



GS 134-6

RECIPROCATING COMPRESSORS TO API 618

November 1994

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING											
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SCOPE AND PURPOSE This BP Group Guidance for Specification covers requirements for Reciprocating Compressors. Excluded are compressors with single-acting trunk-type (automotive type) pistons that also serve as crossheads, and either utility or instrument air compressors that discharge at 8.6 bar effective or below. It supplements the API standard, defining a number of the optional clauses and substituting, modifying or qualifying certain other clauses in the light of BP experience.											
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CUSTODIAN (See Quarterly Status List for Contact) Rotating Machinery											
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CONTENTS

Section	Page
FOREWORD	iii
1. INTRODUCTION.....	1
1.1 Scope	1
1.2 Alternative Designs.....	1
1.3 Conflicting Requirements.....	1
1.6 Co-ordination	1
2. BASIC DESIGN.....	2
2.1 General	2
2.2 Allowable Speeds	2
2.3 Allowable Discharge Temperature	3
2.5 Critical Speeds.....	4
2.6 Compressor Cylinders.....	5
2.8 Pistons, Piston Rods, and Piston Rings	5
2.9 Crankshafts, Connecting Rods, Bearings and Crossheads	5
2.10 Distance Pieces	6
2.11 Packing Case and Pressure Packing.....	6
2.12 Compressor Frame Lubrication.....	6
2.14 Materials	7
3. ACCESSORIES	7
3.1 Drivers	7
3.2 Couplings and Guards.....	8
3.3 Reduction Gears	8
3.4 Belt Drives	8
3.6 Controls and Instrumentation.....	8
3.7 Piping and Appurtenances.....	10
3.8 Intercoolers and Aftercoolers.....	10
3.9 Pulsation and Vibration Control Requirements.....	10
3.11 Tools	11
4. INPECTION, TESTING AND PREPARATION FOR SHIPMENT.....	11
4.1 General	11
4.2 Inspection	11
4.3 Testing	12
FIGURE 1	13
FLANGED THERMOWELL WELDED CONSTRUCTION	13



FIGURE 2	15
FLANGED THERMOWELL WITH RETAINING FLANGE	15
APPENDIX A.....	17
DEFINITIONS AND ABBREVIATIONS	17
APPENDIX B.....	18
LIST OF REFERENCED DOCUMENTS.....	18



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 defines a number of optional API clauses and may substitute, add to or qualify other API clauses using BP's knowledge and experience world-wide.

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.

It is a transparent supplement to API 618 Third Edition, dated February 1986, showing substitutions, qualifications and additions to the API text as necessary. As the titles and numbering of the BP text follow those of API, gaps in the numbering of the BP document may occur. Where clauses are added, the API text numbering has been extended accordingly.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification, and may discuss alternative options.

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 134-6) 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

This Specification covers BP requirements for reciprocating compressors conforming generally to [API 618](#). They shall meet the requirements of [API 618](#), Third Edition, dated February 1986, except as modified and amplified herein. Unless stated otherwise, integral gas-engine driven and packaged high-speed separable engine driven reciprocating gas compressors shall meet the requirements of this specification.

(Modification)

1.2 Alternative Designs

Requirements alternative to those prescribed will be acceptable provided it can be shown to the satisfaction of the purchaser's Professional Engineer that the required performance and function is attained.

(Substitution)

1.3 Conflicting Requirements

In case of conflict between various documents, their order of precedence shall be:-

- (a) Local Authority or Statutory Regulations.
- (b) The equipment requisition or order.
- (c) Data sheets.
- (d) This specification.
- (e) Referenced industry standards.

(Substitution)

1.6 Co-ordination

The compressor vendor shall be responsible for the co-ordination of the design and for the satisfactory functioning of the complete unit, i.e. compressor, driver and ancillaries. In cases where the compressor vendor supplies equipment that he has not manufactured, he shall be responsible for ensuring that the designs of these items are compatible with each other and with his own equipment in all respects. In performance, in control and in vibration characteristics such that a fully integrated unit is achieved. The satisfactory functioning of the



complete unit shall form part of the compressor vendor's contractual guarantee.

(Addition)

2. BASIC DESIGN

2.1 General

- 2.1.2 Noise levels at or beyond 1 m from the machine (plus driver and ancillaries) surfaces, shall not exceed 85 dB(A) unless an alternative limit is specified on the data sheet.

Noise limits below 85 dB(A) may be required in some countries.

When the vendor cannot meet the foregoing limits without the addition of noise attenuating features, the levels with and without these features shall be stated in the proposal.

Noise-attenuating enclosures shall not unduly compromise operation and maintenance. All instrumentation and controls shall be mounted either externally to the enclosure, or clearly visible and controllable from outside the enclosure.

Enclosures shall be adequately purged and cooled. Instrumentation, sensors and cables installed inside enclosures shall not be subjected to an environment which causes the component to be operated outside the vendor's specified ambient temperature limits.

(Substitution)

Noise attenuating enclosures should only be accepted when there is no practical alternative form of noise control.

The sound intensity method for measuring the noise level of equipment offers significant advantages over conventional sound pressure measurement techniques. These are:-

- (a) *Measurement of sound radiated from each surface or area of the equipment. This enables the principal contributors to overall noise levels to be identified and reduced by locally applied absorption materials.*
- (b) *Improved compensation for background and reverberative effects.*

2.2 Allowable Speeds

- 2.2.1 For lubricated cylinders, mean piston speeds shall not exceed 4.3 m/sec (14 ft/sec).

For non-lubricated cylinders, mean piston speeds shall not exceed 3.5 m/sec (11.5 ft/sec).

(Addition)



For oil lubricated cylinders the limit of 4.3 m/sec on mean piston speed is a nominal value, based on experience, and should result in acceptable component life (piston rings, rider rings, packings, liners etc.) for most heavy duty process applications in this industry. An increase in this limit may be feasible, but speeds in excess of 4.5 m/sec should be viewed with caution and are not generally recommended.

Where the process gas affects the lubricant or where different materials are used, a limit lower than 4.3 m/sec will need to be considered.

The selection of materials for piston and rider rings in non-lubricated service, particularly where gases contain neither oxygen or water vapour, shall be based upon references in identical services.

For non lubricated cylinders the limit of 3.5 m/sec on mean piston speed is a nominal value. Where the ring material selected is compatible with the process duty, the life of the piston rings is largely dependent on the ring mean temperature and the differential pressure across the piston. Consequently, the limit on mean piston speed generally reduces as the differential pressure increases. There may be some scope for increasing this where the pressure differential is low, and where the manufacturer can demonstrate relevant experience with the gas in question. However the absolute maximum is considered to be 3.8 m/sec.

For more arduous duties where the discharge temperature approaches the API limit of 150°C, piston speeds lower than 3.5 m/sec will need to be considered.

Where compressors will operate unloaded for substantial periods, it is recommended that lower limits on piston speeds be considered.

- 2.2.2 Compressors handling gas containing H₂S in any concentration, together with water in any form, shall be limited to a maximum of 500 rev/min.
- (Addition)

Problems (mainly stress corrosion cracking) have occurred with valve components in machines on sour service. The limit of 500 rev/min is a nominal value based on experience.

2.3 Allowable Discharge Temperature

For hydrocarbon lubricated compressors handling air or other oxygen bearing gases which will support combustion of the lubricant, the maximum actual discharge temperature shall not exceed the following limits:-

Discharge Pressure		Maximum Actual Discharge Temperature	
bar (ga)	(psig)	°C	(°F)
0 to 20	(0) to (290)	140	(284)
20 to 50	(290) to (725)	130	(226)



For discharge pressures greater than 50 bar (ga) (725 psig), discharge temperature limits shall be agreed for each case.

(Addition)

2.3.2

The following high discharge temperature alarms and trips shall be provided for hydrocarbon lubricated compressors handling air or other oxygen bearing gases:-

Discharge Pressure		Alarm		Trip	
bar (ga)	(psig)	°C	(°F)	°C	(°F)
0 to 20	(0) to (290)	150	(302)	155	(310)
20 to 50	(290) to (725)	140	(294)	145	(293)

For discharge pressures greater than 50 bar (ga) (725 psig), discharge temperature alarms and trips shall be agreed for each case.

(Addition)

2.5

Critical Speeds

2.5.2

Where torsional critical speeds exist between dead stop and trip speed or synchronous speed, the torsional analysis shall include calculation transient vibratory torques and stresses generated in all system components during start up and shut down. The basis of this calculation, and the method of start up and shut down (in particular the pressures pertaining in individual compressor cylinders) shall be agreed with the purchaser.

In addition, transient vibratory torques and stresses generated in all system components during an emergency shutdown shall be calculated. For this it should be assumed that there is insufficient time to vent down the system with the result that the machine decelerates whilst loaded. In the event that excessive stresses cannot be avoided, the manufacturer shall propose the installation of a torque limiting drive release to prevent damage to the machine components.

(Addition)

The requirement for the calculation of transient torques and stresses during start up and shut down applies normally only to geared units where torsional natural frequencies are likely to exist below the rated speed. For direct coupled motor driven units, the torsional natural frequencies will normally be very much higher than the rated speed and this requirement does therefore not apply.



2.6 Compressor Cylinders

2.6.1 General

2.6.1.2 The arrangement of valves and ports in horizontal cylinders shall be such as to ensure complete drainage of cylinders.

(Addition)

2.6.4. Cylinder Connections

2.6.4.4 For flammable and toxic services, screwed or screwed and seal welded fittings are not permitted. For corrosive and sour services socket welded fittings are not permitted.

(Qualification)

Socket welded fittings are not permitted for corrosive and sour services because of potential corrosion problems of both pipe and socket.

2.8 Pistons, Piston Rods, and Piston Rings

2.8.3 Where piston wear bands are fitted, a system for monitoring wear shall be installed.

(Addition)

The wear of wear bands is usually determined from measurement of the displacement (i.e. drop) of the piston rod.

A typical arrangement would be permanently mounted vertical and horizontal proximity probes attached to some fixed reference, such as the packing box flange, and continuous monitoring instruments to display piston rod displacement. Proprietary equipment using proximity probes and a phase marker is available commercially. However, in applications with a known rate of ring wear which falls within known experience, a simple mechanical/pneumatic device to give warning of excessive piston rod movement will normally suffice.

2.9 Crankshafts, Connecting Rods, Bearings and Crossheads

2.9.7 Crankcases shall be fitted with British Internal Combustion Engine Research Institution (BICERI) type relief valves and flame traps. The relief area shall not be less than $0.035 \text{ m}^2/\text{m}^3$ ($1.5 \text{ in}^2/\text{ft}^3$) of crankcase volume.

Crankcase breathing devices shall be fitted with approved flame traps.

The compressor manufacturer shall specify the maximum pressure that the crankcase can withstand.

(Qualification)



2.10 Distance Pieces

- 2.10.1.3 Long, two compartment distance pieces (Type C) shall be provided for compressors on flammable or toxic service.

(Qualification)

Long, two compartment distance pieces (API Type C) are generally required for flammable and toxic gas service. For applications where space is very limited, e.g. sometimes offshore, short, double compartment distance pieces (API Type D) should be considered. Long single compartment distance pieces (API Type B) are not permitted.

- 2.10.2 For flammable and toxic services, distance pieces shall be provided with gasketed, solid covers.

(Qualification)

- 2.10.4 For flammable and toxic services the outboard compartment (i.e. that nearer the cylinder) shall be purged with nitrogen and shall be vented to an area where it is safe to vent. The inboard compartment shall be separately vented to an area where it is safe to vent.

(Addition)

2.11 Packing Case and Pressure Packing

- 2.11.3 For H₂S service where the concentration is above 8%, and on other services specified as toxic, each packing case shall be purged with nitrogen via a connection inboard (crankcase end) of the packing vent.

- 2.11.5 *When cooling of packing boxes is required the use of water has given problems with leakage and consequential damage to piston rods and packings. Closed loop systems using oil as the coolant should be considered.*

2.12 Compressor Frame Lubrication

- 2.12.4 Unless a particular type of cooler is specified, a plate type heat exchanger shall be supplied.

(Substitution)

Plate type heat exchangers are generally lower in cost than shell and tube type, particularly where sea water cooling is used. However, provision for the removal of solids or particulate matter from the cooling water may be necessary.

- 2.12.6 Unless a particular type of cooler is specified, an electrical immersion heater shall be used.

(Qualification)



2.14 Materials

2.14.1 General

- 2.14.1.1 For flammable and toxic gases, grey cast iron is not permitted for pressure containing cylinder parts. Nodular iron is permitted, but is limited to the maximum pressures specified in Table 1. Nodular iron shall not be used for pressures in excess of 69 bar (ga).

(Qualification)

Flake Graphite Cast Iron (Grey Iron) is a low strength, brittle, notch sensitive material with low impact strength and is considered unsuitable for flammable and toxic gas service.

Where manufacturers offer Nodular Iron cylinders, their references and source of castings should be investigated. It is recommended that Nodular Iron is accepted only where satisfactory experience of the foundry and the particular casing can be demonstrated. The acceptability of repairs and the procedures to be adopted should be agreed, at least in outline before any commitment is made.

- 2.14.1.10 When compressors are specified for sour service, the materials shall be selected in accordance with the requirements of BP Group [GS 136-1](#).

(Qualification)

3. ACCESSORIES

3.1 Drivers

3.1.1 General

- 3.1.1.3 The actual pressures in the compressor cylinders during start up shall be agreed between the purchaser and the vendor. Where the machine has to accelerate through a torsional natural frequency (frequencies), it may be necessary to depressure the stages below their normal suction pressure in order to avoid damaging oscillations of the shaft system. See also 2.5.2 of this Specification.

(Addition)

Torsional natural frequencies are unlikely to occur below running speed where direct coupled motors are used.

3.1.2 Motor Drivers

- 3.1.2.4 Electric motors shall be supplied in accordance with the appropriate Specification.



(Addition)

3.2 Couplings and Guards

3.2.2 Guards

- 3.2.2.1 All moving parts shall be guarded in accordance with [BS 5304](#) or equivalent national standard. Coupling guards shall be sufficiently robust to resist distortion under normal industrial use, to avoid risk of sparking by contact with moving parts.

(Addition)

3.3 Reduction Gears

- 3.3.1 Separate gear units within the scope of [API 613](#) shall comply with BP Group [GS 134-10](#).

(Substitution)

3.4 Belt Drives

- 3.4.1 Belts shall meet the anti-static requirements of [ISO 1813](#) or [BS 2050](#).

They shall not self-ignite under any condition of slip, up to and including total slip.

(Addition)

- 3.4.2 Belts shall be adjustable without the need to remove the guard.

(Addition)

3.6 Controls and Instrumentation

3.6.1 General

- 3.6.1.3 Instrumentation equipment shall conform to BP Group [GS 130-2](#)

(Substitution)

- 3.6.1.4 Unless otherwise specified, a separately mounted local instrument panel shall be provided. It shall contain indication of all alarms, trips and important instruments and controls for the compressor, transmission and driver, to facilitate safe control and rapid fault finding.

(Addition)



3.6.4 Instrumentation

3.6.4.2 Temperature Measurement

- 3.6.4.2.1 Process gas inlet and discharge temperature for each cylinder shall be indicated on the panel. The remaining temperature measurements may be indicated either on the panel or locally.

(Qualification)

3.6.4.3 Pressure Measurement

- 3.6.4.3.1 The following pressure measurements are the minimum to be indicated on the panel:-

- (a) Lube oil pressure at frame headers(s).
- (b) Process gas inlet and discharge for each cylinder.

The remaining pressure instruments may be indicated either on the panel or locally.

(Qualification)

3.6.5 Alarms and Shutdowns

- 3.6.5.1 The following alarms shall be regarded as the minimum required, but particular installations may require additions:-

- (a) High gas discharge temperature - each cylinder.
- (b) Low pressure frame oil header(s).
- (c) Compressor suction drum, high level.

The following trips shall be regarded as the minimum required, but particular installations may require additions:-

- (a) Emergency shutdown facilities, arranged to directly trip motor contactors/circuit breakers, shall be provided local to the machine. This is to be in addition to and separate from any other 'local' or 'remote' shutdown or normal control facilities which may be routed through a logic system.
- (b) Extra low pressure of frame oil header(s).
- (c) Compressor suction drum, extra high level.
- (d) Overspeed (variable speed drivers).



(Qualification)

- 3.6.5.7 Where a local panel is specified, the minimum annunciation provided shall be by a common alarm and a common trip annunciator, where individual indication is provided in the control room.

(Qualification)

3.6.6 Electrical Systems

- 3.6.6.1 All electrical components and their installation shall conform to the requirements of BP Group [GS 112-16](#).

(Qualification)

3.7 Piping and Appurtenances

3.7.1 General

- 3.7.1.11 All piping containing process fluids or cooling water shall conform to the relevant Plant Piping Specification. Threaded connections are not acceptable for oil, flammable or toxic services, even if seal welded.

- 3.7.1.14 The use of compression couplings on piping systems containing process fluids is not permitted.

3.8 Intercoolers and Aftercoolers

- 3.8.1 Shells for water cooled intercoolers shall conform to BP Group [GS 146-4](#). In the event that such vessels are outside the scope of this specification BP Group [GS 146-2](#) shall apply.

(Substitution)

- 3.8.10 Tubes in hydrogen service shall be seal welded. Tubes in ferrous materials shall be welded in accordance with BP Group [GS 118-8](#).

(Addition)

3.9 Pulsation and Vibration Control Requirements

3.9.2 Design Approaches

- 3.9.2.1 Pulsation suppression devices shall be supplied in accordance with the relevant Design Approach specified by paragraphs 3.9.2.4.1 and 3.9.2.4.2 of [API 618](#).

(Qualification)



- 3.9.3 Pulsation Suppression Devices
- 3.9.3.11 Thermowell connections shall be designed to accommodate flanged thermowells to Figures 1 and 2.

(Addition)

- 3.9.3.14 Threaded connections on pulsation dampers are not permitted.

(Qualification)

3.11 Tools

- 3.11.3 A means of barring shall be provided for all machines.

(Qualification)

4. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

4.1 General

Verification of the vendors 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.

Further suggestions may be found in the BP Group RPSE's Introductory Volume.

4.2 Inspection

- 4.2.3 The Vendor shall table his internal inspection and test plan as the basis of discussion to agree the extent of purchaser participation in inspection and testing.

(Substitution)

The following is a list of typical inspection requirements:-

- (a) Materials of all critical components.*
- (b) Welding and heat treatment procedures.*
- (c) Non-destructive test procedures.*
- (d) All proposed repairs.*
- (e) Hydrostatic and gas testing of all pressure containing components.*



- (f) *Mechanical running tests on individual machines and, where applicable, on complete trains.*
- (g) *Performance Tests.*
- (h) *Sound level tests.*
- (i) *Post test inspection of components.*
- (j) *Dimensions of critical components. Dimensions and relative positions of nozzles, supports, couplings shaft ends, etc., affecting assembly on site.*
- (k) *Weights of major components to be lifted during maintenance on site.*
- (l) *Cleanliness.*
- (m) *Painting and corrosion prevention.*
- (n) *Packing.*

(Addition)

4.3 Testing

4.3.2 Mechanical Running Tests

4.3.2.1 All compressors shall be run unloaded at maximum speed for a minimum of 4 hours.

(Addition)

4.3.2.2 Skid mounted, packaged units shall receive a 4 hour mechanical running test.

(Qualification)

4.3.2.5 Sufficient dismantling to allow inspection of bores, piston rods, big ends and main bearings is required.

(Qualification)

4.3.3 Other Tests

4.3.3.2 The vendor shall include for the assembly of all items of equipment supplied by others to the main manufacturer before shipment.

(Qualification)

4.3.3.3 Performance Testing, if required, shall be to [ASME Power Test Code 9](#) (PTC 9), unless otherwise agreed by the Purchaser's Professional Engineer.

(Qualification)



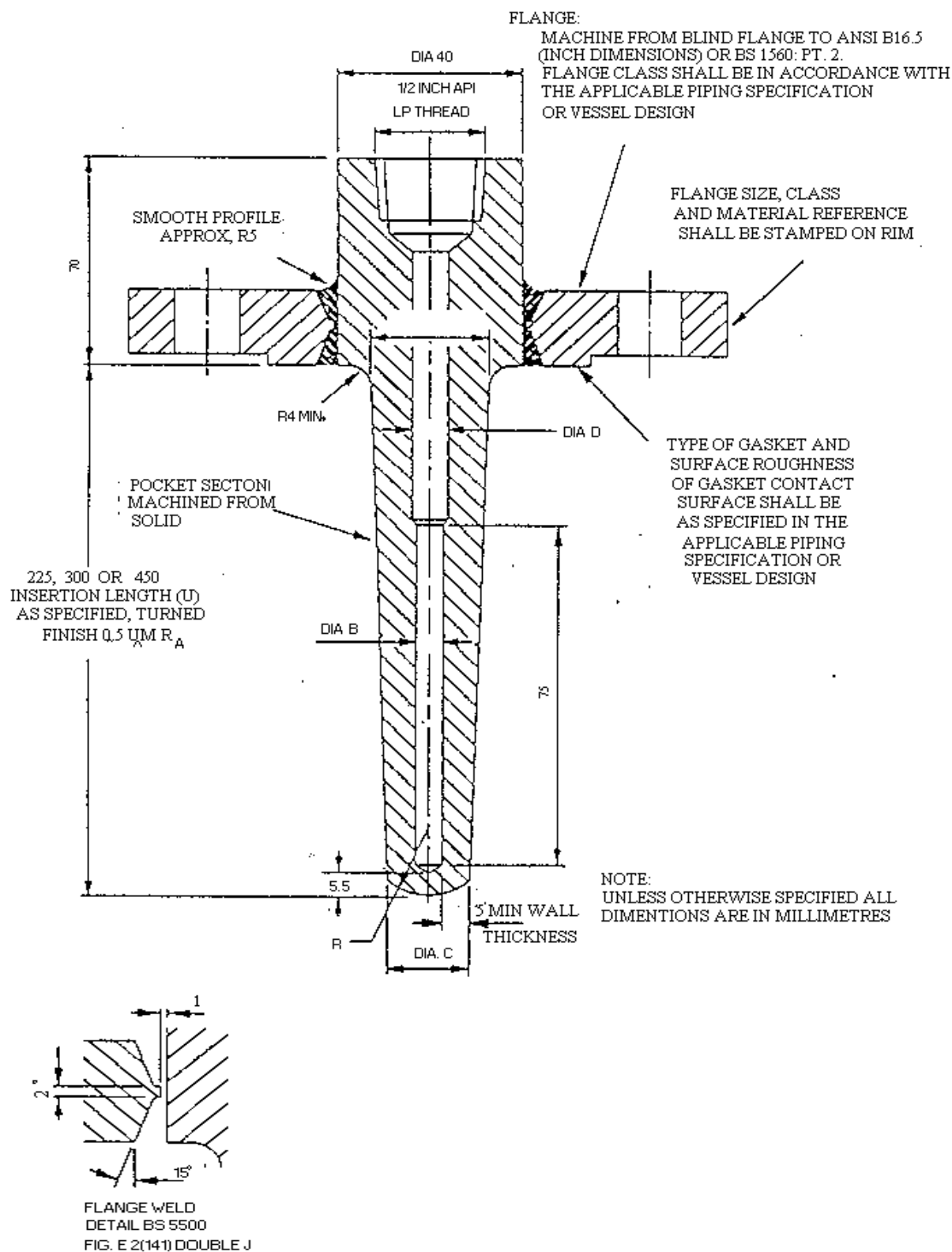


FIGURE 1
FLANGED THERMOWELL WELDED CONSTRUCTION

APPLICATION:

FOR USE WITH RAISED FACE FLANGES TO [ANSI B16.5](#) (INCH DIMENSIONS) OR TO BS 1560: PT.2, UP TO AND INCLUDING CLASS 300.

MAXIMUM AND MINIMUM WORKING PRESSURE AND TEMPERATURE:

AS SPECIFIED BY [ANSI B16.5](#) FOR THE CLASS OF FLANGE AND THE MATERIALS SPECIFIED ON THIS DRAWING.

MATERIALS OF CONSTRUCTION:

BAR: [BS1502 316S31, B51502 OR B51506 GRADE 815.](#)
FORGINGS: [B51503 316S31, BS1503 OR ASTM A182 F316](#)
PLATE: [BS1501 PT.3 316S16 OR ASTM A240 316.](#)

NOTE THAT THE MATERIAL OF POCKET AND FLANGE SHALL HAVE THE SAME COMPOSITION.

SPECIAL MATERIALS:

THE USE OF MATERIALS OTHER THAN THESE SPECIFIED ON THIS DRAWING SHALL BE SUBJECT TO APPROVAL BY BP.

WELDING:

1. FULL PENETRATION WELD ONLY
2. T.I.G. WELD SHALL BE EMPLOYED USING A HIGH FREQUENCY STARTING UNIT AND CRATER ELIMINATING DEVICE
3. WELD MATERIALS SHALL BE OF SAME COMPOSITION AS FLANGE AND POCKET
4. BACKFACE OF WELD TO BE INERT GAS PURGED
5. FINISHED WELD TO BE DYE PENETRANT TESTED.

BORE:

BORING SHALL BE CARRIED OUT ON A GUN- DRILLING MACHINE TO ENSURE STRAIGHTNESS AND GOOD FINISH

FOR THERMOCOUPLES & RESISTANCE ELEMENTS, DIMENSIONS SHALL BE IN ACCORDANCE WITH THOSE LISTED IN THE FOLLOWING TABLE FOR ELEMENT DIA 6

FOR FILLED SYSTEMS, E.G. MERCURY IN STEEL, THE BORE SHALL SUIT VENDORS EQUIPMENT, TYPICAL DIMENSIONS ARE SHOWN IN THE FOLLOWING TABLE. FOR INTERMEDIATE SIZES, DIMENSIONS SHALL BE DETAILED

ELEMENT DIA	6	TYPICAL MAX 1.3
DIA B	6,2 1 1 0 1	13,2 1 0 1
DIA C	18	25
DIA D	8	15
RAD R	12 1 2	17 1 2

ALL OTHER DIMENSIONS 10.5

HEAT TREATMENT:

AFTER WELDING, THE COMPLETE ASSEMBLY SHALL BE SOLUTION ANNEALED AT 1050°C FOR 1 HOUR PER 25mm OF SECTION (MINIMUM PERIOD 1 HOUR) FOLLOWED BY WATER QUENCH.

TEST:

FINISHED THERMOWELL SHALL BE SUBJECT TO AN EXTERNAL TEST PRESSURE OF 1.5 TIMES THE MAXIMUM NON-SHOCK WORKING PRESSURE RATING FOR THE MATERIAL AND CLASS OF FLANGE AT AMBIENT TEMPERATURE.

FIGURE 1
FLANGED THERMOWELL WELDED CONSTRUCTION



RETAINING FLANGE:
 MACHINE FROM BLIND FLANGE TO ANSI B16.5 (INCH DIMENTIONS)
 OR BS 1560:PT.2 FLANGE CLASS AND DIAMETER OF FACING
 (RAISED FACE OR JOINT RING) SHALL BE IN ACCORDANCE
 WITH THE APPLICABLE PIPING SPECIFICATION OR VESSEL DESIGN.

SIZE : NPS 1 1/2 (DN 40) FOR SCHEDULE 160 NOZZLES
 NPS 1 (DN 50) FOR HEAVIER WALL NOZZLES.

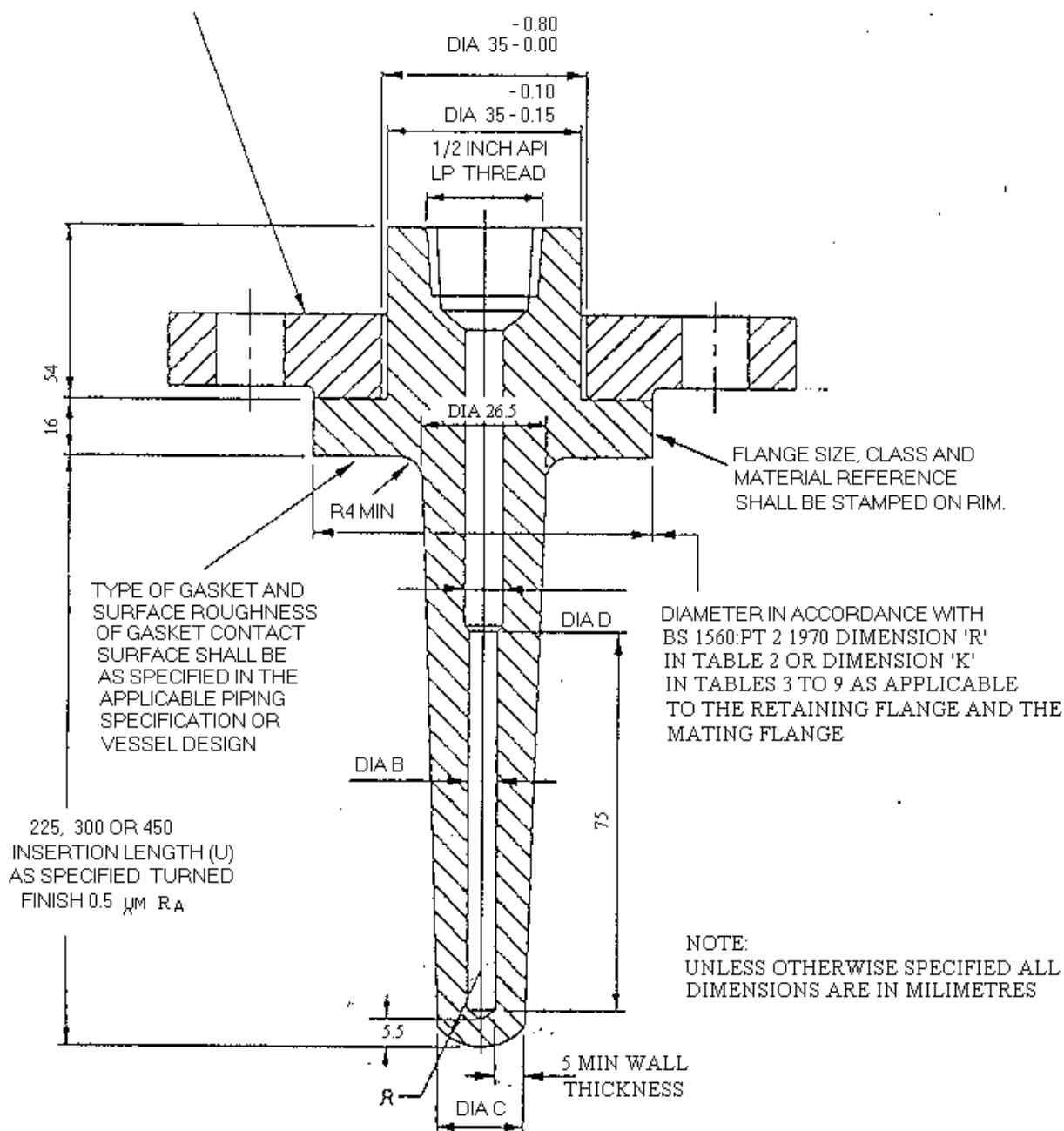


FIGURE 2
FLANGED THERMOWELL WITH RETAINING FLANGE

APPLICATION:

FOR USE WITH RAISED FACE OR SOLID METAL RING-JOINT FLANGES TO [ANSI B16.5](#) (INCH DIMENSIONS) OR [B1560](#):PT.2. UP TO AND INCLUDING CLASS 2500.

MAXIMUM WORKING PRESSURE AND TEMPERATURE:

AS SPECIFIED BY [ANSI B16.5](#) FOR THE CLASS OF THE RETAINING FLANGE

MINIMUM WORKING TEMPERATURE:

MINIUS 200°C

CONSTRUCTION:

POCKET:
RETAINING FLANGE

FORGED AS A SINGLE PIECE.
IN ACORDANCE WITH [ANSI B16.5](#) OR [BS1560:PT2](#)

MATERIALS OF CONSTRUCTION:

POCKET:
RETAINING FLANGE:

[BS 1503 316S31](#), [BS1503 316S33](#), OR [ASTM A182 F316](#)
IN ACCORDANCE WITH THE APPLICABLE PIPING SPECIFICATION OR VESSEL DESIGN

MATERIALS:

SPECIAL THE USE OF MATERIALS OTHER THAN SPECIFIED ON THIS DRAWING SHALL BE SUBJECT TO APPROVAL BY BP.

BORE:

BORING SHALL BE CARRIED OUT ON A GUN- DRILLING MACHINE TO ENSURE STRAIGHTNESS AND GOOD FINISH

FOR THERMOCOUPLES & RESISTANCE ELEMENTS, DIMENSIONS SHALL BE IN ACCORDANCE WITH THOSE LISTED IN THE FOLLOWING TABLE FOR ELEMENT DIA 6

FOR FILLED SYSTEMS, E.G. MERCURY IN STEEL, THE BORE SHALL SUIT VENDOR'S EQUIPMENT. TYPICAL DIMENSIONS ARE SHOWN IN THE FOLLOWING TABLE.
FOR INTERMEDIATE SIZES, DIMENSIONS SHALL BE DETAILED

ELEMENT DIA	6	TYPICAL MAX 1.3
DIA B	6,2 1 1 0 1	13,2 1 0 1
DIA C	18	25
DIA D	8	15
RAD R	12 1 2	17 1 2

ALL OTHER DIMENSIONS 10.5

HEAT TREATMENT:

FORGING SHALL BE SOLUTION ANEALED AT 1050°C FOR 1 HOUR PER 25 mm OF SECTION (MINIMUM PERIOD 1 HOUR), FOLLOWED BY WATER QUENCH. NO HEAT TREATMENT REQUIRED AFTER MACHINING.

TEST PRESSURE:

FINISHED THERMOWELL SHALL BE SUBJECTED TO AN EXTERNAL TEST PRESSURE OF 1.5 TIMES THE MAXIMUM NON-SHOCK WORKING PRESSURE RATING FOR THE MATERIAL AND CLASS OF FLANGE AT AMBIENT TEMPERATURE.

FIGURE 2
FLANGED THERMOWELL WITH RETAINING FLANGE



DEFINITIONS AND ABBREVIATIONS

Definitions

Standard definitions may be found in the BP Group RPSE's Introductory Volume

Abbreviations

API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BICERI	British Internal Combustion Engine Research Institution
BS	British Standard
EEMUA	Engineering Equipment and Materials Users Association



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.

British Standards

BS 1501 Part 3	Specification for Steel Forgings for Pressure Purposes
BS 1502	Specification for Steels for Fired and Unfired Pressure Vessels: Sections and Bars
BS 1503	Specification for Steel Forgings for Pressure Purposes
BS 1506	Specification for Carbon, Low Alloy and Stainless Steel Bars and Billets for Bolting Material to be used in Pressure Retaining Applications
BS 1560	Circular Flanges for Pipes, Valves and Fittings (Class designated)
BS 2050	Specification for Electrical Resistance of Conducting and Anti-Static Products made from Flexible Polymeric Material
BS 5304	Safety of Machinery
BS 5500	Specification for Unfired Fusion Welded Pressure Vessels

American

API 613	Special-Purpose Gear Units for Refinery Services (to be replaced by ISO 13711)
API 618	Reciprocating Compressors for General Refinery Services (to be replaced by ISO 13707)
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASME PTC 9	Displacement Compressors, Vacuum Pumps and Blowers



ASTM A182	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A240	Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
ASTM F316	Pore Size Characteristics of Membrane Filters by Bubble Point and Mean Flow Pore Test
ISO 1813	Anti-Static Endless V-Belts; Electrical Conductivity and Method of Test
BP Group Documents	
BP Group GS 112-16	Electrical Requirements for Packaged Equipment
BP Group GS 118-8	Tube End Welding of Heat Exchanger Tubes (replaces BP Std 191)
BP Group GS 130-2	Instrumentation for Rotating Machinery (replaces BP Std 128)
BP Group GS 134-10	Special Purpose Gear Units to API 613 (replaces BP Std 202)
BP Group GS 136-1	Materials for Sour Service to NACE Std MR0175-90 (replaces BP Std 153)
BP Group GS 146-2	Unfired Pressure Vessels: Vessels to BS 5500 (replaces BP Std 194 pt 1)
BP Group GS 146-4	Unfired Pressure Vessels: Vessels not exceeding 20 mm thick (replaces BP Std 194 Pt 3)

