



GS 126-5

Guidance for Specification 126-5

**DESIGN OF PLATE-AND-FRAME
HEAT EXCHANGERS FOR
OFFSHORE USE**

July 1993

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING											
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Document Title DESIGN OF PLATE-AND-FRAME HEAT EXCHANGERS FOR OFFSHORE USE											
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SCOPE AND PURPOSE This document specifies the general requirements for the Mechanical Thermal design and Testing of Plate and Frame Heat Exchangers for use offshore. Its purpose is for the specification of fit-for-purpose Heat Exchangers at minimum cost.											
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

This Guidance for Specification was developed under the BP Exploration XEU Simple Specifications Initiative. This initiative is intended to simplify the purchasing requirements through a minimum conditions of satisfaction approach in regions where there is a mature supplier resource.

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification, and may discuss alternative options. It also gives guidance on the implementation of any 'Specification' or 'Approval' actions; specific actions are indicated by an asterisk (*) preceding a paragraph number.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Specification Ready for Application

A Specification (BP Spec 126-5) is available which may be suitable for enquiry or purchasing without modification. It is derived from this BP Group Guidance for Specification by retaining the technical body unaltered but omitting all commentary, omitting the data page and inserting a modified Foreword.



Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP International or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION

1.1 Scope

1.1.1 This document specifies BP general requirements for design of plate-and-frame heat exchangers for use offshore.

It is intended for use in conjunction with a functional specification and associated data sheets and drawings which give specific project requirements.

The design life of the equipment shall be 20 years. The required corrosion allowances shall be as stated on the exchanger data sheets.

Thermal Design is the act of providing of a completed Exchanger Specification Datasheet and (optionally) an Exchanger Setting Plan.

An Exchanger Setting Plan is a simple diagram outlining approximate overall dimensions of the unit including headers, nozzles etc.

Detailed Exchanger Drawings covering exact overall dimensions and other details e.g. flange thicknesses, shell thicknesses etc. are considered to be 'Mechanical Design'.

1.1.2 These requirements are applicable to process heat exchangers, and do not include ancillary units used to cool non-process streams.

Occasionally a plate-and-frame exchanger is supplied as part of an overall process package e.g. compressors with intercoolers. This specification is deemed to apply unless the vendor can demonstrate that any proposed departure is proven and accords with their normal practice.

1.2 Quality Assurance

Verification of the vendor's quality system is normally part of the pre-qualification procedure, and is therefore not specified in the core text of this specification. If this is not the case, clauses should be inserted to require the vendor to operate and be prepared to demonstrate the quality system to the purchaser. The quality system should ensure that the technical and QA requirements specified in the enquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free issue materials.

Further suggestions may be found in the BP Group RPSEs Introductory Volume



2. GENERAL REQUIREMENTS

2.1 Data Sheets

- * 2.1.1 Process and Physical Property data sheets (Appendix C) shall be completed by the Purchaser. As a minimum, items 1, 2, 3, 6, 7, 8, 9, 12 and 13 in the Process Data Section must be completed. Maximum weights shall also be stated.

Sufficient data must be filled in the property data sections to enable an accurate design to be obtained. This will generally include as a minimum inlet and outlet properties. In addition, properties should be specified at dew and/or bubble points if these are between the inlet and outlet conditions. Additional intermediate points may be necessary for very non linear cooling/heating curves.

- * 2.1.2 The Exchanger Specification Datasheet (Appendix D) shall be completed by the Purchaser and/or Vendor as appropriate.

As a rule, it is expected that the Exchanger Specification Datasheet will initially be partly completed by the Purchaser e.g. specifying materials of construction, fouling factors etc., and then fully completed by the Thermal Designer.

- 2.1.3 Upon request by the Purchaser, the Thermal Designer shall supply an Exchanger Setting Plan.

- 2.1.4 The Purchaser may use his own standard data sheets, providing they give all the information required in Appendices C and D.

- 2.1.5 Plate heat exchangers shall be designed and constructed to [ASME VIII](#) Division 1 unless agreed otherwise with the Purchaser.

2.2 Vendor Responsibilities

- 2.2.3 The Vendor shall be responsible for ensuring the following, as a minimum:-

- Satisfactory thermal design and mechanical design and operational performance for the heat exchangers.
- Maintenance of performance guarantees and warranties.
- Providing all necessary interface documentation, including overall general arrangement drawings,



dimensional outline drawings and foundation loading drawings.

- Ensuring that the heat exchangers will operate satisfactorily at all specified operational extremes.
- Ensuring that the heat exchangers are suitable to withstand the specified external nozzle loadings.
- Providing complete installation, maintenance and operating instructions for the heat exchangers.

2.3 Thermal Guarantee

2.3.1 A thermal guarantee shall always be supplied. In most cases the Thermal Designer shall supply this, but in exceptional circumstances it may be another party subject to approval by the Purchaser.

2.3.2 The Vendor may be requested to provide a thermal guarantee, when the thermal design has been done by the Purchaser, in which case he shall check the proposed design.

2.4 Mechanical Guarantee

2.4.1 The Vendor shall provide a Mechanical Guarantee against the mechanical conditions given on the datasheet.

2.5 Design Methods/Software

2.5.1 Vendor's own software may be used, but in the event of a dispute, BP may require a cross-check with HTFS or HTRI programs (see Appendix A) or equivalent.

In general, Vendors will have detailed in-house correlations, and such information is not usually available. Thus any cross-check with HTFS/HTRI can only be considered to be a guide rather than a definitive answer.

2.6 Operating Environment

The environmental conditions shall be as indicated on the data sheets.



3. THERMAL DESIGN

3.1 Design Pressure/Temperature Limitations

- * 3.1.1 Plate-and-Frame Exchangers may not be used at design pressures above 30 bar abs (435 psi abs) without approval by the Purchaser.

Plate-and-Frame Exchangers may not be used at design temperatures above 260°C (500°F) without approval by the Purchaser.

As a rule, the higher the design temperature, the lower the design pressure and vice-versa. Caution must be exercised when specifying a high design temperature and pressure.

The plate shall be designed such that each stream can operate at full design pressure/temperature with no pressure on the other stream(s).

3.2 Fluid Systems

- * 3.2.1 In most cases, plate-and-frame exchangers will be limited to single phase liquids, and single-phase gases.

Vaporising duties are not permitted.

Condensing duties (with the exception of condensing steam) shall only be used subject to Purchaser approval.

3.3 Fouling Resistances

- * 3.3.1 Fouling resistances will be specified by the Purchaser on the data sheets. Alternatively a percent excess area for fouling may be specified.

Fouling resistances are generally lower in plate-and-frame exchangers compared with shell-and-tube exchangers. In absence of any reliable data, it is recommended that a percent excess area be specified, and an "effective" fouling factor equivalent to this be calculated to assess if the percent excess area is reasonable.

3.4 Number of Streams

- * 3.4.1 In general, there shall only be two streams. More than two streams are only permissible subject to Purchaser approval.

Occasionally, two or more duties may be combined in a single frame so as to save space/weight/cost.



3.5 Plate-Pass Arrangements

- 3.5.1 The number of passes for each stream shall be determined by the thermal designer unless stated on the Exchanger Specification Sheet.

It is expected that there will only be one pass per stream (pure countercurrent) in most cases.

- 3.5.2 Where possible, all the port connections shall be on one side only of the plate pack (the fixed head plate) - commonly termed the U-arrangement, so as to ensure the plate pack can be modified without removing external pipework. Occasionally, it is necessary to have two connections on the fixed head plate and two on the floating head plate, in order to avoid flow distribution problems between the channels and shall be checked by the thermal designer. This is commonly termed the Z arrangement.

3.6 Flow Velocity/Pressure Drop Limits

- 3.6.1 The maximum flow velocity (m/s) in the inlet and outlet ports shall not exceed $150/\sqrt{\rho}$ where ρ is the mean fluid density in kg/m³.

- * 3.6.2 The maximum pressure drop through the inlet and outlet ports and nozzles shall not exceed 10% of the allowable unit pressure drop as specified on the Process Data sheet.

4. MECHANICAL DESIGN

4.1 General

- 4.1.1 The design shall incorporate design features to minimise the effects of corrosion generated by galvanic action between dissimilar metals used for plates and heads.
- 4.1.2 The design shall incorporate a protective metal shroud to cover the sides and top of the exchanger plate pack. The shroud shall have minimum clearance of 50 mm (2 in) from the plate pack.
- 4.1.3 A drip tray with drain connections shall be provided as an integral part of the exchanger frame. The drip tray shall extend for the full length of the frame and be 25 mm (1 in) wider all round than the shroud.



4.2 Mechanical Design Requirements

- 4.2.1 All plate heat exchangers and attachment welds shall be designed for the most severe combinations of conditions, caused by dead weights, internal pressure, piping loads, and all other loads which are likely to be imposed during erection, operation, maintenance and testing at the Vendor's work and in situ. In addition, due consideration shall be given to the effects of transportation.
- 4.2.2 Full design calculations shall be in accordance with the design code specified. S.I. units shall be used throughout with the exception of nozzles and piping nominal sizes which shall be in imperial sizes.
- 4.2.3 The exchanger frame shall be designed to allow the complete assembled dry unit to be lifted and installed without the need for temporary stiffening.
- * 4.2.4 The tow-out loads shall be given by the Purchaser in the data sheet.
- 4.2.5 Nozzles shall be designed for the loadings given in Appendix E. Should the nature of the plate exchanger design preclude economic design for these loads, the Vendor shall supply details of the maximum allowable loads and moments with his quotation.
- 4.2.6 The corrosion allowance for all wetted surfaces other than the plate pack shall be as specified on the data sheets.
- * 4.2.7 The basic allowable stresses for non-pressure parts shall be subject to approval by the Purchaser. The basic allowable stress for carbon steel anchor bolts shall be 110 N/mm² (16000 psi) calculated on the root area of the bolts.

4.3 Plate Design

- 4.3.1 The plates shall be designed such that each stream can operate at full design temperature/pressure with no pressure on the other stream.
- 4.3.2 Individual plates shall be removable and replaceable without having to remove adjacent plates from the frame.



- 4.3.3 All plate gaskets shall be properly secured over the entire periphery.
- 4.3.4 All corner ports carrying a different process or service stream to that on the plate shall incorporate double gaskets with the space between gaskets vented directly to atmosphere.

5 CONSTRUCTION REQUIREMENTS

5.1 General

- 5.1.1 All components other than the frame and heads, shall be the Vendor's standard type and shall be replaceable from stock.
- 5.1.2 Each exchanger shall contain a plate loading identification stating the number of plates and recommended tightened dimensions.

5.2 Nozzles

- 5.2.1 The exchangers shall be provided with flanged nozzles in accordance with the type specified on the data sheets.
- 5.2.2 Flanges shall be of the weld neck, or integrally forged long weld neck type. Pad type connections shall not be permitted.
- 5.2.3 Nozzle standouts shall be provided by the Vendor with the quotation.
- 5.2.4 All bolt holes in the nozzles shall straddle the vertical centreline of the nozzles.

5.3 Lifting Lugs

- 5.3.1 Each exchanger shall be provided with the lifting lugs/holes, so placed as to avoid overstressing the frame during lifting operations.
- 5.3.2 Lifting lugs shall be designed using shackle pin sizes in accordance with [BS 6994](#), unless other shackles are specified on the data sheets. The design shall incorporate an impact factor of 2.

- * 5.3.3 All calculations related to provisions for lifting shall be submitted to the Purchaser for approval.



5.4 Earthing Bosses

- 5.4.1 Two earthing bosses shall be provided, one at each end of the frame. Earthing boss details shall be in accordance with the Vendor Standard Drawings.

6. MATERIALS

6.1 General

- * 6.1.1 Materials of construction shall be as specified on the data sheets.

Carbon-Steel shall not be used for the plates.

In most cases, for non-corrosive services, the plates will normally be made of stainless steel, and for corrosive services of titanium.

- 6.1.2 Material certificates shall be supplied for all materials, showing chemical analyses and all test results required by the relevant material specification.

- 6.1.3 All materials shall be identified against its material certificates.

- 6.1.4 Each plate shall be stamped with the heat number for the material and its year of manufacture.

6.2 Bolting

- * 6.2.1 Pipe flanges shall be designed for alloy steel stud bolting in accordance with the appropriate grade specified in [BS 4882](#), or equivalent, for the design conditions given on the data sheets. Stud bolts shall have a full continuous thread and shall be long enough to extend 6 mm (1/4 in) outside each nut.

6.3 Tie Rods and Tie Rod Bolting

- * 6.3.1 Tie rods and tie rod bolting shall be of alloy steel material in accordance with the appropriate grade specified in [BS 4882](#), or equivalent, for the design conditions given on the data sheets.



6.4 Gaskets

6.4.1 Gaskets shall be furnished by the Vendor for all bolted attachments and plates.

- * 6.4.2 Materials for plate gaskets shall be specified by the Vendor and shall be suitable for the service based on proven field experience. Plate gasket materials shall be subject to approval by the Purchaser.

Full details of the service performance of the proposed gasket material on comparable duties shall be provided by the Vendor with his quotation.

A full specification for the gaskets, together with the name of the proposed supplier shall also be given.

7. WELDING

*** 7.1 General**

7.1.1 The Vendor shall submit proposed weld procedures, weld details and welder qualifications, etc. for the Purchaser's review and approval prior to commencing any production welding.

7.1.2 Repair welding of the heat transfer plates shall not be permitted.

8. INSPECTION, TESTING AND CERTIFICATION

8.1 General

- * 8.1.1 Inspection and testing shall be carried out on all equipment at the applicable manufacturer's works and shall be witnessed by the Purchaser's representatives and/or the Certifying Authority.

8.1.2 All non-destructive examination shall be carried out in accordance with the design code as a minimum. All personnel involved in non-destructive testing shall be qualified to a nationally recognised standard.



8.2 Non-destructive Examination (NDE)

- 8.2.1 All welds on heat exchangers shall be checked by dye penetrant/magnetic particle inspection (MPI). MPI shall be used for ferromagnetic materials and dye penetrant inspection for non-ferrous materials and austenitic stainless steels.
- 8.2.2 All cut edges, including cut outs for nozzles shall be visually checked followed by dye penetrant examination.
- 8.2.3 The tie bars shall be subject to a visual examination to check that no mechanical damage exists.
- 8.2.4 Butt welds on nozzle necks shall be subjected to 100% radiographic examination where practicable.

8.3 Hydrostatic Testing

- 8.3.1 All plate heat exchangers shall be hydrostatically tested at the Vendor's works in accordance with the design code.

The test shall consist of the following:-

- (a) Hot side for 30 minutes duration
- (b) Cold side for 30 minutes duration.
- (c) Hot side and cold side for 30 minutes duration.

- 8.3.2 The test pressure used shall be calculated in accordance with the design code.
- 8.3.3 Normally, only fresh water shall be used for hydrostatic testing, heated if necessary to achieve the required minimum metal temperature. For austenitic and duplex stainless steels, chloride content shall be less than 30 ppm.

*

Where it is proposed that the test fluid be something other than water, or that a chemical be added to the water for any reason, the Purchaser shall be consulted, and approval granted before testing.

- 8.3.4 On completion of hydrostatic testing, exchangers shall be drained and blown dry with hot air for 30 minutes. A 50 mm (2 in) (approx.) wide band shall be painted diagonally across the edges of one side of the plate pack in order to ensure correct assembly during subsequent maintenance. Marking paint shall not contain metallic pigments, chlorides or other



materials which are incompatible with the materials of construction.

8.4 Reports and Acceptance Certificates

The Vendor shall prepare a report on the tests and the results, which shall be included in the 'Data Books'. All Data Books produced shall be complete and copies shall be submitted to the Purchaser for review.

9. PART IDENTIFICATION AND NAMEPLATES

9.1 Nameplates

9.1.1 Each complete heat exchanger shall be provided with a type 316 stainless steel nameplate securely fixed to the fixed head and located so that it is clearly visible after installation.

9.1.2 The nameplates shall incorporate the following stamped data as a minimum:-

- Equipment Item Number
- Purchaser's Name and Order Number.
- Manufacturer's Name and Serial Number.
- Purchaser's Works Identification Number (9 digits)
- Year of Manufacture
- Heat Exchanger Surface (m²)
- Design Code
- Test Pressure (New) Hot Side/Cold Side (barg)
- Design Pressure Hot Side/Cold Side (barg)
- Design Temperature Hot Side/Cold Side (°C)
- X-Ray
- PWHT
- Total Weight Empty (kg)
- Weight of Plates Clean (kg)
- Number of Plates

The letters and figures shall be clearly stamped. The height of the letter shall be approximately 10 mm (3/8 in).

The design temperatures shall be the co-incident temperatures to the design pressures.

9.2 Component Marking

9.2.1 The following parts shall be stamped with the manufacturer's serial number and match marked to prevent misassembly in the field:-

- Frame Section



- Fixed Head
- Floating Head
- Tie Rods
- Plates

10. PREPARATION FOR SHIPMENT

10.1 General

- 10.1.1 Requirements for painting and preparation for shipment shall be as specified by the Purchaser.

These requirements should be covered in a functional specification.



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

thermal designer: the party who actually does the thermal design. May be Purchaser, Vendor or another party subcontracted to carry out the Thermal Design.

Abbreviations

HTFS	Heat Transfer & Fluid Flow Service
HTRI	Heat Transfer Research Incorporated
MPI	Magnetic Particle Inspection



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

BS 4882	Specification for Bolting for Flanges and Pressure Containing Purposes.
BS 5500	Specification for Unfired Fusion Welded Pressure Vessels.
BS 6994	Specification for Steel Shackles for Lifting and General Engineering Purposes.



APPENDIX C

PROCESS AND PHYSICAL PROPERTY DATA SHEET (Imperial Units)

Process Data			Note 1	STREAM NO.		STREAM NO.	
Fluid Name				Inlet	Outlet	Inlet	Outlet
1	Total Fluid Quantity	lb/h					
2	Vapour	lb/h					
3	Liquid	lb/h					
4	Steam/Water	lb/h					
5	Non-Condensable	lb/h					
6	Temperature	F					
7	Inlet Pressure (abs)	psi					
8	Pressure drop	psi					
9	Fouling Resistance	h ft ² F Btu					
10	Maximum Velocity	ft/s					
11	Minimum Velocity	ft/s					
Exchanger Size							
12	Maximum Exchanger Weight (dry)	lb					
13	Maximum Bundle/Core/Pack Weight	lb					
14	Maximum Plot Area (L x W)	ft x ft	/				
PROPERTY DATA - STREAM			Note 2				
1	Fluid						
2	Reference Flowrate	lb/h					
3	Reference Pressure	psia					
Enthalpy Curve				1	2	3	4
4	Temperature	F	required				
5a	Specific Enthalpy, and/or	Btu/lb	Note 3,4				
5b	Heat Load	MM Btu/h	Note 3,4				
6	Vapour Mass Fraction	-	required				
Liquid Properties							
7	Temperature	F	required				
8	Density	lb/ft ³	required				
9	Viscosity	cP	required				
10	Thermal Conductivity	Btu/h ftF	required				
11	Specific Heat Capacity	Btu/lb F	required				
12	Surface Tension	dyne/cm	Note 5				
Vapour Properties							
13	Temperature	F	required				
14	Density	lb/ft ³	required				
15	Viscosity	cP	required				
16	Thermal Conductivity	Btu/h ftF	required				
17	Specific Heat Capacity	Btu/lb F	required				
PROPERTY DATA - STREAM			Note 2				
1	Fluid						
2	Reference Flowrate	lb/h					
3	Reference Pressure	psia					
Enthalpy Curve				1	2	3	4
4	Temperature	F	required				
5a	Specific Enthalpy, and/or	Btu/lb	Note 3,4				
5b	Heat Load	MM Btu/h	Note 3,4				
6	Vapour Mass Fraction	-	required				
Liquid Properties							
7	Temperature	F	required				
8	Density	lb/ft ³	required				
9	Viscosity	cP	required				
10	Thermal Conductivity	Btu/h ftF	required				
11	Specific Heat Capacity	Btu/lb F	required				
12	Surface Tension	dyne/cm	Note 5				
Vapour Properties							
13	Temperature	F	required				
14	Density	lb/ft ³	required				
15	Viscosity	cP	required				
16	Thermal Conductivity	Btu/h ftF	required				
17	Specific Heat Capacity	Btu/lb F	required				
Notes							
1	Fill in as many copies of this sheet as necessary for exchangers with more than two streams						
2	For single-phase streams, only relevant property section needs to be filled in						
3	Heat Load or specific enthalpy (preferred option) may be supplied and both increase with temperature						
4	If heat load is supplied the reference flowrate (usually stream flowrate) relevant to enthalpy curve is needed						
5	Surface tension is only required for boiling/condensing streams						



APPENDIX C

PROCESS AND PHYSICAL PROPERTY DATA SHEETS (Metric Units)

Process Data		Note 1	STREAM NO.		STREAM NO.	
Fluid Name						
			Inlet	Outlet	Inlet	Outlet
1	Total Fluid Quantity	lb/h				
2	Vapour	lb/h				
3	Liquid	lb/h				
4	Steam/Water	lb/h				
5	Non-Condensable	lb/h				
6	Temperature	F				
7	Inlet Pressure (abs)	psi				
8	Pressure drop	psi				
9	Fouling Resistance	h ft ² F/Btu				
10	Maximum Velocity	ft/s				
11	Minimum Velocity	ft/s				
Exchanger Size						
12	Maximum Exchanger Weight (dry)	lb				
13	Maximum Bundle/Core/Pack Weight	lb				
14	Maximum Plot Area (L x W)	ft x ft	/			

PROPERTY DATA - STREAM		Note 2						
1	Fluid							
2	Reference Flowrate	lb/h						
3	Reference Pressure	psia						
Enthalpy Curve			1	2	3	4	5	6
4	Temperature	F	required					
5a	Specific Enthalpy, and/or	Btu/lb	Note 3,4					
5b	Heat Load	MM Btu/h	Note 3,4					
6	Vapour Mass Fraction	-	required					
Liquid Properties								
7	Temperature	F	required					
8	Density	lb/ft ³	required					
9	Viscosity	cP	required					
10	Thermal Conductivity	Btu/h ftF	required					
11	Specific Heat Capacity	Btu/lb F	required					
12	Surface Tension	dyne/cm	Note 5					
Vapour Properties								
13	Temperature	F	required					
14	Density	lb/ft ³	required					
15	Viscosity	cP	required					
16	Thermal Conductivity	Btu/h ftF	required					
17	Specific Heat Capacity	Btu/lb F	required					

PROPERTY DATA - STREAM		Note 2						
1	Fluid							
2	Reference Flowrate	lb/h						
3	Reference Pressure	psia						
Enthalpy Curve			1	2	3	4	5	6
4	Temperature	F	required					
5a	Specific Enthalpy, and/or	Btu/lb	Note 3,4					
5b	Heat Load	MM Btu/h	Note 3,4					
6	Vapour Mass Fraction	-	required					
Liquid Properties								
7	Temperature	F	required					
8	Density	lb/ft ³	required					
9	Viscosity	cP	required					
10	Thermal Conductivity	Btu/h ftF	required					
11	Specific Heat Capacity	Btu/lb F	required					
12	Surface Tension	dyne/cm	Note 5					
Vapour Properties								
13	Temperature	F	required					
14	Density	lb/ft ³	required					
15	Viscosity	cP	required					
16	Thermal Conductivity	Btu/h ftF	required					
17	Specific Heat Capacity	Btu/lb F	required					

Notes	
1	Fill in as many copies of this sheet as necessary for exchangers with more than two streams
2	For single-phase streams, only relevant property section needs to be filled in
3	Heat Load or specific enthalpy (preferred option) may be supplied and both increase with temperature
4	If heat load is supplied the reference flowrate (usually stream flowrate) relevant to enthalpy curve is needed
5	Surface tension is only required for boiling/condensing streams



APPENDIX D

PLATE AND FRAME HEAT EXCHANGER SPECIFICATION SHEET (Imperial Units)

1	SERVICE OF UNIT										ITEM NO														
2	SIZE (W x L) x ft										CONNECTED IN PARALLEL SERIES														
3	SURF/UNIT (GROSS) (EFF) ft ² EXCHANGERS/UNIT										SURF/EXCHANGER (GROSS) (EFF) ft ²														
4	% EXCESS AREA/DUTY:										THERMAL RATING/DESIGN CASE NO.														
5	PERFORMANCE OF ONE UNIT																								
6	FLUID ALLOCATION					HOT-SIDE IN					HOT-SIDE OUT					COLD-SIDE IN					COLD-SIDE OUT				
7	FLUID NAME																								
8	TOTAL FLUID QUANTITY lb/h																								
9	VAPOUR (IN/OUT)																								
10	LIQUID (IN/OUT)																								
11	STEAM/WATER																								
12	NON-CONDENSABLE																								
13	TEMPERATURE (IN/OUT) °F																								
14	LIQUID / VAPOUR LIQUID / VAPOUR LIQUID / VAPOUR LIQUID / VAPOUR																								
15	DENSITY lb/ft ³ / / / /																								
16	VISCOSITY cP / / / /																								
17	SPECIFIC HEAT Btu/lb °F / / / /																								
18	THERMAL CONDUCTIVITY Btu/h ft °F / / / /																								
19	MOLECULAR WEIGHT																								
20	LATENT HEAT Btu/lb @ °F AT °F AT °F AT °F AT °F																								
21	INLET PRESSURE psi abs bs																								
22	PLATE VELOCITY ft/s																								
23	PORT VELOCITY ft/s																								
24	PRESSURE DROP (ALLOW/CALC) psi / /																								
25	MEAN METAL TEMPERATURE °F																								
26	FOULING RESISTANCE h ft ² °F/Btu																								
27	% EXCESS AREA TO ALLOW FOR FOULING:																								
28	HEAT EXCHANGED (DUTY) MM Btu/h										WEIGHTED MEAN TEMP DIFF. °F														
29	TRANSFER RATE Btu/h ft ² °F										SERVICE CLEAN														
30	CONSTRUCTION OF EACH EXCHANGER										SKETCH (PLATE/NOZZLE POSITION)														
31	HOT-SIDE										COLD-SIDE														
32	DESIGN/TEST PRESSURE psi abs																								
33	DESIGN TEMPERATURE °F																								
34	NO. PASSES PER STREAM																								
35	CORROSION ALLOWANCE in																								
36	CONNECTION INLET																								
37	NUMBER/SIZE OUTLET																								
38	AND RATING INTERMEDIATE																								
39	MAIN PLATE DETAILS										MATERIALS														
40	NUMBER OF PLATES										PLATES														
41	PLATE WIDTH/HEIGHT ft/ft										FRAME														
42	PORT DIAMETER - HOT STREAM ft										GASKETS														
43	PORT DIAMETER - COLD STREAM ft																								
44	HORIZONTAL PORT CENTRE DISTANCE ft																								
45	HORIZONTAL PORT CENTRE DISTANCE ft																								
46	COMPRESSED PLATE PITCH in																								
47	CHEVRON ANGLE (MEASURED FROM HORIZONTAL) DEGREES																								
48	CODE REQUIREMENTS										STAMP (Y/N)														
49	WEIGHTS/EXCHANGER DRY lb										FILLED WITH WATER lb PLATE-PACK lb														
50	HEAT EXCHANGER TO COMPLY WITH LOCAL/NATIONAL REQUIREMENTS (OF MANUF) (OF OPER)																								
51	REMARKS SEE BP SPECIFICATION GS 126-5																								
52	DATE		NOTES																						
53			(1)																						
54			(2)																						
55			(3)																						
56			(4)																						
57			(5)																						
58	REVISION		DATE		REMARKS										BY		APPROVED								
59																									
60																									
61																									
62																									
63																									
64																									
65			CLIENT												PLATE AND FRAME HEAT EXCHANGERS		SHEET								
66			PROJECT																						
67			LOCATION																OF						



APPENDIX D

PLATE AND FRAME EXCHANGER SPECIFICATION SHEET (Metric Units)

1	SERVICE OF UNIT										ITEM NO													
2	SIZE (W x L)		x	m											CONNECTED IN		PARALLEL	SERIES						
3	SURF UNIT (GROSS) (EFF)				m ²		EXCHANGERS UNIT				SURF EXCHANGER (GROSS) (EFF)				m ^{-W40}									
4	% EXCESS AREA/DUTY:										THERMAL RATING/DESIGN CASE NO.													
5	PERFORMANCE OF ONE UNIT																							
6	FLUID ALLOCATION		HOT-SIDE IN					HOT-SIDE OUT					COLD-SIDE IN					COLD-SIDE OUT						
7	FLUID NAME																							
8	TOTAL FLUID QUANTITY		kg/h																					
9	VAPOUR (IN/OUT)																							
10	LIQUID (IN/OUT)																							
11	STEAM/WATER																							
12	NON-CONDENSABLE																							
13	TEMPERATURE (IN/OUT)		°C																					
14			LIQUID		/		VAPOUR		LIQUID		/		VAPOUR		LIQUID		/		VAPOUR					
15	DENSITY		kg/m ³																					
16	VISCOSITY		cP																					
17	SPECIFIC HEAT		kJ/kg °C																					
18	THERMAL CONDUCTIVITY		Btu/h ft °F																					
19	MOLECULAR WEIGHT																							
20	LATENT HEAT		Mj/kg @ °C		AT		°C		AT		°C		AT		°C		AT		°C					
21	INLET PRESSURE		bar abs																					
22	PLATE VELOCITY		m/s																					
23	PORT VELOCITY		m/s																					
24	PRESSURE DROP (ALLOW)		Cabar																					
25	MEAN METAL TEMPERATURE		°C																					
26	FOULING RESISTANCE		m ² /C.W																					
27	% EXCESS AREA TO ALLOW FOR FOULING:																							
28	HEAT EXCHANGED (DUTY)		kW		WEIGHTED MEAN TEMP DIFF.		°C																	
29	TRANSFER RATE		W/m ² °C		SERVICE				CLEAN															
30	CONSTRUCTION OF EACH EXCHANGER										SKETCH (PLATE/NOZZLE POSITION)													
31			HOT-SIDE					COLD-SIDE																
32	DESIGN/TEST PRESSURE		psi abs																					
33	DESIGN TEMPERATURE		°C																					
34	NO. PASSES PER STREAM																							
35	CORROSION ALLOWANCE		mm																					
36	CONNECTION		INLET																					
37	NUMBERS		OUTLET																					
38	AND RATING		INTERMEDIATE																					
39	MAIN PLATE DETAILS										MATERIALS													
40	NUMBER OF PLATES																							
41	PLATE WIDTH/HEIGHT		m/m																					
42	PORT DIAMETER - HOT STREAM		m																					
43	PORT DIAMETER - COLD STREAM		m																					
44	HORIZONTAL PORT CENTRE DIST		m																					
45	HORIZONTAL PORT CENTRE DIST		m																					
46	COMPRESSED PLATE PITCH		m m																					
47	CHEVRON ANGLE (MEASURED FROM HORIZONTAL)		DEGREES																					
48	CODE REQUIREMENTS																							
49	WEIGHTS/EXCHANGER		DRY		kg				STAMP (Y/N)															
50	HEAT EXCHANGER TO COMPLY WITH LOCAL NATIONAL REQUIREMENTS (OF MANUF) (OF OPER)																							
51	REMARKS		SEE BP SPECIFICATION GS 126-5																					
52	DATE		NOTES																					
53			(1)																					
54			(2)																					
55			(3)																					
56			(4)																					
57			(5)																					
58	REVISION		DATE		REMARKS										BY		APPROVED							
59																								
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62																								
63																								
64																								
65			CLIENT																					
66			PROJECT												PLATE AND FRAME HEAT EXCHANGERS		SHEET							
67			LOCATION														OF							



NOZZLE LOADS ON PLATE HEAT EXCHANGERS

D1. GENERAL

Due to thermal expansion, internal pressure, dead weight etc., pipework that is connected to nozzles on plate heat exchangers may exert forces and moments on to the exchanger. The design of the heat exchanger shall take account of these forces and moments (loads).

D2.

NOTATION

D	-	Nominal diameter of nozzle (mm)
F_R	-	Positive or negative radial force (N)
M_L	-	Longitudinal moment on the cylinder (Nm)
M_C	-	Circumferential moment on the cylinder (Nm)
P	-	Internal pressure of the vessel (barg)

D3.

ANALYSIS OF LOADS

- D3.1 The effects of torsional moment and shear forces may be ignored.
- D3.2 The loads at the intersection of the axis of the nozzle with the mid-plane of the heat exchanger end plate shall be evaluated from the following formula:-

- (a) Radial Force

$$F_R = \pm [20 \times D^{1.2} + P \times D^{0.85}]$$

The effect of both positive and negative values of the force shall be evaluated.

- (b) Moment

$$M_L = M_C = [1.75 \times D^{1.4}] + [5.0 \times 10^{-6} \times P \times D^{2.9}]$$