Researcher

PFPNet E-Tech Ltd.

Participants

AIS, Akzonobel, Armacell, Carboline, Chevron, Equinor,
Hempel, JGC, Jotun, Kawasaki Heavy Industries, PPG, Roxtec, Shell, Morgan Thermal Ceramics, Vipo

"Engulfing Gaseous H2 Jet Fires, Experimental Programme Delivery"

TENDER DOCUMENT

TENDER DOCUMENT
Experimental Programme Delivery
Tender Reference: PFPNet2026-008
Issue Date: September 7th 2026
Closing Date: October 14th 2026
Contract Value: Fixed Budget of £65,000 (excluding VAT)
Contract Duration: 6 months

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1. Introduction

PFPNet invites proposals from suitably qualified organisations to deliver an experimental programme characterising a range of H2 releases in support of development of a future standard test method to determine the resistance of Passive Fire Protection Materials and System to engulfing gaseous H_2 jet fires.
This procurement is intended to support research, experimentation, prototyping and demonstration activities. As the programme is experimental in nature, innovative methodologies are encouraged.
The available funding is fixed. Bidders should therefore propose the optimum programme that can be delivered within the available budget rather than pricing individual requirements.

The final subcontract agreement shall reflect the principles set out in this Tender Document and the JIP (joint industry project) Terms of Participation. In the event that material deviations are proposed which may adversely affect the rights or protections granted to Participants under the JIP Terms of Participation, such deviations shall be presented to the Steering Committee for review and approval before execution of the subcontract agreement.

This tender document shall be read in conjuction with the terms of participation of the JIP and the definitions given therein shall apply.

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2. Background

Work undertaken by PFPNet in 2024 demonstrated that H_2 jet fires impinging on a target at a distance of 1m can impose heat loads and can have local dynamic pressures significantly greater than those in the natural gas jet fires that the ISO 22899-1 jet fire test was designed to represent. It concluded that the existing jet fire test standards do not adequately capture the conditions within gaseous H_2 jet fires.

Further work concluded that while PFP materials can offer a degree of resistance to H_2 jet fires, the rates of temperature rise are in the region of 1.5x to 2.5x higher, and different mechanisms of failure are possible.

This Joint Industry Project (JIP) has been commissioned by the participants to produce a future standard method of test suitable as a means of to determining the resistance of Passive Fire Protection Materials and System to engulfing gaseous H_2 jet fires. The intent is to submit the

output of the project to ISO TC92 SC2 for consideration as a future part of the ISO 22899 jet fire test series.

Work undertaken so far includes a review the facilities and likely scenarios under which a hydrogen jet fire could be generated and numerous CFD studies of the conditions within gaseous H2 jet fires. Review of the simulation results has led to the design of a series of experiments intended to characterize specific release conditions and conditions experienced by engulfed targets. The tender document is divided into three packages (A, B, and C) reflecting different release conditions. Bidders may choose to bid for one, two, or all three of these packages.

The results of this experimental programme will be used to define an experimental setup that will be finalised and published as a PFPNet test procedure, prior to being submitted to ISO TC92 SC2 for consideration as an international standard. This experimental setup will be the basis of a future tender document that will undertake tests at realistic durations with actual PFP materials and systems. The tender for this later package will not be issued at a fixed price, instead competitive bids will be sought.

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3. Objectives

The successful subcontractor shall design and deliver an experimental programme that:

- complies with the release conditions identified
- undertakes the series of tests identified within this document
- generates robust evidence
- identifies operational limitations
- provides recommendations for future implementation

The programme should prioritise accuracy of measurement over time and the number of tests undertaken

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4. PFPNet contributions

The researcher (PFPNet E-tech) will provide the following to the successful bidder:

- instrumentation and test specimens as described in Annex A for engulfment in the H2 jet fires
- access to the following supporting documentation as described in Annex B
- support and advice on interpretation of the requirements in the event of ambiguity

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5. Scope of Work

The subcontractor will be expected to undertake activities including, but not limited to:

Programme Design

- develop experimental methodology
- produce experimental plan

Phase 2 – Experimental Delivery

- procure required materials
- conduct trials and demonstrate the ability to realise the required programme
- undertake experiments as described in annex C
- manage risks

Phase 3 – Analysis

- process raw data into excel

Phase 4 – Reporting

Deliver:

- Detailed report of the experimental setup
- Processed experimental dataset
- Videos and images

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6. Budget

The total available contract value is:
£65,000 (Fixed Budget)
This represents the maximum available funding.
Bidders shall submit proposals that maximise data collection and research programme value within this budget.
No additional funding will be available.
PFPNet E-tech reserves the right to award a contract for less than the maximum available budget should a proposal demonstrate better value for money.

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7. Deliverables

Minimum deliverables, with target due dates, include:

Deliverable	Due
Project Plan	Week 4
Experimental Methodology	Week 6
Commencement of experimental work	Month 3
Completion of experimental work	Month 4

Deliverable	Due
Processed experimental data	Month 4
Final Report	Month 6

8. Timetable

Activity	Date
Tender Published	September 7th
Questions Deadline	September 30th
Tender Closing	October 14th
Evaluation	October 14th-16th
Contract Award	October 19th
Delivery of instrumentation and specimens	November 30th
Target Programme Start	November 30th

9. Tender Response Requirements

Tenderers shall provide:

9.1 Technical Proposal

Including:

- understanding of objectives
- proposed methodology
- project plan – clearly identifying the experiments in annex C that will be achieved
- innovation – identifying further experiments which can be included within the project budget, if any
- risk management
- quality assurance

Maximum:
30 pages

9.2 Project Team

Include:

- organisational structure
- key personnel
- relevant experience
- subcontractors (if any)

9.3 Programme Schedule

Provide:

- Experimental programme start date
- Gantt chart
- milestones
- dependencies
- critical path

9.4 Budget Allocation

Although the maximum contract value is fixed, bidders shall state the cost of their bid clearly and show how funding will be allocated across package A and B including a clear indication of the cost if one work package alone is commissioned by PFPNet.

Example:

Work Package A (only) Budget

Design

Equipment

Trials

Analysis

Reporting

Work Package B (only) Budget

Design

Equipment

Trials

Analysis

Reporting

Work Package C (only) Budget

Design

Equipment

Trials

Analysis

Reporting

All Work Packages Together Budget

9.5 Risk Register

Include:

- technical risks
- programme risks
- commercial risks
- mitigation measures

9.6 Commitment to obligations imposed on the subcontractor within the JIP Terms of Participation

Include statements that the subcontractor:

- has the necessary right and authority to enter into Subcontract Research Agreement;
- shall ensure that all work related to its Subcontract Researcher Responsibilities shall only be undertaken by employees of said Subcontract Researcher and/or persons whose contracts with said Subcontract Researcher provide for the assignment to said Subcontract Researcher of all Intellectual Property Rights created by them during the course of their duties under such contracts;
- is the sole beneficial owner of all of its Background intellectual property, as defined within the JIP terms of participation;
- has the expertise and resources to conduct its Subcontract Researcher Responsibilities in accordance with the Project Proposal and with the terms of this Agreement;
- commits that all reports and results of its Subcontract Researcher Responsibilities will be accurate and complete in all material respects and will properly represent the work carried out by the Subcontract Researcher and the results thereof;
- it has taken and will take all reasonable steps to protect and secure its proprietary information, Background and Foreground intellectual property, as defined within the JIP terms of participation, for the benefit of the Project and this Agreement;
- will make no representation or do any act which may be taken to indicate that it has any rights in any Background, other than its own Background, and other than when subject to a license granted by the Subcontract researcher to use the Subcontract Researcher's background, if applicable, nothing in this Agreement shall give it any right or interest in or title to any Background, other than its own Background;
- shall meet confidentiality obligations requiring Subcontract Researcher to treat Confidential Information as confidential and in the same manner and to an equivalent extent with regard to confidentiality, disclosure and use;

- will permit each Participant within the JIP access, at all reasonable times and at said Participant's expense, to witness the Project in progress at any such premises where the Project is being conducted;
- shall meet the obligations and indemnities equivalent to the provisions in clauses 8.1 – 8.5 of the JIP terms of participation inclusive for the benefit of the Researcher and each Participant, except that the indemnities granted by the Subcontract Researcher, shall be limited to a maximum aggregate total not to exceed the value of the contract under which the work is to be performed by the Subcontract Researcher.

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10. Evaluation Criteria

Criterion	**Weighting**
Technical Quality (number of characterisation tests that can be undertaken)	40%
Delivery Timeframe	40%
Laboratory and team track record of delivering quality research programmes	20%

The contract will be awarded to the Most Advantageous Tender. Preference will be given to a subcontractor that can undertake multiple packages, however in the event that timeframes do not permit this packages may be awarded separately.

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11. Programme Principles

The subcontractor should:

- encourage innovation
- adapt experiments where justified
- document failures as well as successes
- maximise learning
- maintain transparency

Because the programme is experimental, changes to the experimental design may be approved during delivery where these improve evidence quality.

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12. Intellectual Property

The Subcontractor shall retain ownership of its Background Intellectual Property.

All Foreground shall be the property whichever Researcher or Subcontract Researcher was primarily responsible for its creation from the date of its creation. The Subcontract Researcher shall clearly delineate responsibility and ownership with regard to Foreground, and that in the event of any dispute between Researcher and Subcontract Researcher, the Participants' rights under this Agreement shall not be affected.

The Subcontract Researcher shall grants to each Participant individually and its Affiliates and its CoVenturers an irrevocable, worldwide non-exclusive, royalty free licence to use the Foreground (and any Background of the Researcher incorporated into the Foreground), excluding that which is stated in Schedule 5 of the JIP Terms of Participation as remaining confidential, from the date of its creation. This licence shall not be affected by termination of this Agreement or by a Participant's withdrawal from this Agreement, save that such Participant shall have no right to a licence hereunder in respect of any Foreground created after the date of such Participant's withdrawal.

Following notification by PFPNet of the conclusion of the joint industry project the Subcontractor shall be free to publish research based on the foreground intellectual property created, subject to review by the researcher (in a timely manner) and confirmation that the publication does not include any restricted data or information as stated in Schedule 5 of the JIP Terms of Participation.

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13. Reporting Requirements

Monthly progress reports shall include:

- activities completed
- expenditure to date
- technical progress
- risks
- deviations
- next month's activities

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14. Acceptance Criteria

The programme will be accepted when:

- agreed experiments have been completed
- required evidence has been collected
- reports have been accepted
- financial reconciliation has been completed

Success of individual experiments is not itself an acceptance criterion.

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15. Payment Schedule

Example:

Milestone	**Payment**
Contract Award	10%

Milestone	Payment
Experimental Plan Approved	40%
Commencement of experimental programme	30%
Final report acceptance	20%

16. Submission Instructions

Tender responses shall include:

- Technical proposal
- Project Schedule / Plan
- Total Budget and Budget Allocation
- Risk Register
- Project Team and CVs
- Relevant Experience delivering research project on time and in budget
- A statement of commitment to the requirements laid down by the JIP terms of participation, or a statement clearly indicating which terms cannot be complied with and giving an explanation as to why

Submissions must be sent to ian.bradley@pfpnet.com and received by:
October 14th 2026
Late submissions may not be considered.

17. Programme Access

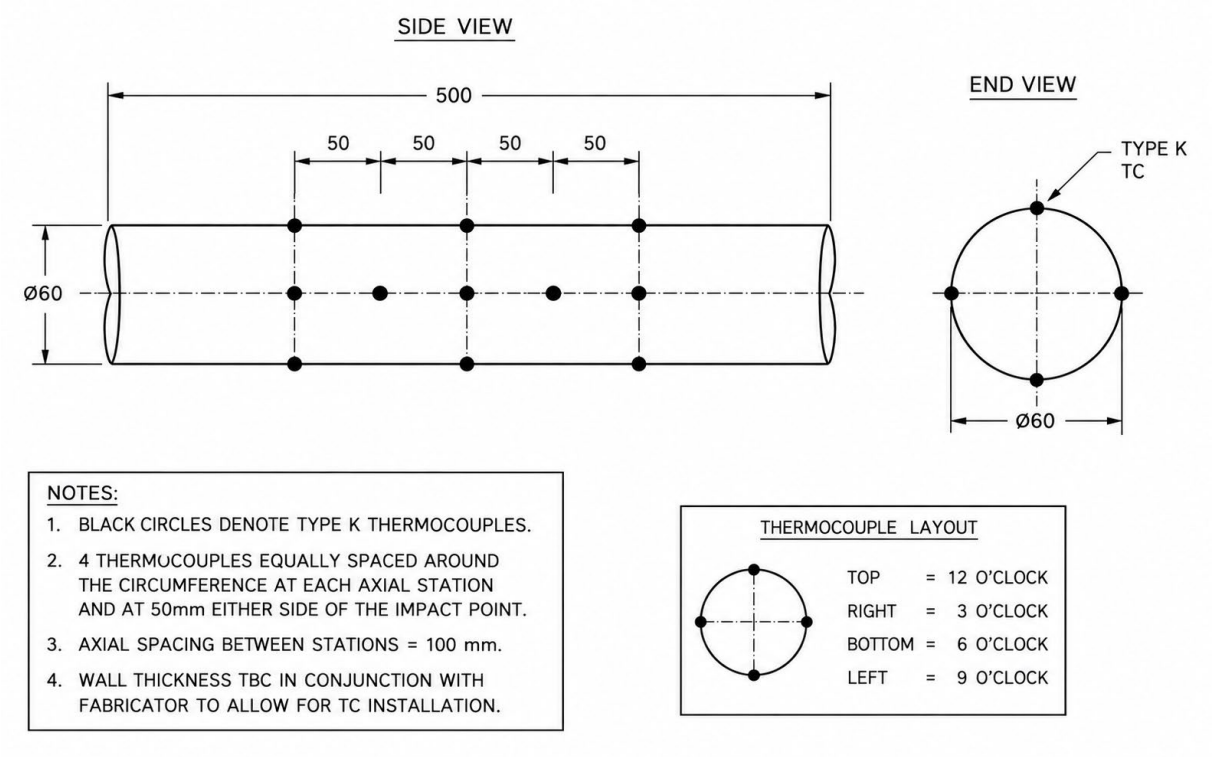
The contractor shall:

- Permit access to 2 representatives of PFPNet throughout the experimental programme and commissioning phase
- will permit each JIP Participant access, at all reasonable times and at said Participant's expense, to witness the Project in progress at any such premises where the Project is being conducted, subject to reasonable restrictions on the number of participants present at any one time.

Annex A – Instrumentation and Test Specimens

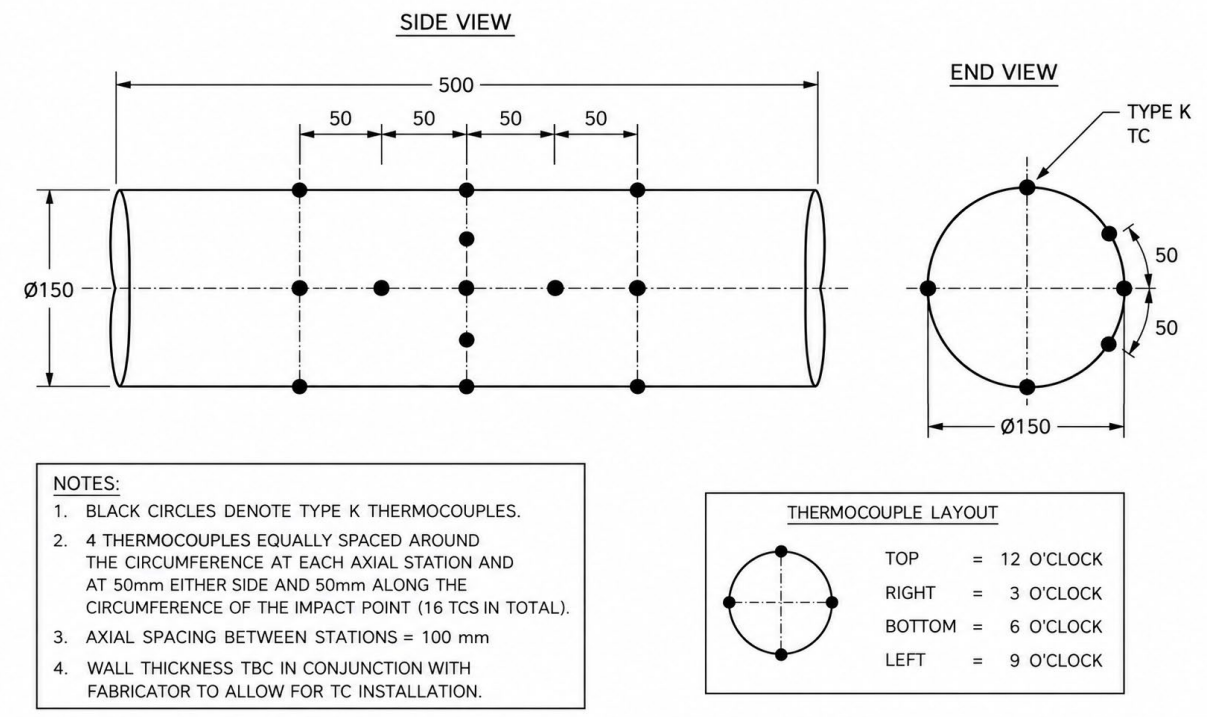
Specimen 1- 60mm pipe. 14 TCs as shown

Pipe to be cut in half longitudinally and welded back together in order to fit thermocouples, minimum 3.2mm wall thickness, 5mm preferable.



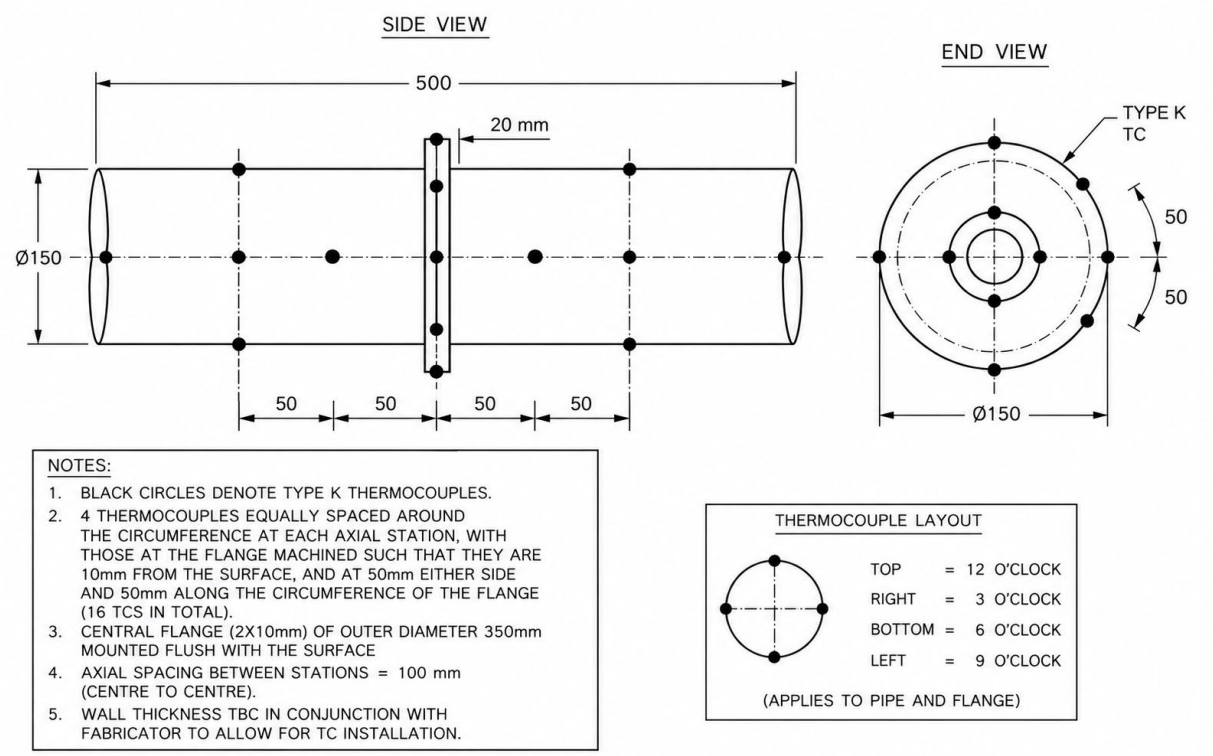
Specimen 2- 150mm pipe. 16 TCs as shown

Pipe to be cut in half longitudinally and welded back together in order to fit thermocouples, minimum 3.2mm wall thickness, 5mm preferable.



Specimen 3 – 150mm pipe with flange

The pipe shall have a flange with an outer diameter of 350mm, consisting of 2x10mm plates with TCs positioned in machined channels so that they are 10mm from the surface. The intent is to replicate the central web arrangement of ISO 22899-1 to see if the pipe flange provides a suitable alternative for characterising performance on structural steel.



NOTES:

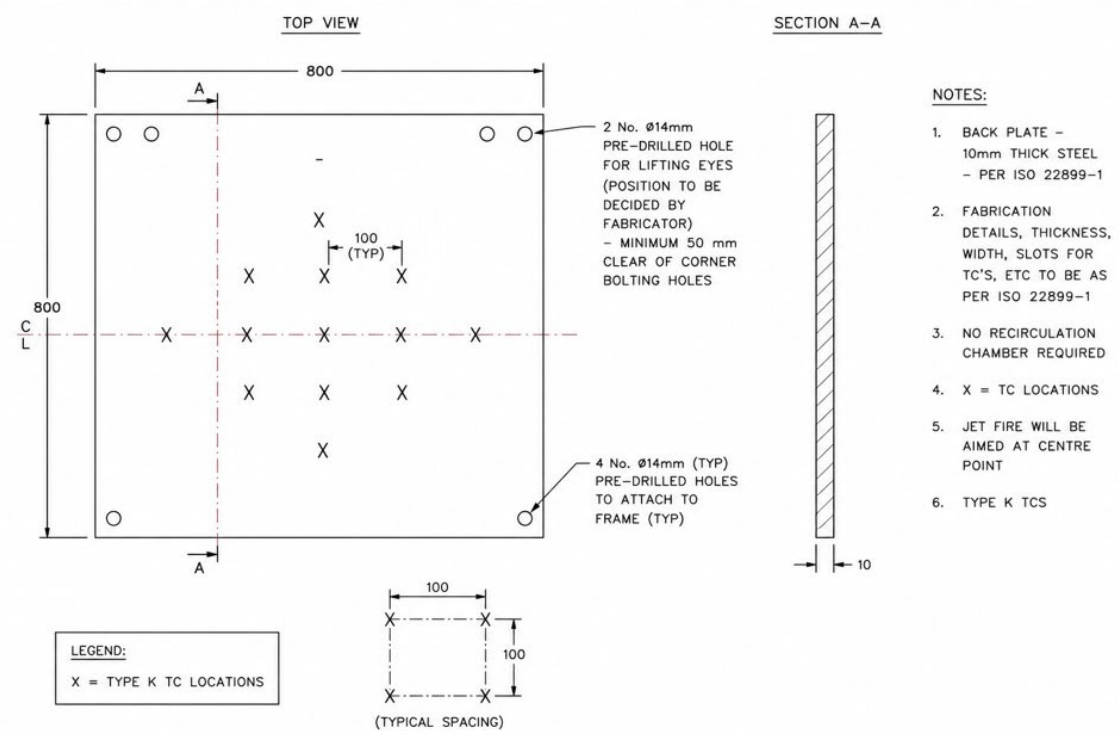
1. BLACK CIRCLES DENOTE TYPE K THERMOCOUPLES.
2. 4 THERMOCOUPLES EQUALLY SPACED AROUND THE CIRCUMFERENCE AT EACH AXIAL STATION, WITH THOSE AT THE FLANGE MACHINED SUCH THAT THEY ARE 10mm FROM THE SURFACE, AND AT 50mm EITHER SIDE AND 50mm ALONG THE CIRCUMFERENCE OF THE FLANGE (16 TCS IN TOTAL).
3. CENTRAL FLANGE (2X10mm) OF OUTER DIAMETER 350mm MOUNTED FLUSH WITH THE SURFACE
4. AXIAL SPACING BETWEEN STATIONS = 100 mm (CENTRE TO CENTRE).
5. WALL THICKNESS TBC IN CONJUNCTION WITH FABRICATOR TO ALLOW FOR TC INSTALLATION.

THERMOCOUPLE LAYOUT

TOP = 12 O'CLOCK
RIGHT = 3 O'CLOCK
BOTTOM = 6 O'CLOCK
LEFT = 9 O'CLOCK

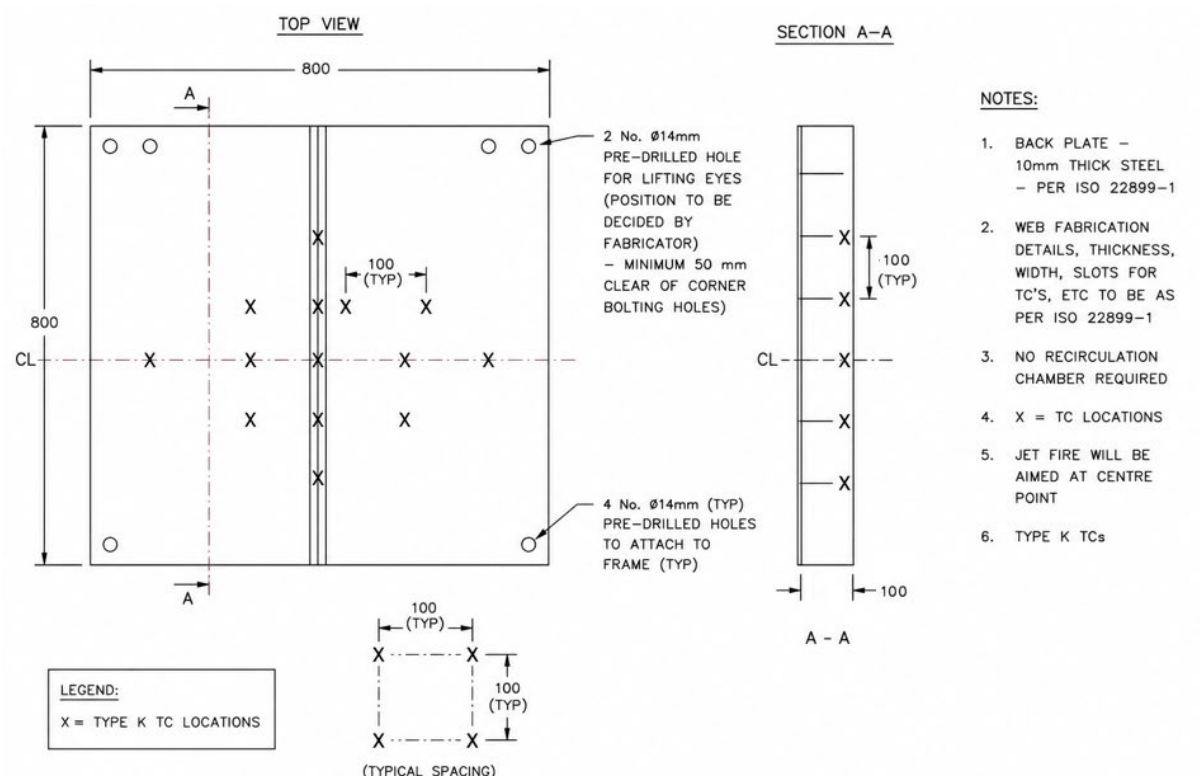
(APPLIES TO PIPE AND FLANGE)

Specimen 4 – plate



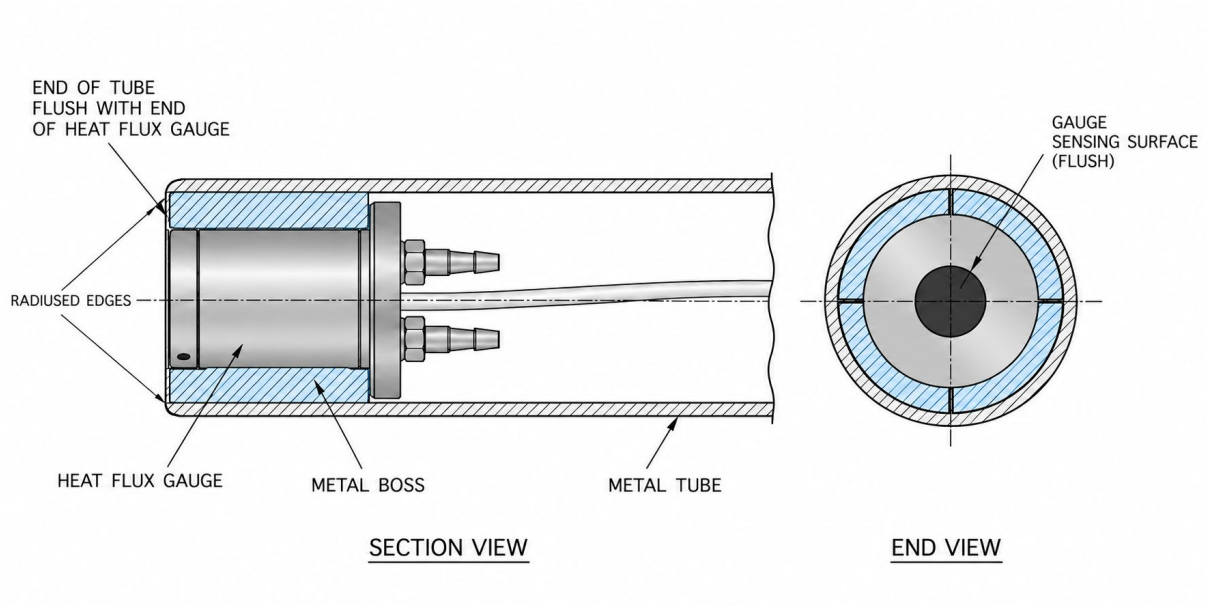
Specimen 5 – plate with structural web

The below is also adapted from the ISO 22899-1 structural box. The recirculation chamber is not necessary for flame characterisation but may be optionally used to protect the rear instrumentation. Having the option of comparing with and without the recirculation chamber would be beneficial, if the budget allows. The central web total depth will be 100 mm. The web TCs shall be installed 10 mm from the surface, as per ISO 22899-1.



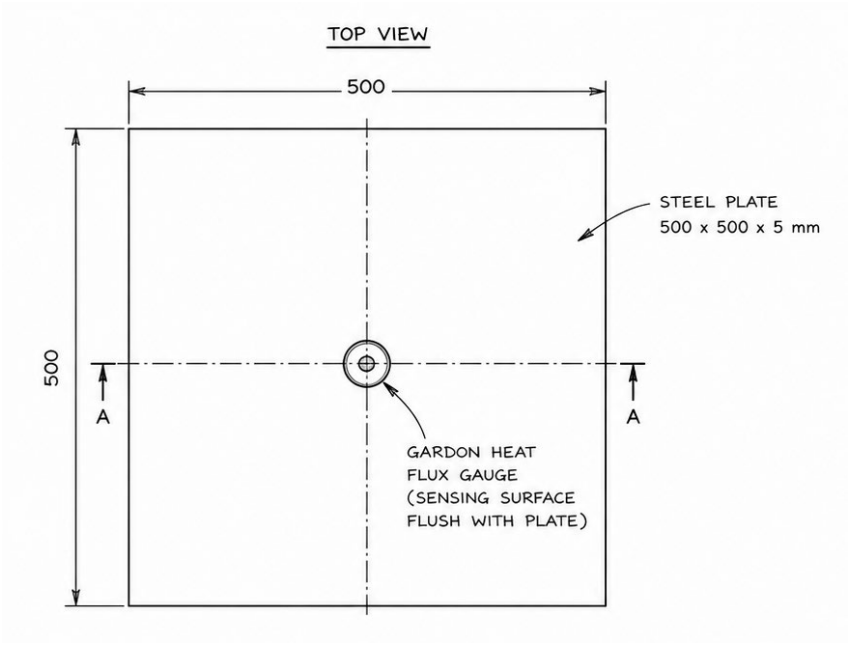
Specimen HF1 – total heat flux gauge within tube

Guage to be mounted in a tube 1000mm long via use of a steel mounting boss which can then be loaded into the tube with the sensor attached and is secured (preferably) by screws or by welding. The edges of the steel boss / tube to be radiused to improve flow.

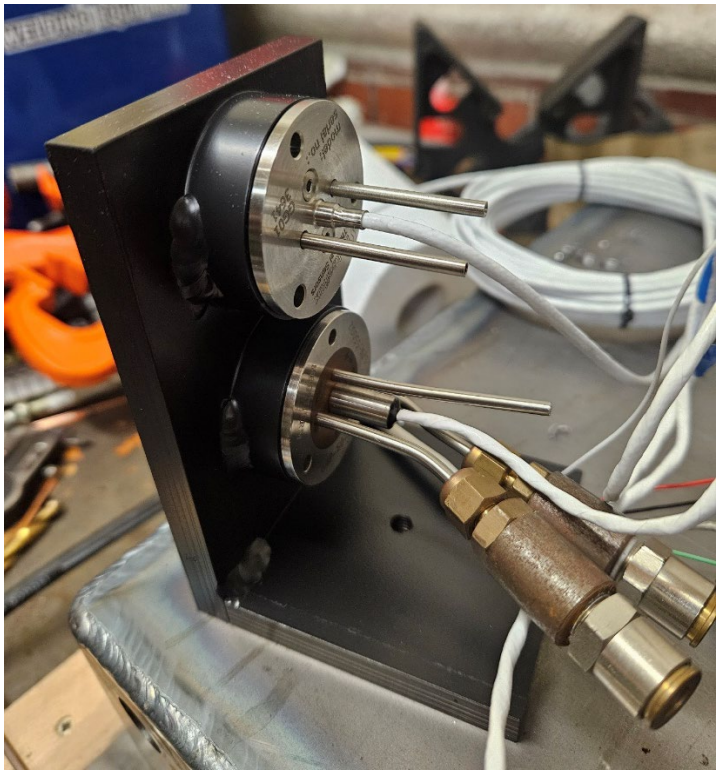


Specimen HF2 – total heat flux gauge within plate

Total heat flux gauge (Gardon or Schmidt-Boulter type) to be mounted in the centre of a 500 mm x 500 mm plate such that the front of the gauge is flush with the plate.



L shaped box section brackets to be attached so it can be bolted to concrete. Mounting to be by means of a steel boss 44mm dia and 20.4 long welded to the back of the plate to which the sensor is fastened using 4mm screws through the provided holes giving a flush mounting, as shown in the image below.

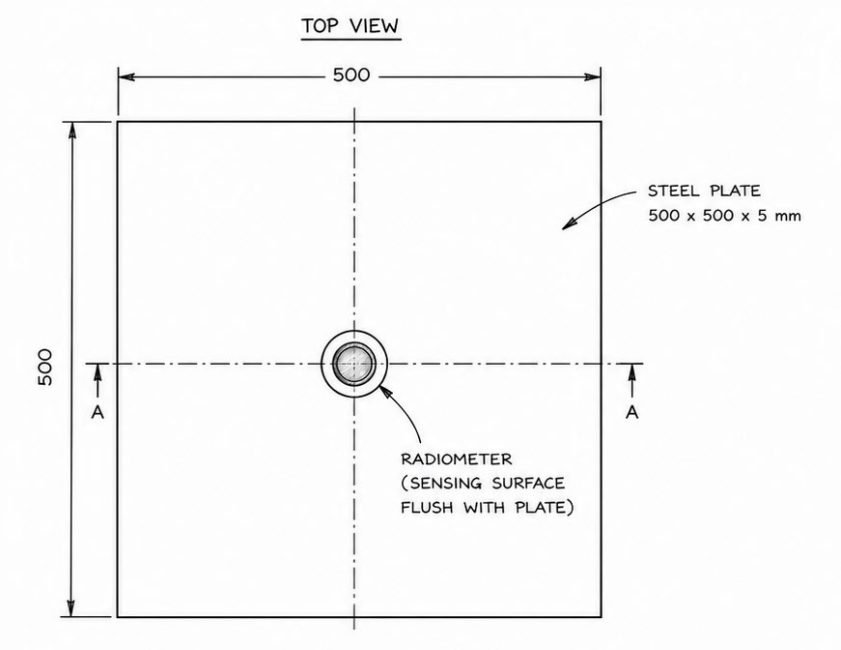


Specimen RHF1 – radiometer within tube

As per HF1 but with a radiometer instead of a total heat flux gauge.

Specimen RHF2 – radiometer within plate

As per specimen HF2 but with a radiometer instead of a total heat flux gauge.



Annex B – Supporting Documentation

Update to the review of H2 Hazard Scenarios	JIP document	PFPNet2025-007	1	Nov-25	JIP only
H2 JIP: CFD setup critical analysis report	JIP document	PFPNet2026-001	1	Jan-26	JIP only
H2 JIP: Comparison between the bam and rise tests	JIP document	PFPNet2026-002	1	Mar-26	JIP only
H2 JIP: Development and Assessment of a Revised Notional Nozzle Approach	JIP document	PFPNet2026-003	1	Mar-26	JIP only
H2 JIP: Revised Results with an Alternative Notional Nozzle	JIP document	PFPNet2026-004	1	Apr-26	JIP only
H2 JIP: Modelling of plates and comparison with tubes	JIP document	PFPNet2026-005	1	Apr-26	JIP only
H2 JIP: Modelling of plates and comparison with tubes - CFD Modelling of H2 JF Impingement – Preliminary Conclusions	JIP document	PFPNet2026-007	1	Jun-26	JIP only

Annex C – Requirements Common to Test Packages A & B

Requirements common to both test packages A & B (and preferable for package C, but it is recognised that this may be undertaken by an organisation in conjunction with another project and therefore not all of the below points may be achievable).

- The mass flow rate shall be controlled with an intent to ensure a constant mass flow rate over the test period
- A Coriolis meter shall be used to ensure mass flow rate data is available throughout the duration of the test
- The mass flow rate shall be reported for all tests
- The pressure and temperature immediately prior to the nozzle shall be reported for all tests throughout the duration of the test
- The test duration is from the opening of the valve, not the establishment of the target mass flow rate, however the mass flow rate shall be achieved within 2 seconds of the start of the test or the test duration shall be extended to be the target time minus 2 seconds plus the time taken to achieve the mass flow rate
- IR and normal high resolution videos shall be taken of all tests
- The predicted nozzle diameter for the target mass flow rates at the given pressures can be obtained from Annex E – the actual nozzle size shall be confirmed in the commissioning stage
- All measurements shall be reported at a frequency of no less than 10 Hertz
- Measurement of environmental conditions within the vicinity of the test (including wind direction and speed, ambient temperature and humidity).

Notes to the specimens tables:

Specimen references as per Annex A, but with the following instruments to be supplied by the subcontractor

Pr – Prandtl Pitot tube for dynamic pressure measurements

IR – IR camera for flame length analysis

Unless otherwise stated the specimen is positioned such that the centre is on the jet centre-line and perpendicular to the jet release direction

Annex D1 – Package A Test Programme

Release conditions:

0.005 kg/s

Pressure immediately before the nozzle: 30 bar

Test Ref	Jet ignited	Specimen	Duration (seconds)	Distance to specimen (m)
APr.1	N	Pr	5	0.15
APr.2	N	Pr	5	0.20
APr.3	N	Pr	5	0.25
APr.4	N	Pr	5	0.30
APR.5	N	Pr	5	0.35
AHF1.1	Y	HF1	10	0.15
AHF1.2	Y	HF1	10	0.20
AHF1.3	Y	HF1	10	0.25
AHF1.4	Y	HF1*	10	0.30
AHF1.5	Y	HF1	10	0.35
AHF1.6	Y	HF1 – 90° rotation so sensing surface is parallel with the flow	10	0.25
AHF2.1	Y	HF2	10	0.15
AHF2.2	Y	HF2	10	0.20
AHF2.3	Y	HF2	10	0.25
AHF2.4	Y	HF2*	10	0.30
AHF2.5	Y	HF2	10	0.35
ARHF1.1	Y	RHF1	10	0.20
ARHF1.2	Y	RHF1	10	0.25
ARHF1.3	Y	RHF1*	10	0.30
ARHF2.1	Y	RHF2	10	0.20

ARHF2.2	Y	RHF2	10	0.25
ARHF2.3	Y	RHF2*	10	0.30
A1.1	Y	1	30	0.20
A1.2	Y	1	30	0.25
A1.3	Y	1	30	0.30
A2.1	Y	2	30	0.20
A2.2	Y	2	30	0.25
A2.3	Y	2	30	0.30
A3.1	Y	3	30	0.25
A3.1	Y	3	30	0.30
A4.1	Y	4	30	0.20
A4.2	Y	4	30	0.25
A4.3	Y	4	30	0.30
A5.1	Y	5	30	0.20
A5.2	Y	5	30	0.25
A5.3	Y	5	30	0.30
AU.1	Y	IR	10	N/A
TOTAL # OF TESTS	37	TOTAL DURATION	665 s	

- Denotes repeat test for reproducibility checks

Annex D2 – Package B Test Programme

Release conditions:

0.012 kg/s

Pressure immediately before the nozzle: 30 bar

Test Ref	**Jet ignited**	**Specimen**	**Duration (seconds)**	**Distance to specimen (m)**
APr.1	N	Pr	5	0.15
APr.2	N	Pr	5	0.20
APr.3	N	Pr	5	0.25
APr.4	N	Pr	5	0.30
APR.5	N	Pr	5	0.35
AHF1.1	Y	HF1	10	0.15
AHF1.2	Y	HF1	10	0.20
AHF1.3	Y	HF1	10	0.25
AHF1.4	Y	HF1	10	0.30
AHF1.5	Y	HF1	10	0.35
AHF1.6	Y	HF1 – 90° rotation so sensing surface is parallel with the flow	10	0.25
AHF2.1	Y	HF2	10	0.15
AHF2.2	Y	HF2	10	0.20
AHF2.3	Y	HF2	10	0.25
AHF2.4	Y	HF2	10	0.30
AHF2.5	Y	HF2	10	0.35
ARHF1.1	Y	RHF1	10	0.20
ARHF1.2	Y	RHF1	10	0.25
ARHF1.3	Y	RHF1	10	0.30

ARHF2.1	Y	RHF2	10	0.20
ARHF2.2	Y	RHF2	10	0.25
ARHF2.3	Y	RHF2	10	0.30
A1.1	Y	1	30	0.20
A1.2	Y	1	30	0.25
A1.3	Y	1	30	0.30
A2.1	Y	2	30	0.20
A2.2	Y	2	30	0.25
A2.3	Y	2	30	0.30
A3.1	Y	3	30	0.25
A3.2	Y	3	30	0.30
A4.1	Y	4	30	0.20
A4.2	Y	4	30	0.25
A4.3	Y	4	30	0.30
A5.1	Y	5	30	0.20
A5.2	Y	5	30	0.25
A5.3	Y	5	30	0.30
AU.1	Y	IR	10	N/A
TOTAL # OF TESTS	37	TOTAL DURATION	625 s	

- Indicates test to be repeated to confirm reproducibility.

Annex D3 – Package C Test Programme

Target release conditions as below

Test C1: 0.1 kg/s

Test C2: 0.5 kg/s

Test C3: 2 kg/s

NOTE: response to tender to indicate flow rates that can be realistically achieved given the limitations in piping diameters and Coriolis meter capacity

Test Ref	Jet ignited	Specimen	Duration (seconds)	Distance to specimen (m)
C1Pr.1	N	Pr	5	Tbc (X/lf =0.15)
C1Pr.2	N	Pr	5	Tbc (X/lf =0.20)
C1HF1.1	Y	HF1	10	Tbc (X/lf =0.15)
C1HF1.2	Y	HF1	10	Tbc (X/lf =0.20)
C2Pr.1	N	Pr	5	Tbc (X/lf =0.15)
C2Pr.2	N	Pr	5	Tbc (X/lf =0.20)
C2HF1.1	Y	HF1	10	Tbc (X/lf =0.15)
C2HF1.2	Y	HF1	10	Tbc (X/lf =0.20)
C3Pr.1	N	Pr	5	Tbc (X/lf =0.15)
C3HF1.1	Y	HF1	10	Tbc (X/lf =0.15)

Annex E – Expected nozzle diameters