PROCUREMENT (SUPPLY), CONSTRUCTION, INSTALLATION/ERECTION, PRE-COMMISSIONING, & COMMISSIONING ASSISTANCE FOR NEW CENTRIFUGAL COMPRESSORS AND MODIFICATION WORKS OF EXISTING TURBO COMPRESSOR TRAINS FOR QADIRPUR COMPRESSION PROJECT

TENDER ENQUIRY NO. PROC-FC/CB/PROJ/QP-4369/2019

POST-BID CLARIFICATION No. OGDCL-QP-4369-012

Sr. No.	Bidder Query	OGDCL/ENAR Response (28-Oct-2019)
1	Refer to BOQ M2B, PS-307B (INSTALLATION OF MISCELLANEOUS EQUIPMENT & ITEMS) scope mentioned "scope involves the installation of PSV's, fire hydrants, fire monitors & hose box complete in all respect -----" However BOQ line items showing installation of PSV's and Strainer of different sizes. Please clarify installation of fire hydrant, monitor, hoses not in bidder scope.	Installation of Fire hydrants, Fire monitors & Hose boxes are not in scope of Bidder.
2	Refer to insulation specification Spec. No. 0220-PA-2003, page 10/18, please provide spec for P Type insulation as in specification referred clause 6.1 & 6.2 is missing.	This is a typo error, revised Specification for Insulation (0220-PA-2003 Rev-1) is attached.

Job No. **14-0220**	
Spec. No. **0220-PA-2003**	
Page **1** of **18**	Rev. **1**

SPECIFICATION FOR APPLICATION OF INSULATION ON LINES

Project: **QADIRPUR COMPRESSION PROJECT**

Client: **Oil & Gas Development Company Limited (OGDCL)**

Prepared by:	MR
Checked by:	SFA
Approved by:	TH
Revised by:	-

Rev.	Description of Revision	Date	Revised Page Nos.
1	ISSUED FOR BIDDING	Oct,28 2019	
0	FOR REVIEW AND APPROVAL	May,20 2019	

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1.0 SCOPE

The present specification covers the minimum requirement for the manufacture supply and installation for piping and equipment for Installation of new centrifugal compressor at Qadirpur. The specification applies equally to work carried out at the PC Contractors work as well as at the final site.

2.0 CODES STANDARDS AND REGULATIONS

2.1 All insulation materials, installation and inspection shall as minimum, comply with the requirement of this specification, its attachments and the latest editions of the followings codes, standards and regulations (where applicable):

BS 874 Methods for determining insulating properties with definitions of thermal insulating terms

BS 5422 Specification for the use of thermal insulating materials

BS 5970 Thermal insulation of Pipe work and Equipment

PC Contractor may offer insulation supplied in accordance with other codes and standards provided that they are equal to the above and that OGDCL/Engineering Consultant gives approval prior to commencement of work.

All insulation materials, installation and inspection shall as minimum comply with the requirements of this specification, its attachments and the latest additions of the following codes, standards and regulation where applicable

Insulations must supplied in accordance with other codes and standards procedure that they are equal to the above and that OGDCL/Engineering Consultant gives full approval prior the commencement of work.

Note: *All deviations from the requirement of this specification, its attachment and the reference codes and standards shall be stated in the Tender. In the absence of such a statement full compliance will be assumed.*

3.0 APPLICATION

3.1 **Application to Piping and Equipment**

3.2 Fillings flange and valve insulation covers shall be fabricated from the same material and insulation thickness as specified for the adjacent piping.

Note: *The cover shall be of two pieces removable type and shall be secured with the required specified band and seals. Except surface of screwed or socket welded valves in preference to cladding.*

3.3 Valves and flanges shall not be insulated until permission is obtained from OGDCL/Engineering Consultant.

3.4 The insulation of bends and fittings shall be continuous from the adjacent pipe erection of metal elbows etc. and fitting the void between cladding and pipe with loose insulation is permitted.

3.5 On vertical insulated pipe, the PC Contractor shall supply and install insulation supports at 3700mm pitch. Welding is not permitted on any lines or equipment. Tee branches and pipe support brackets may be utilized as insulation supports.

3.6 Supports vessels should be spaced to suit the insulation but in no case should exceed 3700mm vertical pitch and should be an integral part of the equipment as delivered.

3.7 Suitably oversized insulation material shall be used on traced services to ensure that no burying of the tracer occurs in the insulation. A layer of 0.06mm aluminum foil shall be applied to the line prior to the application of the insulation.

3.8 Unless otherwise noted, insulation shall not normally be applied to fans compressors, pumps and other rotating equipment, valves and flanges, vessel man-way covers, nozzle and flanges on equipment. The exception to this shall be:

- Heat traced lines and equipment
- Where operating temperature exceeds 95ºC

3.9 Bonnet and channel flanges on heat exchangers shall be insulated by means of a removable double skin box. On large exchangers boxes insulation shall be in two or more parts and no part shall weigh more than 25 kg.

3.10 The insulation surrounding equipment nameplates, which indicate design and/or operating data shall be neatly trimmed and seated so that the nameplates are clearly visible.

3.11 For the purpose of taking shell or pipe thickness measurements a removable section of insulation shall be provided as and where indicated by OGDCL/Engineering Consultant. The PC Contractor shall supply design details for approval.

3.12 Single layer insulation shall be applied to pipe and vessels with lateral joints in a staggered arrangement. All joints shall be tightly butted and fitted together so as to eliminate voids. Large voids shall be eliminated by refitting or replacing insulation. Additional layers of pipe insulation, where required, shall be applied in the same manner as the first layer, with lateral and end joints staggered over the preceding layer so that no joints coincide, except where they cross at right angles. The outer layer of insulation shall be secured with specified bands and seals on approximately 600mm centers. Inside layers shall be secured with wire on approximately 600mm centers. With double layer insulation, the thickness or any single layer shall not exceed 50mm.

3.13 Where flanges or flanged fittings are not being insulated, the insulation shall be cut to a 45º bevel and sealed to the pipe adjacent to each side of the flange or flanged fittings to allow bolt removal without damaging the insulation.

3.14 Expansion joints shall be installed in insulation for horizontal and vertical straight run piping and vessels in increments of not more than 12 meters. When flanged fittings or valves are installed within this limit, the joint shall be provided for in flange or valve cover only.

Expansion joints shall have a 12mm space between adjoining pipe insulation sections. Insulation cover the joint shall be of a specified thickness of insulation and shall extend one and one-half times the insulation thickness on each side of the 12mm space.

3.15 Specified sheet cladding shall be applied over all pipe and vessel insulation. The cladding shall be installed with seams and laps arranged to shed water. The cladding on vessels shall be secured with specified bands on 1000mm centers and hardened steel screws on 150mm centers. All joints in the cladding shall have an overlap of 50mm minimum and shall be sealed with non-setting mastic.

On vertical piping and vessels the cladding shall be supported with 50mm 'S' clips secured to the next lower section. The 'S' clips shall be made from the specified banding. Cladding shall not be installed over any insulation that is not thoroughly dry. Spring buckles or bands, which will allow for expansion, shall be used on vessels where necessary.

3.16 Polyvinyl acetate weather-barrier coating may be applied to insulated surfaces of screwed or socket welded valves in preference to cladding.

3.17 The surface of insulation shall receive an adhesive coat of polyvinyl acetate mastic. While still tacky, glass-reinforcing cloth per clause 6.2.5 shall be stretched taut and thoroughly embedded in the coating, care being exercised that the weave is not stretched and that the cloth is overlapping approximately 40 mm. Before the Surface becomes dry to touch, a second coating shall be applied and allowed to dry. Total dry thickness of coating shall be 3.5 mm minimum.

3.18 Cloth shall not be visible on the finished surface. Weather coating shall extend 75mm under cladding adjacent to fittings prior to application of the galvanized sheet cladding.

All sharp corners of insulation shall be rounded and the weather coating provided with a double layer of reinforcing cloth.

3.19 Coating shall not be applied when the atmospheric temperature is such that condensation of moisture and ultimate freezing may occur on the finished surface within 24 hours from time of application. Polyvinyl acetate weather-coating shall not be thinned with water.

3.20 **Materials for Hot Services**

Insulation – Class H

Material	**Temp Range**	**Application**
Mineral Wool preformed Section (100 kg/m^3)	Up to 350ºC	Piping and Equipment below 36" OD
Mineral Wool Stabs (65-80 kg/m^3)	Up to 350º	Equipment above 36" OD
Mineral Wool Section Slabs, (144 kg/m^3)	Up to 650ºC	Equipment and Piping
Mineral Wool Wired Blanket (90 kg/m^3)	Up to 450ºC	Removable boxes for Equipment and irregular surfaces
Mineral Wool Wired Blanket (48 kg/m^3)	Up to 50ºC	Irregular Surfaces
Mineral Wool Stabs (48 kg/m^3)	Up to 250ºC	Rectangular Equipment

Insulation Securement – Class H

Material	**Spacing**	**Application**
1.6mm soft. Annealed Stainless Steel Wire	300mm	Equipment and Piping Up to 1500mm OD Inner Layer
12mm wide by 0.5m Stainless Steel	300mm	Equipment and Piping 250mm

Type 316 Banding		OD to 600 mm OD
18mm wide by 0.5mm Stainless Steel type 316 Banding	300mm	Equipment and Piping above 600mm OD upto 1500mm OD
25mm wide by 0.5 mm Stainless Steel type 316 Banding	300mm	Equipment and Piping above 600mm OD upto 1500mm OD
9mm Dia. Weld pins and self adhesive double prong clips	As necessary	Irregular Surfaces or as required

Insulation Cladding - Class H

Material	**Application**
Stainless Steel Type 304 Sheet 0.5mm thick	Piping and Equipment upto 300mm OD
Stainless Steel Type 304 Sheet 0.5mm thick	Piping & Equipment 350mm to 1500mm OD
Corrugated Stainless Steel type 304 Sheet	Equipment above 1500mm OD

Cladding Securement – Class H

Material	**Spacing**	**Application**
12mm × No. 10 Stainless Steel self-tapping screws.	150mm	Equipment and Piping
Stainless Steel type 316 Banding 12mm wide × 0.5mm thick	700mm	Equipment and Piping above 300mm OD to 1500mm OD
Stainless Steel Type 316 Banding 25mm wide × 0.5mm thick	1000mm	Equipment and Piping above 1500mm OD

Coating and Mastics – Class H

Material	Application
Fire Resistive Mastic and Glass cloth. Natural or impregnated with material compatible with the mastic.	Piping insulation terminations at flanges and valves etc. Insulation finish on horizontal equipment heads, screwed and socket weld fittings.
Non Setting Mastic	Sealing against water ingress on removable items
Sealing Mastics	Sealing against water ingress at sheeting joints/laps/cut-outs etc.

3.21 **Application Requirements: Personnel Protection – Class P**

3.21.1 Where personnel protection is specified on the Piping Line List, all piping, valves, flanges, nozzles and equipment within 2 meters height and one meter reach of walkways, working platforms, ladders etc., Shall be insulated, or otherwise guarded or screened.

3.21.2 Where design temperature is at 55ºC and above, the protection shall be by means of either:

- A suitable guard or screen (e.g. extended hand railing or weld mesh shied)

Or

- Application of hot insulation

This shall be in accordance with sections 3 of this specification with the exception of the insulation thickness, which shall be in accordance with Table II.

3.21.3 Where the design temperature is –25ºC and below, the protection shall be by means of a suitable guard or screen. (e.g. Extended hand railing or weld mesh shield).

3.22 **Application Requirements: Fire Roofing – Class F**

3.22.1 Application to Piping and Equipment

3.22.2 Piping and equipment shall be clad with fireproofing insulation where specified in the Piping Line List or on the P&IDs.

3.22.3 Valves, flanges and equipment shall not be insulated until permission is obtained from OGDCL/Engineering Consultant.

3.22.4 Fittings, flanges and valve insulation covers shall be fabricated from the same material and insulation thickness as specified for the adjacent piping. The covers shall be of the two-piece removable type and shall be secured with the required specified bands and seals.

3.22.5 The insulation of bends and fittings shall be continuous from the adjacent pipe. Erection of metal elbows, etc. and fitting of the void between cladding and pipe with loose insulation shall not be permitted.

3.22.6 On vertical insulated pipe, the PC Contractor shall supply and install insulation supports at 3700mm pitch. Welding is not permitted on any lines or equipment. Tee branches and pipe support brackets can serve as insulation supports.

3.22.7 Supports vessels shall be spaced to suit the insulation but in no case should exceed 3700mm vertical pitch and shall be an integral part of the equipment as delivered.

3.22.8 Items which are removable for routine maintenance, e.g., man-way covers on vessels, bonnet

and channel flanges on heat exchangers, shall be insulated by means of a removable double skin box. On large equipment boxes shall be in two or more parts and no part shall weigh more than 25 kg.

3.22.9 The insulation surrounding equipment nameplates, which indicate design and/or operating data shall be neatly trimmed and sealed so that the nameplates are clearly visible.

3.22.10 For insulation surrounding equipment nameplates, which indicate design and/or operating data shall be neatly trimmed and sealed so that the nameplates are clearly visible.

3.22.11 Single layer insulation shall be applied to pipe and vessels with lateral joints in a staggered arrangement. All joints shall be tightly butted and fitted together so as to eliminate voids. Large voids shall be eliminated by re-fitting or replacing insulation. Additional layers of pipe insulation, where required, shall be applied in the same manner as the first layer with lateral and end joints staggered over preceding layer so that no joints coincide, except where they cross at right angles. The outer layer of insulation shall be secured with specified bands and seals on approximately 600mm centers. With double layer insulation, the thickness of any single layer shall not exceed 50mm.

3.22.12 Expansion joints shall be installed in insulation for horizontal and vertical straight run piping and vessels in increments of not more than 12 meters. When flanged fittings or valves occur within this limit, the joint shall be provided for in flange or valve cover only. Expansion joints shall have 12mm space between adjoining pipe insulation sections. Insulation cover over the joint shall be of a specified thickness of insulation and shall extend one and one-half times the insulation thickness on each side of the 12mm space.

3.22.13 Specified sheet cladding shall be applied over all pipe and vessel insulation. The cladding shall be installed with seams and laps arranged to shed water. The cladding on vessels shall be secured with specified bands on 1000mm centers and hardened steel screws on 150mm centers. All joints in the cladding shall have an overlap of 50mm minimum and shall be sealed with non-setting mastic.

On vertical piping vessels, the cladding shall be supported with 50mm 'S' clips secured to the next lower section. The 'S' clips shall be made from the specified banding. Cladding shall not be installed over any insulation that is not thoroughly dry. Spring buckles or bands, which allow for expansion, shall be used on vessels where necessary.

3.23 Materials for Fireproofing Services

3.23.1 Insulation Class - F

The fireproofing insulation shall be calcium silicate to ASTM C-533, Type II and shall have thermal conductivity of 0.11 W/m per ºC based on 540ºC mean temperature.

The insulation shall be supplied in blocks which must retain their shape and function effectively for a minimum period of twenty minutes when exposed to a surface temperature of 900ºC.

It is to be capable of being easily cut and shaped using conventional hand tools and shall be applied as follow:

Performed sections	Piping and equipment below 36" OD
Slabs	Equipment above 36" OD

3.23.2 Insulation Securement – Class F

Material	Spacing	Application
1.6mm Soft Annealed Stainless Steel Wire	600mm	Equipment and Piping up to 1500mm OD Inner layer
12mm wide by 0.5m Stainless Steel Type 316 Banding	600mm	Equipment & Piping 250mm OD to 600mm OD
1.8mm wide by 0.5mm Stainless Steel Type 316 Banding	600mm	Equipment and Piping above 600 mm OD to 1500mm OD
25mm wide by 0.5mm Stainless Steel Type 316 Banding	600mm	Equipment above 1500mm OD

3.23.3 **Insulation Cladding – Class F**

Material	Equipment
Stainless Steel type 316 Sheet 0.5mm thick	Piping and Equipment up to 300mm OD
Stainless Steel Type 316 Sheet 0.5mm thick	Piping & Equipment 350mm to 1500mm OD
Corrugated Stainless Steel type 316 Sheet	Equipment above 1500mm OD

3.23.4 **Cladding Securement – Class F**

Material	Spacing	Application
12mm × No.10 Stainless Steel Self tapping screws	150mm	Equipment and Piping
Stainless Steel Type 316 Banding 12mm wide × 0.5mm thick	1000mm	Equipment and Piping above 1500mm OD
Stainless Steel Type 316 Banding 25mm wide × 0.5mm thick	1500mm	Equipment and Piping above 1500mm OD

3.23.5 **Cladding and Mastics – Class F**

Material	Application
Fire Resistive Mastic and Glass cloth. Natural or impregnated with material compatible with the mastic	Piping insulation terminations at flanges & valves etc. Insulation finish on horizontal equipment heads, screwed and socket weld fittings.
Non Setting Mastic	Sealing against water and

	vapor ingress on removable items.
Sealing Mastics	Sealing against water and vapor ingress at sheeting joints. Laps/ Cutouts, etc.,

3.24 **Insulation Thickness**

The insulation thickness for piping, vessels and tanks shall be 25mm unless otherwise stated on the P&IDs

TABLE – I

Thickness of insulation for heat conservation - Class H

Thickness of insulation mm at Hot Face Temperature ºC

Nominal Diameter of Pipe mm (in)		Temp up to 100	150	200	250	300
25	(1)	40	50	50	65	65
40	(1½)	40	50	65	65	65
50	(2)	40	50	65	65	65
80	(3)	40	50	65	65	65
100	(4)	50	50	65	75	90
150	(6)	50	65	75	75	100
200	(8)	65	65	75	75	115
250	(10)	65	65	75	100	115
300	(12)	65	65	75	100	115
350	(14)	65	65	75	100	115

400	(16)	65	65	75	100	115
450	(18)	65	65	75	100	115
500	(20)	75	75	75	100	125
550	(22)	75	75	100	100	125
600	(24)	75	75	100	100	125
And above						

Hot face Temperature is defined as Maximum Operating Temperature.

TABLE – II

Thickness of insulation for personnel Protection - Class P

Thickness of insulation mm at Hot Face Temperature ºC

Nominal Diameter of pipe mm (in)		**Temp up to 100**	**200**	**250**	**300**	**350**
25	(1)	20	25	30	30	30
40	(1½)	20	25	30	30	30
50	(2)	20	25	30	30	40
80	(3)	20	30	30	30	40
100	(4)	20	30	30	40	50
150	(6)	20	30	40	40	50
200	(8)	20	30	40	50	60
250	(10)	20	30	40	50	60
300	(12)	20	30	40	50	60
350	(14)	20	40	50	60	70
400	(16)	20	40	50	60	70
450	(18)	30	50	60	70	80
500	(20)	30	50	60	70	80
600	(24)	30	50	60	70	80
And above						

Hot face Temperature is defined as Maximum Operating Temperature

4.0 INSPECTIONS

4.1 OGDCL/Engineering Consultant shall have the right to inspect all work and materials on site or at the PC Contractor's work.

4.2 Of during Inspection any work related to insulation find out below or material standards and specifications as defined than under must be responsible for the further correctness of the materials or work in immediate fashion or work in immediate fashion.