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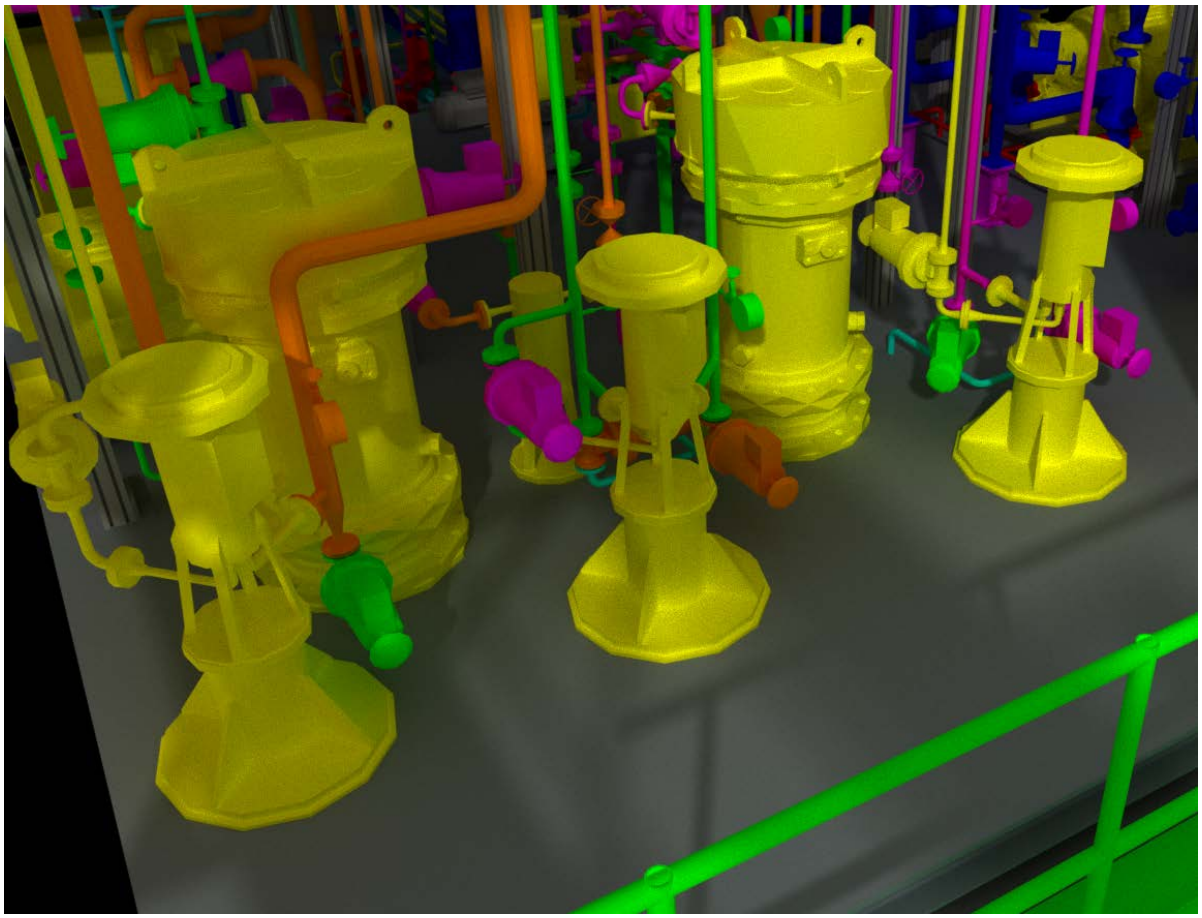
PR18127 - Technical Specification Filter Housing and Cartridges

ISIS-TS1-UPG-SRV-RP-0007
TS1 Project WP1.8 – Water Services



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1. Introduction

The ISIS Neutron and Muon source is a world leading centre for civil research in the fields of engineering, physics and material science. The source has been operational since 1984 and was expected to have an operational life of 20 years, however its continuing success and importance to the international neutron scattering community has secured further investment in the operation of the facility.

The TS1 Project is a programme of works aimed at extending the operational life of ISIS's first target station. As part of the project, the cooling water plant that supplies the target, reflector and moderator (TRAM) assembly is being replaced.

This cooling water plant is comprised of 4 separate, closed loop recirculating circuits:

- Target Circuit
- Reflector Circuit
- Moderators Circuit
- Secondary Circuit

Each cooling water circuit is comprised of one or more sealless centrifugal pumps, heat exchangers, a filter, an ion exchange column, a header tank, and associated valves and process instrumentation. This plant equipment is mounted on a movable trolley, located within the Target Services Area (TSA).

In addition to the above, three under-ground drain tanks and their associated pumps, valves and instrumentation are being refurbished.

This document details the technical requirements of the filters that will be used to guard the pumps and equipment described above from particulate matter and debris. It is comprised of the following sections:

Section 1 – Scope of Supply lists the materials and quantities to be supplied.

Section 2 – Process Design describes the design process conditions of the fluids that will be handled and the flowrates, temperatures and pressures that the cartridge filters will be subjected to.

Section 3 – Mechanical Design details the mechanical requirements. Please take note of the atypical flange facing requirements and restrictions on the materials of construction that may be used.

Section 4 – Testing & Inspection details our testing and inspection requirements.

Section 5 – Packing & Carriage describes the packing and delivery requirements.

Unless otherwise stated, all technical requirements stated hereafter are mandatory and must be complied with.

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2. Nomenclature and Definitions

Symbol	Description	Units (typical)
d	Inside diameter of pipe	mm
m	Mass flowrate	kg s^{-1}
P	Pressure	kPa
ΔP	Pressure drop	kPa
Q	Volumetric flowrate	m^3 s^{-1}
T	Temperature	°C
v	Fluid flow velocity	m s^{-1}
σ	Conductivity	µs m^{-1}
ρ	Density	kg m^{-3}
µ	Dynamic viscosity	Pa s

Abbreviation	Definition
ABS	acrylonitrile butadiene styrene plastic
DO	Dissolved oxygen
EPDM	ethylene propylene diene monomer rubber
NB	Nominal bore
OEM	Original equipment manufacturer
SS316	EN 1.4435 / BS 316S13 austentic stainless steel
FAT	Factory Acceptance Test

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3. Scope of Supply

Materials

- 4 off filter housings, designed to suit the capacities, flowrates and temperatures stated in section 4 and the mechanical specification stated in section 5.
- 6 off sets (1 set commissioning, 1 set duty, 1 set spare) of filter cartridges, to suit the above. Reference to: F101 and F401.
- 6 off sets (1 set commissioning, 1 set duty, 1 set spare) of filter cartridges, to suit the above. Reference to: F201 and F301.
- 4 sets of 2 year operating spare parts/service kits, if applicable.
- All special OEM tools required for maintenance, if applicable.
- Packaging of the above in wooden crates suitable for indoor warehouse storage.

Services

- Delivery duty paid (DDP) Oxfordshire (Incoterms 2010) of the above materials to our site in Oxfordshire, UK, to the requirements and date (15 January 2019) stated in section 7
- 12 months warranty.

Documentation

On Tender, for each item:

- Datasheet.
- Dimensioned General arrangement drawing in pdf or DWG format, or a 3D Model in STEP format.

On Delivery:

- Operating & Maintenance Manual.
- PED Certificate of Conformity, PD5500 Form X and supporting mechanical design calculations.
- Hydrostatic test certificate/report in line with the requirements stated in section 6.

4. Process Design

4.1. Application

Filters F101, F201, F301 and F401 will be installed on the target, reflector, moderators and secondary circuits respectively. They will be used to maintain coolant cleanliness by trapping any particulate matter such as oxidation products, ion exchange resin or debris that may appear in the coolant during operation of the target station.

The circuits (and hence filters) continuously operate at an approximately constant flowrate 24 hours, 7 days a week for approximately 90% of the year. 100% of the circuit bulk flowrate shall pass through each circuit's filter.

For F101, F201 and F301, the cooling media that these items are filtering becomes active during operation of the target. Back-flushing of the filters is not feasible as it would generate undesirable active liquid waste, and duplex or side-stream filtration offers little advantage in maintainability. Once a filter is blocked, the filter cartridges will be removed and disposed of as active waste.

4.2. Pressure and temperature limits

The filter housing and cartridges must be suitable for operation at the following temperature and pressures:

Operating temperature:	30°C
Operating Pressure:	7 bar g
Maximum Design Temperature:	60°C
Maximum Design Pressure:	14 bar g

All filter housings must be designed, manufactured and hydrostatically tested to the requirements of PD5500 and the Pressure Equipment (Safety) Regulations 2015. A copy of form X to PD5500 and a Certificate of conformity to the PED must accompany the filters on delivery.

4.3. Radiation

These filters will be installed in an active area and as such, there are some restrictions on the materials of construction that can be used. Materials that are particularly susceptible to radiation induced embrittlement damage include:

- Certain polymers, such as polypropylene, polystyrene, Teflon and cellulose.
- Synthetic elastomers such as SBR and NBR
- High viscosity synthetic lubricants

The use of these materials shall be avoided. Suppliers must notify STFC should the equipment that they are proposing to supply uses an exotic or unusual material of construction.

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4.4. Process Parameters

Filter Tag No.	Nominal Flowrate	Nominal Filter Capacity	Process Material	Req. Filter Surface Area	Fluid Density	Fluid Abs. Viscosity	Fluid Nominal Temp. Range	Design Pressure	Fluid Solids Content	pH
	L min^{-1}	**L**	**-**	**m^2**	**g ml^{-1}**	**x10^{-3} Pa s**	**°C**	**Bar g**	**ppm**	**-**
F101	490	59	Deuterium Oxide	1.5	1.107	1.2503	30 – 35	14.0	<1,000	~7.0
F201	42	9	Demineralised Water	0.25	1.000	1.0050	30 – 35	14.0	<1,000	~7.0
F301	42	9	Demineralised Water	0.25	1.000	1.0050	30 - 35	14.0	<1,000	~7.0
F401	900	59	Demineralised Water	1.5	1.000	1.0050	30 – 40	14.0	<1,000	~7.0

5. Mechanical Design

5.1. Major External Dimensions

Due to the potential for active particulates to become entrained, the filters on the primary circuits (F101, F201 and F301) will be encased in a removable mild steel and lead biological shield (supplied by others). This is to protect operators from receiving excessive doses while undertaking routine maintenance in the target services area. This is comprised of three pieces – a lid, a body and a base (see figure, right).

To ensure that the new filter can fit within the existing shielding design, maximum dimensions have been specified based on a preliminary mechanical design. Your proposed design must not exceed these dimensions.

Please see the attached SI-5711-015 and SI-5711-016 drawings for major dimensions and nozzle orientations.

Figure 1 - Existing TS1 Filter Shielding

5.2. Materials of Construction

The low conductivity, high purity D^2O and demineralised water is highly corrosive. All wetted parts shall be in stainless steel grade EN 1.4401/1.4404 (316/316L) or equivalent.

The filters shall be subject to a radiation environment for prolonged periods of time, during which the embrittlement and hardening of elastomers and thermoplastics may occur (radiation damage). Suitably radiation resistant elastomers such as EPDM and thermoplastics such as PEEK shall be used where materials cannot be substituted for metals.

5.3. Surface Finish & Coatings

All external stainless steel surfaces shall be left uncoated with a bright cold rolled mill finish to ASTM A840 2B or equivalent.

5.4. Pipework & Flanges

All pipework shall be in be in schedule 10S. All flanges shall be ASME/ANSI B16.5 Class 150 with **raised faces machined to a surface finish of <0.8 microns**. This is an important requirement, as the metallic crush-type gaskets that are used throughout the target services area will not work with rougher surface finishes.

The following inlet, outlet and vent connection flange sizes are required:

Filter	Inlet Flange Size NPS, ins	Outlet Flange Size NPS, ins	Vent Flange Size NPS, ins
F101	2	2	¾
F201	1	1	¾
F301	1	1	¾
F401	2	2	¾

5.5. Fasteners

All fasteners shall be metric standard, coarse-threaded in bright zinc-plated (BZP) mild steel. Flat washers shall be used. Minimum nut thicknesses shall be equal to or greater than one times the nominal bolt diameter, and nuts shall have full engagement (minimum 1-2 exposed threads) on their bolts or studs.

Flange fasteners shall be tightened in a staggered criss-cross pattern to preserve gasket position and alignment. Fasteners are to be tightened to the torque specified by the gasket OEM.

5.6. Gaskets

Proprietary metal gasket shall be used for all flanges, including the lid flange. This item will be supplied by others.

5.7. Cartridges

Each filter shall be a continuous full-flow inline cartridge type filter. The cartridges must screw into the housing. O-ring or compression sealing cartridges are not permitted. Filter performance shall be 98% at 100 μm, at the process parameters specified in section 4.4.

5.8. Lifting

The filter lid shall include one or more suitably rated lifting lugs or bars, to facilitate overhead installation and removal of the lid.

5.9. Nameplates

Each filter shall have mounted on its lid or body a permanently etched thin stainless steel nameplate, complete with the following information as a minimum:

- Tag Number
- Design Code
- Design Pressure (Bar) and Temperature (°C)
- Test Pressure (bar)
- Dry Weight (kg)

Plastic or adhesive label type nameplates are not permitted.

6. Testing & Inspection

An inspecting engineer from The Science and Technology Facilities Council (or an appointed representative) shall be invited to inspect the equipment against this specification and attached drawings, and witness a factory acceptance test (FAT) prior to shipping.

As part of the FAT all ion exchange columns are to be hydrostatically tested to 1.6 times design pressure, with no pressure loss over a 30 minute period (commencing after isolation from supply) being a condition of acceptance. Should this test fail, the supplier is to remedy all faults and re-test to the satisfaction of the inspecting engineer.

A test report/certificate produced by the supplier is to accompany the ion exchange columns on delivery.

7. Packing and Carriage

Prior to transit the equipment shall be shall be fully drained and all nozzles sealed using pipe caps or wooden blanks attached with chloride-free tape. Equipment should be supplied palletized and crated, suitably prepared with adequate strapping and wrapping.

Any spare items or special tools shall be packed separately.

If shipping from overseas terms shall be Delivery Duty Paid (DDP) as per ICC INCOTERMS 2010.

Please include a price in your tender for packing and carriage to the following address:

R40 Stores
Science & Technology Facilities Council
Rutherford Appleton Laboratory
Harwell Science & Innovation Campus
Didcot
OX11 0QX
United Kingdom

Please provide estimated dimensions, estimated weights and number of packages with your quote.

Delivery is required before 15th January 2019.