this solution should be presented.

This TSC must be supplied with a ramp via which the contents of the container can be rolled out in a safe manner. This could be a folding door which folds on to the ground to form a ramp. The Bidder is to advise if there is an alternative solution (e.g. provision of ramp by the Bidder) which is simpler but functionally the same. If a separate ramp is provided, it would be appreciated if it could be used with TAS-F TSC#3 as well to roll the heavy items (max. 320kg) off the base.

4 Transport and Storage Container General Requirements

Generally, all requirements listed in this section are required for all TSCs. Some simplifications for specific containers are preferred and, as such, a simplified solution is preferred: these are highlighted in **Section 2 in an entabulation of the simplifications/exceptions allowable for each of the TSCs for clarity and completeness.**

4.1 Overall Design and Function

4.1.1 TSC components: Inside and Outside Containers

R-2. Each TSC must provide adequate protection from mechanical damage. Appropriate packing and support in the container shall mechanically fix the equipment.

R-3. The 'outside container' of each TSC is a transport container. It shall
a. provide suitable mounting locations to support the 'inner container'
b. be light weighted, reusable (for at least 20 cycles), painted white externally.
c. provide suitable protection such that the OGSE and all associated equipment shall be able to be transported by road, sea or air by commercial facilities
d. have protection of the 12 edges against shocks (8 for the base and 4 for the lid), and protection for the closure devices/locks.

R-4. The 'inner container' shall be air-tight and consist of two nested sealed bags (not a hard container), the 'inner bag' and the 'outer bag'. It will allow for the possibility of evacuation during transport and a dry nitrogen atmosphere to be maintained during storage. It shall conform to CAA and FAA regulations, as the TSC may be transported by air.

R-5. The 'inner container' shall be capable of withstanding a pressure of 0.5psi above atmospheric conditions when configured for use as a storage container.

R-6. The 'inner container' shall be sufficiently large to allow it to expand and contract during transportation by air and thereby maintain a sealed environment during transportation, and must be able to survive a rapid decompression event when travelling in the pressurised hold of an aircraft to BS 88:1996. If Bidder is accustomed to working to a different standard, please advise. Air pressure to be considered in air transport: equivalent to 15 km altitude.

R-7. The inner and outer bags to be zippered and reusable.

4.1.2 Sealing

R-8. Each 'inner container' must be purgeable with dry nitrogen, and seal suitably for long-term storage.

R-9. Each 'outer container' must be capable of 'breathing' during transportation by air

NOTE: In the case that it costs <5% cost delta and < 1 week difference in delivery time, the preference would be that the air drawn into the outer container must be filtered to ISO class 8. If otherwise, please do not design for filtering of air.

4.2 Volume and Mass

R-10. The outside volume of any 'outer container' shall be less than 5.7 m length x 2.2 m width x 2.3 m height.

R-11. The maximum mass of the packed TSCs must be <5 tons.

4.3 Survival Conditions

4.3.1 Overall

R-12. The TSCs must be able to perform with no degradation in transport conditions:

- Temperatures between -20°C and +55°C.
- Pressure between 800 and 1050 mbar.
- Solar radiation <= 100 W/m²
- Humidity of 5-100%, and capable of protecting its contents against rain.

NOTE: Rain-proof covers used in conjunction with water-resistant containers (an example of which are shown in the below figure) are the preferred solution and are acceptable. Please indicate in your solution whether the proposed solution is waterproof or water-resistant. It is not necessary nor desired for the outer container to be able to survive a 'dunk test' without leaking but to keep the content dry if left for a reasonable period in the rain with covers installed.

Figure 4-1: Example TSC with appropriate water-resistance.

R-13. TSC#1,2,3 must be able to withstand impacts and vibrations due to handling and transport as defined below:

– Sinusoidal Vibrations during air transportation and road transportation :

F (Hz)	ACCELERATION/AMPLITUDE
0.1 à 1	± 50 mm
1 to 5	± 8 mm
5 to 20	± 1.25 mm
20 to 200	2 g
200 to 300	3 g

– Random Vibrations during air transportation :

Frequency range	Level	Global (g_{xxx})
5 Hz – 10Hz	+6 db/oct.	0.64
10 Hz – 100 Hz	0.003 g^2/Hz	
100Hz –200 Hz	-12 db/oct.	
200Hz – 400 Hz	0.0001875 g^2/Hz	

– Quasi Static loads during air transportation :

Aircraft Axis	X (forward)	Y	Z (+ up)
Landing	+1.5 g	±1.5 g	-2.0 g
Take-off	-1.5 g	0 g	+2.0 g / -1.5 g

– Shock during the air transportation : 4.2g / 20 ms (½ sinus profile)
– Shock during road transportation : 10g for max. 10ms (½ sinus profile)
– For road transport, container damping system 1st modal should be between 5 and 10 Hz.

TSC#4 must be able to withstand impacts and vibrations due to handling and transport as defined below:

- Vibrations of 5.5 to 200 Hz: ±1.5g
- Impacts
  - Road and air transport: up to 8g for 5 to 50 ms
  - Handling: up to 3g for 15 ms, and 10g for 10 ms
  - Accelerations (air): up to 3 g

Attenuation requirements for contents of containers TBC.

4.3.2 Monitoring

R-14. Each TSC must have a means of monitoring the pressure inside the 'inner container', to ensure that there is a positive pressure difference from inside the 'inner container' to the outside. This must be viewable on the 'outside container' with or without lid. *Note 1: if this is unrealistic, the Bidder is asked to advise if it might be better to monitor humidity instead, with the understanding that this will remain low as long as the dry N2 is still present.*

R-15. During the transport phase, the TSCs shall be equipped with

- *TSC#1 has a three-axes shock logger* positioned 'after' the wire-roped isolated frame (so as to monitor the shock seen by the TSC contents and not the TSC itself), with
  - A wake-up value of 3g TBC (at which the logger starts recording), and
  - A warning value of 10g TBC (at which a red light goes off).
- *TSC#3 and TSC#4 have witness shock indicators* consisting of a bar which becomes red if subjected to levels of shock exceeding a threshold. Indicators required for 10g, 25g and 50g. (If the Bidder prefers a different but similar solution, please advise in the proposal)

NOTE 1: TSC#2 does not require any shock indicators or logs.
NOTE 2: These indicators/logging devices can be the same device as used for R-16.

R-16. TSC#1 shall be equipped with a meter to display the current and max reached humidity during transport and storage to show the conditions inside the outside container that is viewable on the outside of the TSC.
TSCs #3 and #4 shall be equipped with an indicator that triggers at 50% RH.

4.4 *Lifetime and Degradation*

R-17. The TSCs shall have a lifetime of 25 years, without degradation. In the case that there are components with lifetimes shorter than 25 years (or dependent upon a number of uses), full details of all such critical items, with their replacement timeframe and details for reprocurement must be provided and approved with STFC before use.

4.5 *Materials Used*

R-18. All materials used in the 'inner container' of the TSCs must be made from clean non-outgassing materials, with TML < 1% and CVCM < 0.1%.

R-19. The 'inner container' and inside bagging shall be anti-ESD.

R-20. No exposed hygroscopic materials or components may be used in the TSCs, nor any materials liable to corrosion, unless they are not essential to overall TSC performance (e.g. handles)

NOTE 1: Use of timber (etc) is acceptable provided that it is suitably coated
NOTE 2: Please list any such materials (hygroscopic/corroding) as requiring maintenance, with expected lifetime/replacement timeframes.

R-21. All materials used in the 'inner container' shall be non-shedding and compliant with particulate contamination of less than 180 ppm.

4.6 *Manual Handling and Mechanical*

R-22. Specific areas under the TSC shall allow the container to be put on a wedge in order to relieve the loading on the wheels during the storage phase, and to avoid overloading the wheels with the tie-down straps when the containers are being locked onto e.g. the truck during transport. It is foreseen that this can be solved either by using wheels on jacks or by using dedicated blocks stored on the external side of the container which can be removed to place under the container for storage and transport phases. Bidder to advise.

R-23. The 'outside container' of large containers (Bidder to advise) shall have lifting interfaces for forklift (for lifting the fully-loaded container) and be compatible with crane equipment (for lifting the lid-alone off the container, if applicable). The forklift interfaces shall be lifting pockets in order to be transportable by forklift truck. Lifting tunnels shall be compliant with the forklift Figure 4-2. All the security requirements regarding the minimum size of forklift to use shall be provided. Forklift interfaces shall be centred with regard to the CoG of the load.

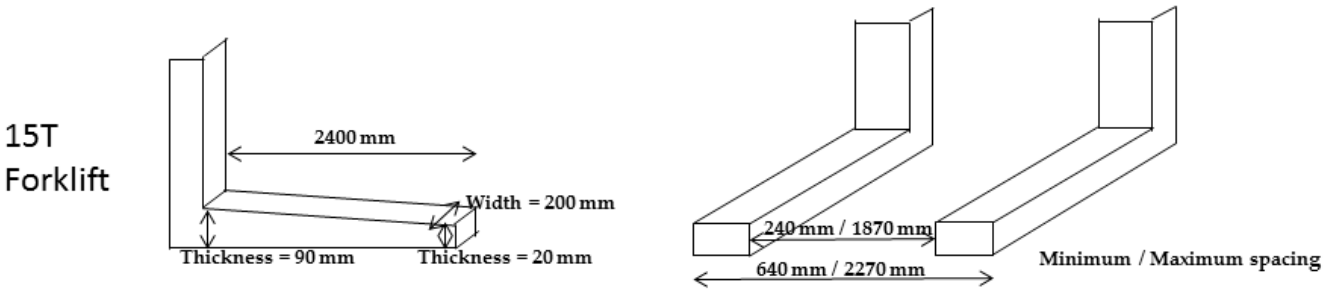

Figure 4-1: Fork dimensions

R-24. The 'inner container' and mounting platform shall have lifting interfaces for forklift equipment. These can be structure built into the inner container.

R-25. The TSCs shall have four jackable castor wheels in (white) polyamide, with brakes, in order to move it easily on the floor. The mount of the wheels shall be made of stainless steel. The Push-pull effort shall be less than 40 daN. They are not to be shock-mounted

R-26. The TSCs shall be compliant with the following load: $P_{punch} < 0.5$ daN/mm² and $P_{floor\ allowable\ load} < 1500$ daN/m².

4.7 *Identification and Markings*

R-27. The SWL of the container shall be clearly displayed on the outside of the container by the Bidder and be legible from at least 3m away.

R-28. Each container shall be identified with a marking applied on 3 sides (not including underside), which contains the following data in English:

a. Project name: 'MTG' painted in black (letters height: 100mm)
b. Identification of the contents painted in black: OGSE code and serial number (letters height: 50mm): to be provided by STFC.
c. PTI number and identification (letters height: 15mm): to be provided by STFC.
d. Contractor name painted in black (letters height: 30mm): 'STFC'
e. Weight painted in black (letters height: 15mm): Empty Weight in kg, and Total Weight in kg: weight of contents to be provided by STFC.
f. Overall dimension in centimetre (letters height: 15mm): Length x Width x Height
g. Support points for lifting devices painted in black
h. Important functional information painted in red
i. CoG marking on 4 sides.

5 Acceptance, Review and Documentation

5.1 Acceptance Testing

R-29. Acceptance testing shall be performed by the Bidder. The scope of the acceptance testing, and test method(s), shall be recommended by the Bidder in accordance to industry standard.

5.2 Documentation

R-30. Manufacturer's data shall be supplied for all components, including operating manuals, a full parts list, maintenance requirements and test/conformance certificates. It shall also include a statement of expected product life and period of support, and provide contact details with which both STFC and the final customers in Europe can procure spare parts should they be necessary over the 25-year period of use of the blackbodies. All test reports and analysis results shall be provided to STFC.

5.3 CE Marking

R-31. The final system and components shall be CE marked, where applicable, and a copy of the Technical File that justifies the CE mark shall be provided by the Bidder. The Bidder shall advise in their proposal which directives apply to this type of equipment, to which they shall be compliant in order to obtain the CE marking. In the

case that CE marking is not applicable to containers, the Bidders will provide upon delivery a technical file which justifies the safety and suitability of design choices made against suitable directives/design standards.

5.4 Review Requirements

R-32. Two reviews shall be conducted:

- A Design Review shall be conducted once the TSC design is complete, but before the manufacturing and procurement phase. This review shall take place within **4 weeks** of kick-off.
- Delivery shall be within **12 weeks** of kick-off.
- An Acceptance Review shall be performed following Acceptance Testing. This Review shall also assess the documentation of Section 5.2. This shall take place within **14 weeks** of kick-off.

6 Appendix

This appendix contains a list of all components of the OGSE to be stored/transported in the TSCs. These are organised into 4 transport boxes. **In the case that the stored item is an assembly, the outside of the assembly will be shown.**

For mass, envelope and quantity estimates, see Section 6.5.

6.1 TSC#1

- Two assembled blackbodies fixed in frame – KE-0269-500, KE-0269-511
- One base frame – KE-0269-503
- Soft protective cover – TBD, but this will be a foldable fabric coversheet, which is expected to occupy very little volume when folded (shoebox in size).

KE-0269-511 and KE-0269-500 must be stored in a configuration such that it is possible for one to be kept in storage while the other is in use.

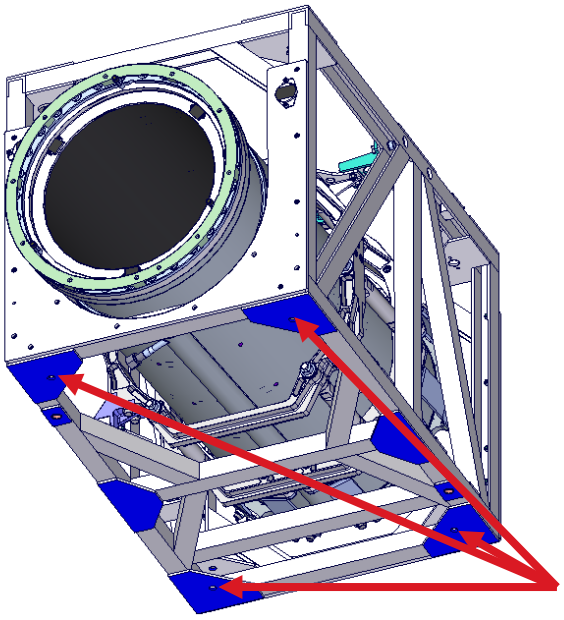

Figure 6-1: Available mounting points of KE-0269-500 and KE-0269-511

6.2 TSC#2

- Alignment mechanism – 4 off KE-0269-1430 (greased, and will require storage in its own inner container)
- Disassembled VBB/DSBB cavity/shield assembly frame – KE-0269-TBD (will be modification of KE-0269-537, so please use KE-0269-537 in quotation/technical proposal)
- Disassembled VBB/DSBB LN2 jacket assembly frame – KE-0259-TBD (will be modification of KE-0269-536, so please use KE-0269-536 in quotation/technical proposal)
- LN2 flange – KE-0269-1456
- He/electrical harnessing flange – KE-0269-1100

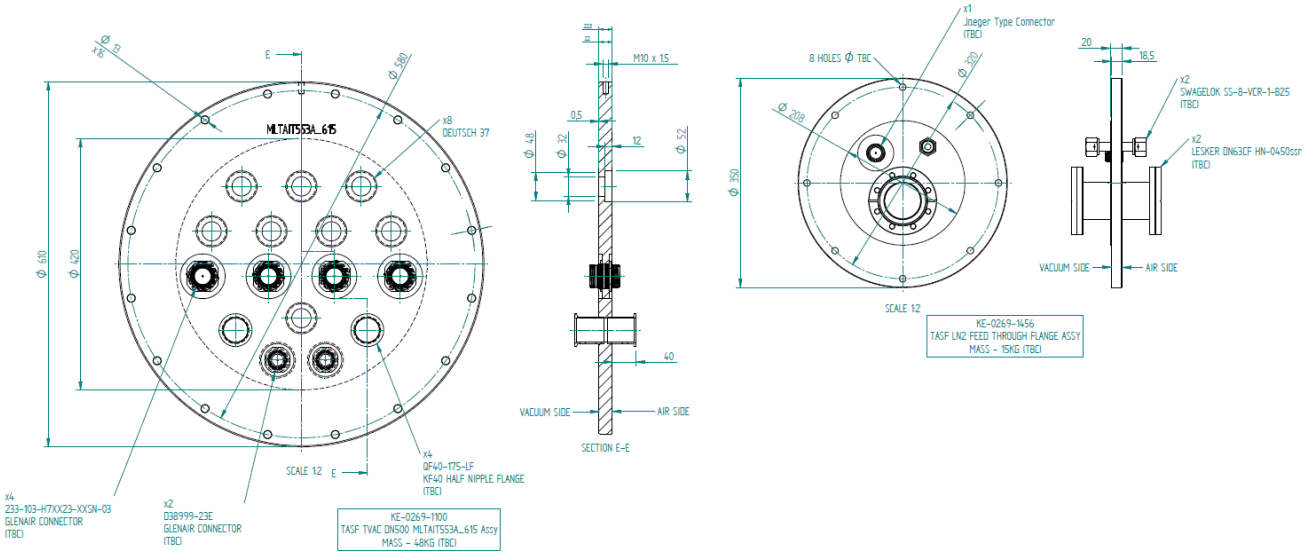

Figure 6-2: He/electrical harnessing flange – KE-0269-1100

- Associated harnesses (in-air and in-vac) for VBB and DSBB – KE-0269-TBD.
  For purposes of quotation, assume
  - 1 x 20 m long, diameter of 2 cm and a bend radius of 15 cm, and
  - 6 x 10 m long, diameter of 15 mm and a bend radius of 15 cm
- LN2 and He pipework for VBB and DSBB – KE-0269-TBD
  For purposes of quotation,
  - He: assume 34 x 1 m long, diameter of 50 mm, bending radius of 50 cm – but likely that they can just be stacked without bending
  - LN2: assume
    - 35 x 1 m long, diameter of 75 mm, bending radius of 70 cm – but likely that they can just be stacked without bending
    - 6 x 1 m long, diameter of 50 mm, bending radius of 50 cm – but likely that they can just be stacked without bending

  - 15 x 1 m long, diameter of 22 mm, bending radius of 20 cm – but likely that they can just be stacked without bending
- Assembled spreader frame and lifting equipment for blackbodies, He supply systems and transformer
- Spares – stored in a way so that each is protected from damage during transport and storage.
  - 6 off Heaters– these will take up a volume of < 20 cm x 10 cm x 5 cm
  - 1 off Thermistors – this will take up a volume of <15cm x 15 cm x 5 cm
  - LN2 pipes ; 5 off 1m lengths of DN40 flex + 5 off 1m lengths ½" flex + 5 off 1m lengths of DN50 flex
  - 20 off DN40 pipe seals
  - 50 off ½" pipe seals
  - 5 off DN50 pipe seals
  - 1 off KVM Switch
  - 1 off Screen, keyboard and mouse
  - 1 off RS232 Bridge
  - 1 off Temperature controllers for 3 PID loops
  - 1 off TAS-F LN2 feedthrough
  - 1 off TAS-F in-vac harnesses
  - 1 off TAS-F in-air harnesses
  - 1 off "Electronic pressure transducer with remote interface"
  - 1 off Pressure regulator
  - 1 off Overpressure safety valve with TUV certificate
  - 1 off ActiveLine Pirani/capacitance transmitter
  - 1 off Forevacuum safety valve
  - 1 off SITOP Smart - Single Phase 24V/20A
  - 1 off TPS 110, Power supply for wall/standard rail fitting, PM 061 340 -T
  - 1 off DN6 2.1BAR PRV
  - 1 off 0.5 BAR PRV
  - 1 off 1 1/2" NON-RETURN VALVE - FIG 113S BS 5154 PN25
  - 1 off Level probe
  - 1 off Burst disc (A.S. Scientific Proprietary ~10 psi)
  - 1 off TAS-F LN2 in/out connector, a VCR fitting and the Jaeger connector
  - 1 off TAS-F He in-out connectors
  - 1 off 233-103-H8Z123-21SN-03
  - 1 off 233-103-H8Z119-35SN-03
  - 1 off 233-103-H7Z123-21SN-03
  - 1 off 233-103-H7Z119-35SN-03

The below drawings are given as an indication only of the dimensions and rough geometry of the assembled framework, and will be updated with the Bidder at the KO.

Wire rope isolators are not required in this T&SC, but all foam must be ISO5 compatible.

6.3 TSC#3

- Two fully-assembled He supply systems – PPS10100

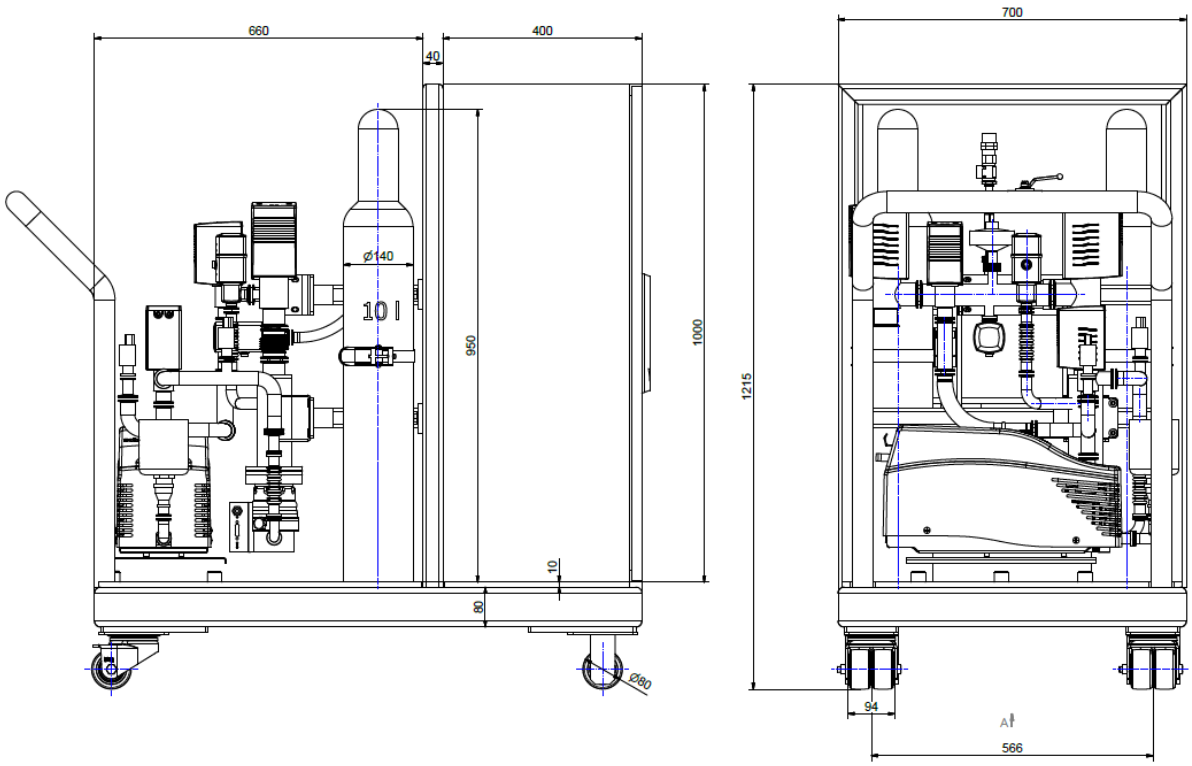

Figure 6-3: He system

- Phase-separator and all fittings up to the internal pipework (which itself will go in TSC#2).

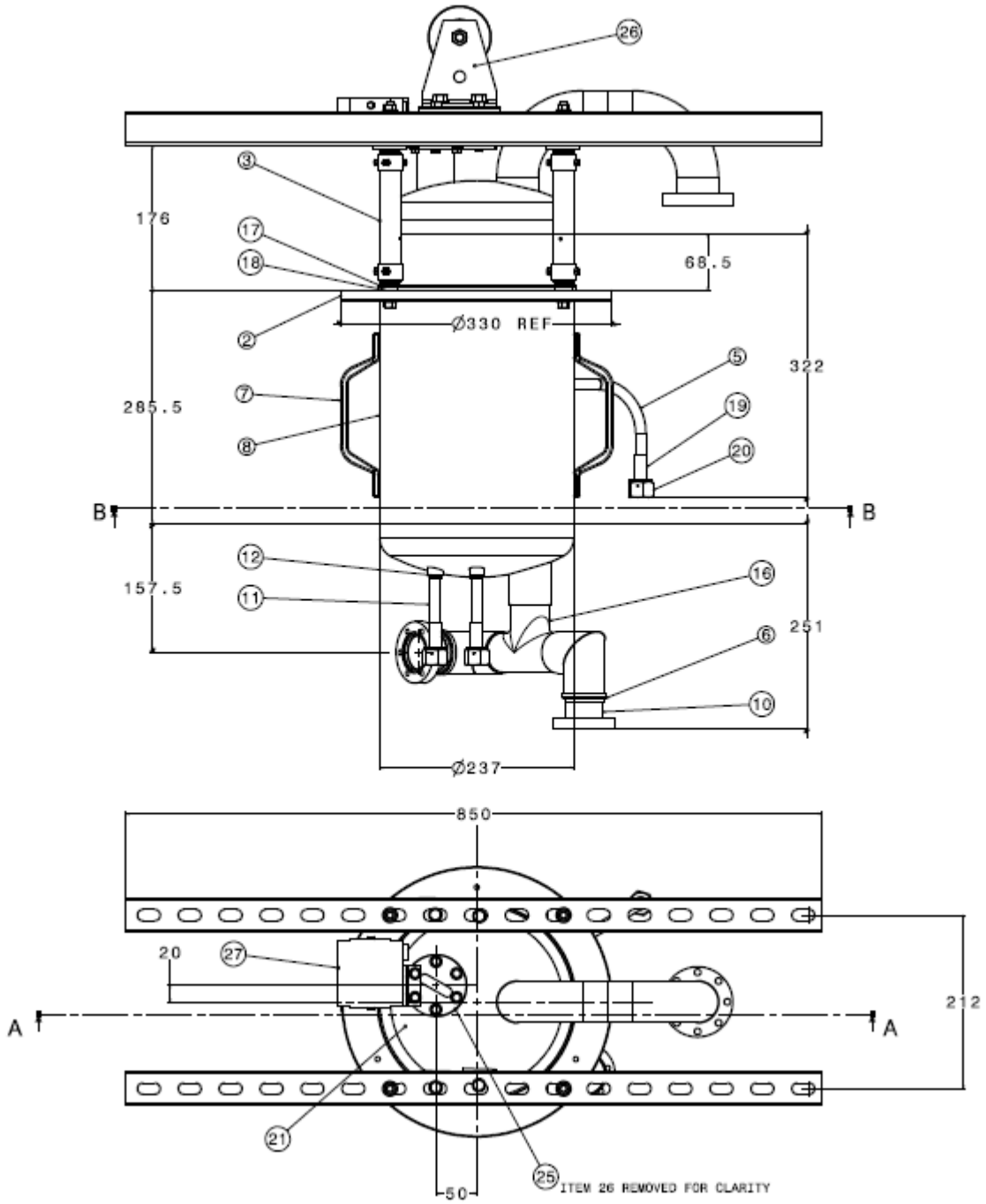

Figure 6-4: Phase separator

- a transformer and its associated harnessing*

*Alternatively, transformer and associated harnessing may be relocated to TSC#4.

6.4 TSC#4

The below drawing is given as an indication only of the rough geometry of the assembled EGSE and will be updated with the Bidder at the KO. The approximate full dimensions (including castors and lifting eyes) are **H1779.4 - 1809.4 x W800 x D1000mm**.

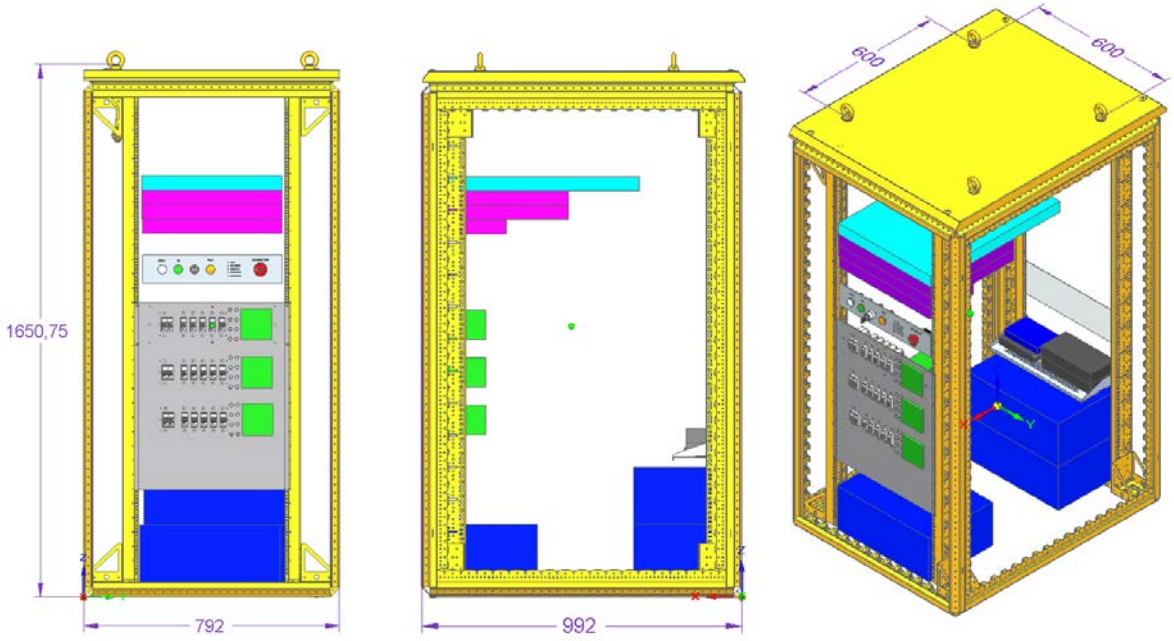

Figure 6-5: EGSE Cabinet, location of CoG with respect to coordinate system shown in diagram is approximately (x 528, y 400, z 841). NOTE: castor wheels and outer panels not shown nor taken into account in CoG measurement.

6.5 List of items for transportation

These drawings and models are given in
https://drive.google.com/open?id=17_J65p_IkWJSphN6cfZn-FlbRKuzNCKZ

For column "Reference":
D = Drawing
M = Model
P = Photograph
W = Weblink

If an item is itemised as delicate and foam mounted, the foam insert should be a good fit for the specific part; if the item is itemised as foam mounted, but not as dlicate, there doesn't need to be a bespoke/good fit for the specific part within the foam mounting.

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
	CALIBRATION RIG AND MAIN GSE								
KE-0269-511	VBB DSBB BB Assy **Upper** Config	285kg		1	1	M		Y	M
KE-0269-500	VBB DSBB BB Assy **Lower** Config	287kg		1	1	M		Y	M

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
KE-0269-503	VBB and DSBB Base Frame Assy	54kg		1	1	M		Y	M
KE-0269-720	TAS-F EGSE	200kg		1	4	P	EGSE	N	M
PPS10100	He System	320kg		2	3	D/M		N	M
CMT20K/151	Transformer	220kg		1	3/4	D		N	M
KE-0269-1305	TAS-F Phase Separator	40kg		1	3	M		N	M
KE-0269-1430	VBB & DSBB Ball Transfer Unit	13kg		4	2	M		N	M
	FLANGES AND HARNESSING								
P1-22103+P1-22107	TAS-F LN2 Flange	15kg		2	2	D		N	F
KE-0269-1100	TAS-F He and Electrical Flange	49kg		1	2	D/M		Y	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
TBD	TAS-F EGSE Harnessing - 20m	TBD – expected ~10kg	Ø½"	1	2	-		N	F
TBD	TAS-F EGSE Harnessing - 30m	TBD – expected ~10kg	Ø½"	1	2	-		N	F
TBD	TAS-F EGSE Harnessing in vac - 5m	TBD – expected ~5kg	Ø½"	2	2	-		N	F
TBD	TAS-F LN2 1/2 inch flex inlet – 2.5m	TBD – expected <1.0kg per metre		2	2	W	Swagelok Stainless Steel Flexible Tubing	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
TBD	TAS-F LN2 1/2 inch flex inlet – 6.2m	TBD – expected <1.0kg per metre		1	2	W	Swagelok_Stainless Steel Flexible Tubing	N	F
TBD	TAS-F LN2 DN40CF flex exhaust – 1m	TBD – expected <1.5kg per metre		1	2	W	Lesker_FormedBellows	N	F
TBD	TAS-F LN2 DN40CF flex exhaust – 2m	TBD – expected <1.5kg per metre		1	2	W	Lesker_FormedBellows	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
TBD	TAS-F LN2 DN50CF facility exhaust – 20m	TBD – expected <1.5kg per metre		1	2	W	Lesker_FormedBellows	N	F
TBD	TAS-F LN2 DN50CF exhaust – 7m	TBD – expected <1.5kg per metre		1	2	W	Lesker_FormedBellows	N	F
TBD	TAS-F He DN50CF 70mm flex - 14m	TBD – expected <2.0kg per metre		1	2	W	Lesker_FormedBellows	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
TBD	TAS-F He DN50CF 70mm flex in vac - 2m	TBD – expected <2.0kg per metre		2	2	W	Lesker_FormedBellows	N	F
	SPARES								
TBD	Heaters	TBD – expected <0.1kg each		6	2	M/P	DSCN4451	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
TBD	Thermistors	TBD – expected <0.1kg each	Wooden box ~20cm x 20cm x 5 cm	1	2	P	DSCN1842	Y	F
	LN2 Pipes								
TBD	1m DN40 flex	TBD – expected <1.5kg each		5	2	W	Lesker_FormedBellows	N	F
TBD	1m ½" flex	TBD – expected <1.0kg each		5	2	W	Swagelok_Stainless Steel Flexible Tubing	N	F
TBD	1m DN50 flex	TBD – expected <2.0kg each		5	2	W	Lesker_FormedBellows	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
COTS	DN40 CF copper gasket	~0.3kg		20	2	W	Pfeiffer_490DFL040-S10.en.pdf	N	F
COTS	1/2″ VCR gasket	~0.05kg		50	2	W	Swagelok VCR-Metal-Gasket-Face-Seal	N	F
COTS	DN50 CF copper gasket	~0.1kg		5	2	W	Lesker OFHC Gasket	N	F

COTS	KVM Switch system • USB VGA Console Extender over CAT5 UTP (SV565UTPUGB) • 4 port rack mountable USB KVM switch with Audio and USB hub (SV431USBAEGB) • 1U rackmount brackets for KVM switch (SV431RACK) • 6 ft 2-in-1 USB KVM Cable (SVUSB2N1_6)	~0.3kg		1	2	W	• https://docs-emea.rs-online.com/webdocs/1447/0900766b8144771f.pdf • https://docs-emea.rs-online.com/webdocs/1447/0900766b81447722.pdf • http://cdn-docs.av-iq.com/dataSheet//SV431RACK_Datasheet.pdf • https://www.startech.com/uk/Server-Management/Cables/6-ft-USB-VGA-2-in-1-KVM-	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
							Switch-Cable~SVUSB2N1_6		
COTS	Dell 18.5in LED KMM DKMMLED185-204(French keyboard)	~5kg		1	2	W	http://www.dell.com/en-uk/shop/dell-185in-led-kmm-dkmmled185-204-french-keyboard/apd/a7485908/networking	N	F
COTS	RS232 Bridge MOXA UPort 1650-16	~0.5kg		1	2	W	https://www.moxa.com/doc/specs/UPort_1600-16_Series.pdf	N	F
Eurotherm 2704	Temperature controllers for 3 PID loops	TBD – expected <5kg	96 x 96 x 150 mm	1	2	W	https://www.eurotherm.com/products/temperature-controllers/multi-loop/2704	Y	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
TBD	TAS-F LN2 feedthrough flange	TBD – expected <15kg		1	2	D	P1-22103 Flange Assembly Sheet	N	F
TBD	TAS-F in-vac harnesses	TBD – expected <20kg	Ø½"	1	2	-		N	F
TBD	TAS-F in-air harnesses	TBD – expected <20kg	Ø½"	1	2	-		N	F
TBD	Electronic pressure transducer with remote interface	TBD – expected <0.5kg	50 x 50 x 100 mm	1	2	-		N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
TBD	Pressure regulator	TBD – expected <0.5kg		1	2	W	https://www.the-gas-safety.co/HELIUM-2-STAGE-0-2-barG-Base-Entry-BS-No3-Outlet-G-38.aspx	N	F
P 0101 090	Overpressure safety valve P 0101 090 with TUV certificate	TBD – expected <0.5kg	50 x 50 x 50 mm	1	2	-		N	F
Pfeiffer PT R26 855	ActiveLine Pirani/capacitance transmitter	0.12kg		1	2	W	Pfeiffer_PTR26855	N	F
Pfeiffer PF A44 536	Forevacuum safety valve	2kg		1	2	W	Pfeiffer_A44_536	N	F
Siemens PSU 100 S	SITOP Smart - Single Phase 24V/20A	2.4kg		1	2	W	Siemens_Product_6EP1336-3BA10	N	F
Pfeiffer PM 061 340 - T	TPS 110, Power supply for wall/standard rail fitting	0.7kg		1	2	W	TPS_110_PM061340-T.en.pdf	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
Part 5 in P1-22103	DN6 2.1BAR PRV	~0.5kg	Ø40 – 70LG	1	2	D, P	Item 5 on P1-22103 – Flange Assembly Sheet 1 2.1 bar PRV.jpg	N	F
Part 3 in P3-22107	0.5 BAR PRV	~0.5kg	Ø60 – 140LG	1	2	P	0.5 bar PRV.jpg	N	F
Part 15 in P3-22107	1 1/2" NON-RETURN VALVE - FIG 113S BS 5154 PN25	~1kg	Ø80 – 210LG	1	2	P	Non return valve.jpg	N	F
P1-22001	Level probe	~1kg		1	2	D		N	F
Part 6 in P3-22107	Burst disc (A.S. Scientific Proprietary ~10 psi)	~0.2kg	Ø115 – 160LG	1	2	P	Burst disc 1.jpg Burst disc 2.jpg	N	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
SS-8-VCR-3 + SS-8-VCR-1	VCR fitting	TBD – expected <0.5kg		1	2	W	https://www.swagelok.com/en/catalog/Product/Detail?part=SS-8-VCR-3 https://www.swagelok.com/en/catalog/Product/Detail?part=SS-8-VCR-1	N	F
J536 208 006	Jaeger connector	TBD – expected <0.5kg	50 x 50 x 100 mm	1	2	-			
J042 955 006	Jaeger connector	TBD – expected <0.5kg	50 x 50 x 100 mm	1	2	-			

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
LESKER DN50 HN-0337R + QF50-224-LF	TAS-F He in-out connectors	TBD – expected <0.5kg		1	2	D	hn-0337r.pdf qf50-224-lf.pdf	N	F
233-103-H8Z123-21SN-03	Heater BB electrical connectors	~0.5kg		1	2	M		Y	F
233-103-H8Z119-35SN-03	Sensor BB electrical connectors	~0.5kg		1	2	M		Y	F
233-103-H7Z123-21SN-03	Heater TVAC electrical connectors	~0.5kg		1	2	M		Y	F
233-103-H7Z119-35SN-03	Sensor TVAC electrical connectors	~0.5kg		1	2	M		Y	F

Part#	Title	Mass	Envelope	Qty	TSC #	Reference	Photograph/Weblink	Delicate	In ESD-foam or mounted (F vs M)
	ASSEMBLY FRAMES								
KE-0269-536	LN2 ASSY FRAME	61kg		1	2	M		N	M
KE-0269-537	Cavity Assy Frame	60kg		1	2	M		N	M
	SPREADER FRAMES								
KE-0269-150	BB/He System/Transformer Spreader Frame	TBD – expected ~20kg		1	2	D		N	F