

एकसीयल तथा सेन्ट्रीफ्यूगल कम्प्रेसरों तथा एक्सपेन्डर-कम्प्रेसरों के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR AXIAL AND CENTRIFUGAL COMPRESSORS AND EXPANDER-COMPRESSORS

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Abbreviations:

API	:	American Petroleum Institute
ASME	:	The American Society of Mechanical Engineers
EQC	:	Equipment Qualification Criteria
PDF	:	Portable Document Format
P&ID	:	Piping and Instrumentation Diagram
PTC	:	Power Test Codes
PTR	:	Proven Track Record
VDR	:	Vendor Data Requirements
QA	:	Quality Assurance
DCIM	:	Document Control Index Module
EDMS	:	Electronic Document Management System

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Chapter 1

General Requirements

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1.0 SCOPE

- (i) This specification together with the attendant data sheets and other specifications/ attachments to inquiry/ order defines the minimum requirements for axial compressors, single-shaft and integrally-gear process centrifugal compressors, and expander-compressors for all types of services [except for packaged, integrally-gear centrifugal plant & instrument air compressors, fans or blowers that develop less than 0.35 kgf/cm² (34 kPa) pressure rise above atmospheric pressure and hot gas expanders over 300°C], including their drivers and drive mechanisms, reducing gears, if any, lubricating/sealing systems, controls, safety devices and instrumentation, and other auxiliary equipment.
- (ii) Vendor shall make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order. In case deviations are considered essential by the vendor (after exhausting all possible efforts) these shall be separately listed in the vendor's proposal under separate section titled as "List of deviations/exceptions to the inquiry document". Deviation shall be listed separately for each document with cross reference to Page No./Section/Clause No./Para etc. of the respective document supported with proper reasons for the deviation for purchaser's consideration. Any deviation not listed under the above section, even if reflected in any other portion of the proposal shall not be considered applicable. No deviation or exception shall be permitted without the written approval of the purchaser.
- (iii) Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions. In case the vendor considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section along with his proposal and include the same in his scope of supply.
- (iv) Except as modified herein, the main equipment and their auxiliaries shall be designed, manufactured, tested and supplied strictly in accordance with the **API Standard 617, Seventh Edition, July 2002, "Axial and Centrifugal Compressors and Expander-compressors for Petroleum, Chemical and Gas Industry Services."**
- (v) Except for new paragraphs, the number and title of the paragraphs in the following Modifications to **API Standard - 617** correspond to the respective sections and paragraphs of the above standard. Paragraphs not addressed in this specification shall be strictly in accordance to **API Standard 617, Seventh Edition July 2002** requirements.

The word in parenthesis following the number or title of a paragraph indicates the following:

(Addition)	:	An addition to a part, section or paragraph referred to.
(Modification)	:	An amplification or rewording has been made to a part of the corresponding section or paragraph but not a substitution replacing the entire section or paragraph.
(Substitution)	:	A substitution has been made for the corresponding section or paragraph of the standard in its totality.
(New)	:	A new section or paragraph having no corresponding section or paragraph in the Standard.
(Delete)	:	This paragraph is deleted.

SECTION 1 - GENERAL

1.1 SCOPE (Substitution)

The entire paragraph excepting Paragraph 1.1.1 and 'NOTE' is substituted by paragraph 1.0 above

1.2 ALTERNATIVE DESIGNS (Delete)

1.3 CONFLICTING REQUIREMENTS (Substitution)

In case of conflict between this specification and the attendant data sheets, job specifications (if any) and other attached specifications the following order of precedence shall govern:

1. Equipment Data Sheets.
2. Job Specifications (if any)
3. P&ID's (if any)
4. This specification
5. Other specifications
6. Other referred codes and standards

1.5 DEFINITION OF TERMS

1.5.45 Standard Volume Flow (Modification)

Nm³/hr is an abbreviation for capacity in normal cubic meters per hour referred to 1.033 kg/cm²a pressure, 0°C temperature with a compressibility factor of 1.0 and 0% relative humidity.

Sm³/hr is an abbreviation for capacity in standard cubic meters per hour referred to 1.033 kg/cm²a pressure, 15°C temperature with a compressibility factor of 1.0 and 0% relative humidity.

1.6 NORMATIVE REFERENCES

1.6.4 (Modification)

The editions of referenced publications that are in effect at the time of inquiry or at a date specified in the inquiry document shall be applicable.

1.6.5 (Modification)

Equipment supplied shall comply with applicable US Standards. However ISO Standards ISO-1940 & ISO-8821 will also be applicable.

1.8 UNIT RESPONSIBILITY (Addition)

Unless otherwise specified, vendor having unit responsibility shall be as defined in Clause# 1.3 of Chapter-2 (Centrifugal & Axial Compressor), Clause# 1.3 of Chapter-3 (Integrally Geared Compressors) & Clause# 1.3 of Chapter-4 (Expander-Compressors).

SECTION 2 - BASIC DESIGN

2.1 GENERAL

2.1.1 Performance

2.1.1.3 (Modification)

Unless otherwise specified the compressor shall be designed to deliver the rated head and rated capacity without negative tolerance.

The BkW at the above condition shall be guaranteed with zero positive tolerance.

2.1.5.1 (Modification)

Unless otherwise specified, cooling water system (jackets, diaphragms, internal coolers, and so forth) shall be designed for the following condition:

Velocity over heat exchanger surface	:	1.5 - 2.5 m/sec.
Maximum Allowable Working Pressure	:	8.0 kg/cm ² g
Test Pressure (1.5 X MAWP)	:	12.0 kg/cm ² g
Maximum Pressure Drop	:	1.0 kg/cm ²
Maximum Inlet Temperature	:	33°C
Maximum Outlet Temperature	:	45°C
Maximum Temperature Rise	:	12°C
Minimum Temperature Rise	:	6°C
Fouling Factor on Water Side	:	0.0004 m ² hr °C/kcal
Shell Side Corrosion allowance	:	3.2 mm

2.1.9 (Modification)

Unless otherwise specified, the maximum permissible sound pressure level of the compressor-driver train shall not exceed 88 dBA measured at 1 meter from the equipment surface for the recommended range of operation.

2.1.14 (Substitution)

All electrical components and installations shall be suitable for the hazardous area classification and gas group specified in the inquiry/order documents.

2.2 MATERIALS

2.2.1.2 (Modification)

Add to this clause: Equivalent materials in accordance with other internationally recognised standards are acceptable.

2.2.1.15.3 (Modification)

Unless otherwise specified, minimum design metal temperature shall be the minimum surrounding ambient temperature or minimum temperature of compressed gas, whichever is lower.

2.2.4.1 (Modification)

Add to this clause: Welders qualified with other internationally recognised standards are acceptable.

2.3 CASINGS

2.3.1 Pressure containing Casings

2.3.1.11.6 (New)

Unless specified otherwise, 100% radiography inspection shall be done in the case of connections welded to pressure castings. In addition cast compressor casings shall be radiographed in critical areas (critical areas are generally defined as those areas where there is a major change in section thickness or direction).

2.3.2 Pressure Casing Connections

2.3.2.1 General

2.3.2.1.6 (Addition)

All casing drain connections shall be valved and brought to a common header terminating with a valve so that the Purchaser has to make a single connection. This common header valve shall be brought to the skid edge and supported.

2.3.2.2 Main Process Connections

2.3.2.2.7 The words 'when specified' stand deleted.

2.6 DYNAMICS

2.6.7 Torsional Analysis

2.6.7.1 (Modification)

Unless specified otherwise, the compressor vendor shall perform a composite torsional vibration analysis of the complete coupled train and shall be responsible for the satisfactory mechanical performance of the train. Other manufacturers providing components for the system shall provide the necessary data to the compressor manufacturer, who shall submit to the Purchaser a complete torsional analysis report.

2.6.8 Vibration and Balancing

2.6.8.2 (Addition)

The final balancing of the rotor assembly shall be carried out along with the coupling half.

2.6.8.2.1.1 (Modification)

The words 'when specified' stand deleted.

2.6.8.3 (Modification)

When the vendor's standard balance method is by operating speed balancing in lieu of sequential low speed balancing, the same is also acceptable.

2.6.8.7 (Modification)

The words: "when specified" stands deleted.

For rotors that are high speed balanced, a low speed residual unbalance check shall be performed in a low speed balance machine. This is done to provide a reference of residual unbalance and phase for future use in a low speed balance machine.

2.8 SHAFT END SEALS

2.8.1 General

2.8.1.1 (Modification)

Where settling out pressure is not specified by the purchaser, settling out pressure shall be taken as equal to the rated discharge pressure of the compressor.

2.8.3 Oil Seals

2.8.3.4 (Modification)

Mechanical contact type seals shall incorporate a suitable design feature to prevent process gas leakage when the compressor is pressurized and not running and the seal oil system is shut down.

2.8.4 Self Acting Dry Gas Seal

2.8.4.1 (Modification): Unless otherwise specified, Tandem DGS with intermediate labyrinths (Fig. 1.C-9) shall be used for toxic or flammable gases.

2.8.4.5 (New): The lift off speed of seal faces shall always be below the compressor train minimum operating speed including the shop speed for performance test.

SECTION 3 - ACCESSORIES

3.1 DRIVERS

3.1.4 (Modification)

Steam turbine driver shall be capable of continuously developing 110% of the maximum power required for the specified conditions while operating at the corresponding speed under specified steam conditions (minimum inlet steam condition and maximum steam outlet condition, unless specified otherwise).

3.1.7 (Modification)

The base continuous rating of the gas turbine driver at rated site conditions of temperature, altitude, humidity, intake/exhaust pressure losses, shall be as a minimum 110% of the greatest power required by the compressor under any of the specified operating conditions including gearbox and all transmission losses.

3.2 COUPLINGS AND GUARDS

3.2.2 (Modification)

Unless otherwise specified, coupling shall be of non-lubricated diaphragm/stainless steel flexible membrane type, as per API Standard 671.

3.3 MOUNTING PLATES

3.3.1 General

3.3.1.2.6 (Substitution)

Unless otherwise specified, anchor bolts will be furnished by the vendor.

3.3.2 Baseplates

3.3.2.1 (Modification)

Unless otherwise specified, the complete compressor unit, including gear and driver, shall be mounted on a single lift base plate of structural steel. There shall be no limits to the size of the base plate other than those derived from transportation, installation (lifting constraints), and/or plant lay-out considerations.

3.3.2.4 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.3.2.6 (Modification)

The words 'when specified' stand deleted.

3.4 CONTROLS & INSTRUMENTATION

3.4.1 General

3.4.1.1 (Substitution)

Minimum instrumentation and process controls as desired by the Purchaser, shall be as specified in the data sheets/job specifications/drawings/general specifications and other documents referenced in the inquiry or order and shall be supplied by the vendor. The vendor shall specify and provide any additional instrumentation and controls as deemed necessary for the smooth and safe operation of the unit under all specified operating conditions. The vendor shall review Purchaser's overall compressor control system for compatibility with the vendor furnished controls/instrumentation.

3.4.2 Control Systems

3.4.2.2 (Modification)

Unless specified otherwise, anti-surge system for compressor shall be furnished by the vendor. The anti-surge system furnished shall enable stable compressor operation at any point on the right side (high flow side) of surge control line.

3.5 PIPING AND APPURTENANCES

3.5.1 General

3.5.1.5 (New)

The vendor shall also supply interconnecting piping between equipment groupings and off-base facilities.

All piping for utilities (cooling water, steam, exhaust gas, purge gas, buffer gas etc.) shall be furnished by the vendor and terminated at the vendor's battery limit (unless otherwise specified, the vendor's battery limit shall be treated as the compressor house battery limit) with single inlet and single outlet flanged connections per service for purchaser's interface.

All vent pipes shall be supplied by the vendor and terminated outside the compressor shelter above the shelter roof level.

To the extent possible all drains shall be manifolded and terminated at the grade level for purchaser's interface. Where manifolding is not feasible/advisable, the individual drains shall be terminated at the grade level. All drains shall be terminated with a flanged valve.

All flare lines required for the package shall be piped by the vendor upto the purchaser's flare header and shall be free draining towards the flare header.

SECTION 4 - INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

4.1 GENERAL

4.1.8 (New)

Rejections made by Purchaser's inspector, based on inspection or tests shall be final. Acceptance by the inspector shall in no way release the vendor from guarantees as to materials, workman-ship, and performance of the equipment inspected.

4.2 INSPECTION

4.2.1 General

4.2.1.5 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

4.3 TESTING

4.3.1 General

4.3.1.2 (Substitution)

At least 12 weeks before the first scheduled test vendor shall submit to the purchaser detailed test procedures for all running tests for his approval.

The test procedure shall as a minimum include the following:

- Test Objectives and Acceptance criteria

- Test Set up (layout) showing the arrangement of equipment & piping system along with location and number of measuring instruments.
- Operating conditions during the test.
- Sequence of various activities during the test starting from preparation for start of test till the final termination of test.
- Sample test log sheets and calculations.

4.3.1.3 (Substitution)

The vendor shall notify the purchaser not less than 4 weeks before the date of scheduled testing and reconfirm the same at least one week before the firm test date.

4.3.6 **Mechanical Running Test**

4.3.6.1.2 (Modification)

The words “when specified” shall be read as “Unless otherwise specified”.

4.3.6.1.3 (Modification)

The words “when specified” shall be read as “Unless otherwise specified”.

4.3.6.1.5 (Modification)

The words “when specified” shall be read as “Unless otherwise specified”.

4.3.8 **Optional Tests**

4.3.8.1 **Performance Test (Addition)**

Unless otherwise specified, all equipment shall be subjected to performance testing in manufacturer's facility.

4.3.8.2 **Helium Test (Addition)**

Casings for compressors handling gas containing 30 mole percent or higher of hydrogen shall be subject to a helium leak test, as defined above.

4.4 **PREPARATION FOR SHIPMENT**

4.4.1 (Modification)

The words “6 months” shall be replaced with the words “8 months”.

SECTION 5 - VENDOR'S DATA

5.1 **GENERAL**

5.1.2 (Substitution)

Refer Clause# 5.3.1.2.

5.2 **PROPOSALS**

5.2.1 **General (Substitution)**

In addition to data specified in clauses 5.2.2 to 5.2.4, the vendor's proposals shall, as a minimum, include the following:

- a. All data sheets, drawings and documents listed under "WITH BID" in the Vendor Data Requirement Form enclosed with the inquiry.
- b. List of recommended commissioning spares included in the offer.
- c. List of insurance spares (where specified by the purchaser) included in the offer.
- d. List of Spare Parts for Two Years Normal Operation

This list shall be made separately for each item including auxiliaries and drivers in the

form of a table & shall show

- i) Part name, description and number.
- ii) Quantity installed in one unit.
- iii) Quantity recommended per unit for 2 years normal operation.
- iv) Quantity recommended for number of units of an item as specified in the inquiry.
- v) Quantity recommended as insurance for the number of units of an item specified in the inquiry.
- e. An itemised list of special tools included in the offer.
- f. Any start-up, shutdown or operating restrictions required to protect the integrity of the equipment.
- g. Any limitations of vendor's test-facility to carryout the specified tests.
- h. A specific compliance statement that the scope of supply, the offered equipment/systems and all its components are in strict accordance with the data sheets, job specifications, this specifications and all other attachments, except for specific deviations as listed in the proposal.

Unless a specific deviation/exception is taken by the vendor at the time of submitting the proposal, it will be understood that final equipment/system shall be designed, fabricated tested and supplied strictly in accordance with Purchaser's specified requirements as covered in the inquiry or order.

5.2.2 Drawings

5.2.2.1 (Addition)

The drawings indicated in the Vendor Data Requirement under "WITH BID" shall also be included in the proposal.

5.2.3 Technical Data

5.2.3 (i) (Addition)

Vendor shall also furnish a consolidated list of all consumables which need to be replaced/replenished periodically (like lube oil, seal gas, greases, any cleaning agent etc.), indicating the total quantity required for the period of commissioning/start-up and one year continuous operation of the unit.

5.2.3 (l) (Substitution)

A list of installations, prepared in a manner so as to give explicit evidence that the offered equipment amply meets the specified design, manufacturing and experience requirements.

5.2.3 (n) (Delete)

5.2.5 Quality Assurance Procedures (Substitution)

Vendor shall furnish his standard QA procedures, duly modified as per requirements of inquiry for the offered equipment.

5.3 CONTRACT DATA

5.3.1 General (Substitution)

5.3.1.1 Drawings and data as required after purchase order has been specified in Vendor Data Requirement. Vendor to note that the drawing/document descriptions/titles as given in the Vendor Data Requirement are generic in nature. It is possible that against one drawing/document specified, there are several drawings to be furnished by the vendor or vice versa. Vendor shall complete & forward a document titled as "Vendor Drawing Schedule", Document Control Index (DCI) to the purchaser (Destination & contact person as per order). This document shall list out in consolidated form all drawings and documents

required by purchaser (As specified in Data Sheets, Specifications and Vendor Data Requirement forms enclosed with the order). Against each drawing/document vendor shall indicate the vendor's drawing number, title, Rev. No., category (whether for information or approval) and schedule of submission.

This shall be the first document to be submitted by vendor within two weeks of order. **No drawing shall be taken up for review till DCI for the inquiry/order is finalized by vendor.**

5.3.1.2 All transmittal letters (covers), drawings and data shall have a title block (in addition to vendor's standard title block) which shall as a minimum contain the following contract information:

- i) Purchaser's and Consultant's Corporate Name
- ii) Project Name.
- iii) Equipment Name and Item No.
- iv) Purchase Order No.
- v) Purchase Requisition No.

Title Block on drawings shall be placed on the lower right hand corner.

5.3.1.3 All vendor data/drawings/documents shall be in English Language and in Metric Systems.

5.3.1.4 Data specified in the VDR is the minimum requirements of Purchaser. Any additional document/data required or requested by Purchaser for engineering or construction shall also be made available by the vendor.

5.3.1.5 Whether or not specified the vendor shall furnish the following, before shipment:

- As built running clearances and when applicable; thrust bearing, radial bearing and seal running clearances.
- A supplementary list of spare parts other than those included in his original proposal. The supplementary list shall include recommended spare parts, cross-sectional or assembly type drawings, parts numbers, materials, prices and delivery period. The vendor shall forward this supplementary list to the purchaser promptly after receipt of the reviewed drawings and in time to permit order and delivery of parts before field start-up.
- A parts list for all equipment supplied. This list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the parts with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number.
- At least 8 weeks before shipment, the vendor shall submit equipment preservation, packaging and shipping procedures to the purchaser for review.

5.3.2 Drawings and Technical Data (Addition)

The number of prints required and the times within which these are to be submitted by vendor are specified in Purchaser's inquiry/order.

The purchaser's review of the vendor's drawings shall not constitute permission to deviate from any requirements in the purchase order/specifications unless specifically agreed upon in writing. After the drawings have been reviewed, the vendor shall furnish certified copies in the quantity specified. All drawings must be clearly legible and shall be folded to 216 mm x 279 mm size.

Drawings/documents with following titles shall contain as a minimum the following information:

a) General Arrangement Drawing

A general arrangement drawing shall indicate:

- Outline dimensions (minimum three views) (All principal dimensions).
- Allowable forces and moments on suction and discharge nozzles.
- Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains lubricating oil, sealing fluid, cooling water, steam & Electrical/Instrumentation.
- Direction of rotation, viewing from the driving end.
- Weight of each assembly/component.
- The weight & location of center of gravity of the heaviest assembly/components that must be handled for erection.
- Identification, weight and dimensions of the heaviest equipment assembly / subassembly / component required to be handled for maintenance.
- Maintenance clearances and dismantling clearances.
- Speeds of Driven Equipment and Driver with Driver rating. Location of driver terminal box (in case of Electric motor Driver).
- Layout of auxiliary equipment and operating platform.
- Make, Type and Size of couplings and the location of guards and their coverage.
- A list of reference drawings if any.
- A list of any special weather-protection and climatic features.
- Equipment furnished (loose) by the vendor for mounting by the purchaser.

b) Foundation Drawings

A foundation drawing shall indicate complete information required for foundation design by purchaser including the following:

- Foundation bolt sizes, pipe sleeve details, pocket sizes and locations.
- Grouting thickness and other necessary technical details.
- Static weight of each skid/independently grouted item and location of center of gravity of each of such skid/items in all three planes.
- Weight distribution for each bolt/subsole plate location and total static weight.
- Dynamic loading caused due to various items grouted independently.
- The direction and magnitude of unbalance forces and moments generated by each such item at the worst operating condition and short circuit moments of motor drivers
- GD^2 value of each item resolved to driver speed.
- Maximum permissible amplitude of vibration on the foundation at base level.
- Total mass of rotating parts.
- Suggested dynamic factor and ratio of foundation weight to weight of skid/equipment as per vendor experience.

c) Layout Drawing (For multi-skid packages)

This drawing shall include atleast the following:

- Layout of all skid/equipment and their auxiliaries, vessels, control panels, exchangers etc. Vendor shall furnish an optimised layout (considering the space allocated, site wind conditions, area classification, the type of equipment located in the vicinity etc.) indicating elevation and dimension of skids/equipment.
- Minimum spacing required between the various skids/equipment and between the skids and the walls/columns/roof for an easy accessibility and maintenance.
- Layout for water piping, trenches for water piping, cable tray/trenches layout.
- Piping arrangement and piping support arrangement/location for piping in vendor's scope.
- Layout for auxiliary equipment and operating platform details.
- Specification for crane/mono rail (including suggested crane/mono rail layout) recommended for maintenance and height of the lifting hook from the centerline of equipment.

d) **Field Alignment Diagram**

The diagram shall indicate the relative displacement to be kept between the centerlines of various equipments at the time of installation, so that under normal running conditions the equipments get fully aligned. This relative displacement should be decided on the basis of centerline temperature rise data of driver, gear box/transmission system, driven equipment.

e) **Heat Exchanger Drawings**

Heat exchanger drawing and data shall include heat and mass balance data, details of provisions for separating and withdrawing the condensate, construction details, cross sections & general arrangement drawings of heat exchangers, vendors recommendations regarding provision for support and piping expansion.

f) **P&I Diagrams (with Bill of Materials)**

Vendor shall supply P&I Diagrams along with Bill of Materials of each system in the vendor's scope of supply or specified in the order. P&I Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID. Vendor's scope and purchaser's scope shall be clearly demarcated. Each item shall be identified by an item No./item tag no., which shall correspond to the item no. shown on the bill of materials. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable. Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing. The legends shall be as per ISA.

g) **Cross-sectional Drawing with Bill of Materials**

The vendor shall supply cross-sectional or assembly type drawings for all equipment furnished showing all parts, design assembly and running clearances, and balancing data required for erection and maintenance. Each part shall be numbered which shall correspond to the part number on the bill of materials. The bill of materials shall include the part no., name of component, materials quantity installed per unit & sizes where applicable (say for bolts, nuts, rings, gaskets etc.). All bought-out items shall also be indicated with make and brief specifications.

A separate cross-sectional drawing showing installation and setting dimensions for the seals shall be furnished.

5.3.5 **Installation, Operation, Maintenance and Technical Data Manuals.**

5.3.5.3 (Substitution)

Refer Clause# 5.3.5.4

5.3.5.4 **Technical Data Manual/Mechanical Catalogue (Substitution)**

5.3.5.4.1 Technical Data Manual is a compilation of "As Built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.

5.3.5.4.2 Not later than two weeks after successful completion of all specified tests, the vendor shall furnish the required number of Technical Data Manuals for the equipment, any auxiliaries and instruments that the vendor is providing. The Technical Data Manual shall include the following documents as a minimum:

- (i) All drawings and data as listed in the vendor data index & schedule. (For drawings, where purchaser's approval is required, the final certified drawings shall be attached.) Sections shall be organised in a manner that data & drawings related to one subject is grouped together such as Mechanical, Electrical, Instrumentation etc.
- (ii) All manufacturing, inspection and test data and records.
- (iii) Installation Manual

The vendor shall provide sufficient written instructions, including a cross-reference list of all drawings, to enable the purchaser to correctly install the equipment and prepare the equipment for start-up. It shall include any special information required

for proper installation that is not on the drawings, special alignment or grouting procedures, utility specifications (including quantity) and all installation data. It shall also contain the following information:

- a) Instructions for erecting, piping, aligning (including the expected thermally induced shaft centerline shift between normal site ambient temperature position and that at normal equipment operating temperature).
 - b) A description of rigging procedures, including the lifting of the assembled equipment, and methods of disassembly, repair, adjustment, inspection and reassembly of the equipment and auxiliaries.
 - c) Pre-commissioning / commissioning / functional test procedures and acceptance criterion.
 - d) Lube and Seal oil, Seal Gas/Purge Gas recommendations.
- (iv) Operation and Maintenance Manual
- This manual shall provide sufficient written instructions and data to enable purchaser to correctly operate and maintain the equipment ordered. It shall include a section to cover special instructions for operation at extreme environmental and/or extreme operating conditions. The following shall be included in this manual:
- a) Instructions covering start-up, normal shutdown, emergency shutdown, operating limits and routine operational procedures.
 - b) A description of equipment construction features and the functioning of component parts or systems (such as control, lubrication, sealing systems etc.).
 - c) Outline and sectional drawings, schematics and illustrative sketches in sufficient details to identify all parts and clearly show the operation of all equipment and components and the methods of inspection and repair. Standardised sectional drawings are acceptable only if they represent the actual construction of the equipment.
 - d) The following maintenance information:
 - Maximum and minimum bearing, labyrinth and seal clearances including any other clearance between moving and stationary parts of the equipment affecting proper running and maintenance of the equipment.
 - Instructions for measuring and adjusting cold clearances, shaft runout, concentricity etc.
 - Rotor float allowance.
 - Interference fits on parts that are required to be removed or replaced for maintenance of normally consumable spares.
 - Balancing tolerances.
 - Lubricating schedules indicating recommended grades of oil, their properties, replacement period etc.
 - Normal maintenance procedure including disassembly procedures.
 - Preventive maintenance schedules and criterion for replacement of parts.
 - Trouble - shooting procedures.
 - e) The following reassembly information:
 - Bolting sequence and torque values for all bolts affecting equipment performance/integrity/safety.
 - Reassembly sequences together with required inspection checks.
 - Adjustment procedures to achieve required positions, clearances, float and so forth.
 - Detailed procedures for pre-operational checks, including settings and adjustments.
 - Seals and coupling installation procedures.
 - Parts list indicating cross-sectional drawings of various assemblies and sub-assemblies, part numbers, materials of construction (ASTM grades) etc.to facilitate identification of parts and for procurement of spares.
- (v) Following information shall also be included in the Technical Data Manual:
- a) Storage instructions for storing and preserving the equipment (including driver and all the auxiliary units) at the plant site before installation of the same.

- b) Instructions for preserving the equipment after it has been installed. This is particularly required in cases where a long time gap is expected between equipment installation and commissioning.
- c) Field performance test procedures and acceptance criterion.

5.3.5.4.3 Technical Data Manual shall be in Hard board folder(s) of size 265 mm x 315 mm and shall not be more than 90 mm thick; it may be of several volumes and each volume shall have a volume number, index of volumes & index of contents of that particular volume.

5.3.5.4.4 Title sheet (Top sheet) of each volume of Technical Data Manual shall contain the contract information as defined under clause 5.3.1.2 besides the volume number.

5.3.5.4.5 In case order contains more than one item, separate dedicated Technical Data Manuals shall be submitted for each item.

5.3.5.4.6 Final drawings & documents shall also be submitted as Electronic Files (preferably in portable document format i.e. PDF) on CD/DVD's.

Chapter 2

Centrifugal and Axial Compressors

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SECTION 1 - GENERAL

1.3 EQUIPMENT QUALIFICATION CRITERIA (New)

- 1.3.1 Unless otherwise specified elsewhere, the Equipment Qualification Criteria (EQC) specified vide para 1.3.2 to 1.3.6 of this specification shall be applied for acceptance of the offered compressor model and its manufacturer.
- 1.3.2 The vendor for the complete unit shall be an established manufacturer of the type of Compressors required and he shall also be the manufacturer of the proposed compressors having adequate design, engineering, manufacturing & testing facilities for the same.
- 1.3.3 The vendor shall have designed, engineered, packaged, tested and supplied in the last TEN (10) years, from the proposed manufacturing plant, at least ONE (1) same type of Compressors which is from the same model series with same type of driver having similar driver power as offered.
As a minimum, this package shall have completed ONE year of satisfactory operation at site, as on the bid due date.
- 1.3.4 The vendor besides satisfying the requirements of clause 1.3.2 & 1.3.3 above shall also be the packager of the complete system proposed and shall have the SINGLE POINT RESPONSIBILITY for the entire package.
- 1.3.5 The compressor model offered shall be from the existing compressor model series and shall be from the regular manufacturing range of the vendor.
The offered compressor model shall meet the following minimum service and manufacturing experience requirements as specified below:
Compressors shall be identical in Model No./frame size and similar in terms of Power rating, Inlet and discharge pressures, Inlet temperatures, Actual Inlet flow, Process Gas, Induction/Extraction Side streams, Speed, Number & Type of Impellers/blades(for axial compressors), Type of Sealing System, Rotor dynamics, Mechanical Design, Materials, Bearing span etc. as compared to at least ONE (1) unit designed, manufactured, tested and supplied from the proposed manufacturing plant in the last TEN (10) years and the reference unit shall have completed ONE year of satisfactory operation at site, as on the bid due date.
- In case all the above parameters are not available from single past reference, more than one reference can be cited / considered to satisfy the above qualification requirement.
- As an alternative vendor may show to the satisfaction to the purchaser, that the equipment offered comprises of components each of which individually satisfies the requirements specified above.
- 1.3.6 In case the vendor is a licensee and does not meet on his own the above criteria as per 1.3.5, he can substitute the references of his Collaborator (licensor) provided the following conditions are met by him:
- 1.3.6.1 The vendor shall be a regular & established manufacturer of specified type of compressor and shall have supplied smaller & larger frame sizes of compressors from the proposed manufacturing plant and proves to the satisfaction of the purchaser that he does possess the manufacturing & testing facilities for the offered compressor.
- 1.3.6.2 His Collaborator (licensor) meets the criteria as per 1.3.5.
- 1.3.6.3 His license agreement is valid & continues to be valid till atleast TWO years after the delivery of the compressors. Necessary documents to establish the same shall be furnished

in proposal.

- 1.3.6.4 The vendor imports the following critical components from his Collaborator (licensor)/Collaborator's sub-vendors.
- Impellers and Diffusers, as applicable.
 - Complete rotor
 - Stationary blades in case of axial compressors
 - Casing, rough machined. Casing includes all pressure containing parts.
 - Bearings
- 1.3.6.5 His Collaborator (licensor) furnishes the detailed design & drawings for critical sections such as
- Housings, supply & return arrangements & partitioning arrangements between lube & seal chamber along with buffer gas induction system.
 - Mixing chambers for side stream induction/extraction
 - Thrust balance system
- 1.3.6.6 His Collaborator (licensor) furnishes a written back up guarantee regarding design, mechanical integrity and performance of the machine equivalent to as if the machines were manufactured & supplied by the Collaborator (licensor).
- 1.3.7 Proven Track Record (PTR)
The vendor shall complete the Experience Record Proformas as enclosed in the inquiry specification to amply prove that the Equipments offered meet the EQC for technical acceptance. Vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for all the above equipments shall also be furnished alongwith the proposal.

SECTION 2 - BASIC DESIGN

2.5 ROTATING ELEMENTS

- 2.5.3.2 (Modification)
Modular rotors shall not be provided for centrifugal compressors.

- 2.5.4.3 (Modification)
The words 'when specified' stand deleted.

2.7 BEARINGS AND BEARING HOUSING

- 2.7.1.1.1 (Modification)
Directed lubricated bearings can also be offered based on compressor manufacturer's proven experience on similar type and size of bearing that have been used on similar sizes of machines, bearing spans, and operating speeds.

2.11 NAMEPLATES AND ROTATION ARROWS

- 2.11.2 (Modification)
Replace the last sentence by "MKS Units shall be used".

SECTION 3 - ACCESSORIES

3.4 CONTROLS & INSTRUMENTATION

3.4.2 Control Systems

3.4.2.2 (Modification)

Unless otherwise specified, control valve shall be in vendor's scope of supply.

3.4.7 Vibration, Position, and Bearing Temperature Detectors

3.4.7.2 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.4.7.4 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

SECTION 4 - INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

4.3 TESTING

4.3.1 Mechanical Running Test

4.3.1.2.1 (Modification)

In case mechanical run test is performed with shop motor. The compressor is to be operated at speeds from 30% to MCS in 10% increments and run at the MCS until bearing lube oil temperature & shaft vibrations have stabilized.

4.3.1.3.5 (Modification)

Replace the words "spare rotor" with "spare rotor/cartridge"

4.3.3 Optional Tests (Modification)

Performance test shall be performed on each compressor.

4.3.3.1 Performance Test

4.3.3.1.1 (Addition)

- (a) The compressor shall be performance tested in accordance with ASME PTC-10, Type 1, wherever feasible. The test procedure containing following information shall be made available at least 12 weeks prior to test for Purchaser's approval.
 1. Interpretation of performance specifications and a detailed statement of the test objectives.
 2. Identification of the type of test (type-1 or type-2) required to meet objectives and selection of operating conditions to satisfy the limitations outlined in ASME PTC-10.
 3. The nature of the test gas, if the design or specified gas cannot be used, and the means for establishing its physical and thermodynamic properties.
 4. Piping arrangement and location of instrumentation.
 5. Deviations from Code rules to be applied.
 6. Procedure to be used for adjusting test results to specified operating conditions with respect to test type-1 or type-2.
 7. Estimates of possible error in the measurements and methods selected.
 8. Test acceptance criteria.
- (b) Within two weeks after successful completion of the test, a test report shall be submitted by the vendor in accordance with section 6 of ASME PTC-10. Performance data for 75%, 80%, 85%, 90%, 95%, 100% and 105% of the speed, as

established on the basis of test results shall form part of the test report.
The test report shall end with a discussion about the test results and final conclusion.

4.3.3.1.2 (Substitution)

Unless otherwise specified, the rated point shall be the guarantee point. Head and capacity shall have zero negative tolerance at the guaranteed point and the horsepower at this point shall be guaranteed with zero positive tolerance including instrument and measuring tolerances. Surge shall comply with provisions of clause 2.1.1.1.

4.3.3.1.3 (Substitution)

For variable-speed compressors, a speed other than the vendor's originally estimated speed may be used to achieve the guaranteed performance and performance tolerance provided that:

1. This adjusted speed meets the criteria specified in Chapter 1, 2.6.
2. The adjusted speed does not exceed the 100% speed of the compressor i.e. the adjusted speed does not encroach on the margin of 5% between 100% speed and maximum continuous speed, and therefore does not affect in any way the requirements of impeller overspeed as per clause 4.3.3 of Chapter 1.

4.3.3.1.4 (Substitution)

For constant speed compressors, the guaranteed capacity shall have zero negative tolerance. The head shall be within the range of 100% to 102% of the guaranteed head. Beyond 102% head and up-to 105% head, at purchaser's option, the impellers shall be trimmed, but the test need not be repeated. Beyond 105% head, the impellers shall be trimmed and the complete test shall be repeated. The horsepower based on measured head at guaranteed capacity shall not exceed the value as given by

$$BKW_{Test} \leq BKW_{Guaranteed} \times [\text{Measured Head} / \text{Guaranteed Head}]$$

4.3.3.1.6 (Substitution)

For multi compressor trains and for compressors with intermediate process stream pressures, the additional tolerance on individual sectional pressures shall be specified in the data sheets. But notwithstanding the individual sectional tolerance, the overall tolerances as in clauses 4.3.3.1.2 to 4.3.3.1.4 shall govern.

Chapter 3

Integrally Geared Compressors

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SECTION 1 - GENERAL

1.3 EQUIPMENT QUALIFICATION CRITERIA (New)

- 1.3.1 Unless otherwise specified elsewhere, the Equipment Qualification Criteria (EQC) specified vide para 1.3.2 to 1.3.5 of this specification shall be applied for acceptance of the offered compressor model and its manufacturer.
- 1.3.2 The vendor for the complete unit shall be an established manufacturer of Integrally Geared Centrifugal Compressors (Process Air/Gas) and he shall also be the manufacturer of the proposed compressors having adequate design, engineering, manufacturing & testing facilities for the same.
- 1.3.3 The vendor shall have designed, engineered, packaged, tested and supplied in the last TEN (10) years, from the proposed manufacturing plant, at least ONE (1) Integrally Geared Centrifugal Compressor which is from the same model series with same type of driver having similar driver power as offered.
As a minimum, this package shall have completed ONE year of satisfactory operation at site, as on the bid due date.
- 1.3.4 The vendor besides satisfying the requirements of clause 1.3.2 & 1.3.3 above shall also be the packager of the complete system proposed and shall have the SINGLE POINT RESPONSIBILITY for the entire package.
- 1.3.5 The compressor model offered shall be from the existing compressor model series and shall be from the regular manufacturing range of the vendor.
The offered compressor model shall meet the following minimum service and manufacturing experience requirements as specified below:
Compressors shall be identical in Model No./frame size and similar in terms of Power rating, Inlet and discharge pressures, Inlet temperatures, Actual Inlet flow, Process Gas, Bull Gear / Pinion Speeds, Number of stages, Type of Impellers, Type of Sealing System, Rotor dynamics, Mechanical Design, Materials etc. as compared to at least ONE (1) unit designed, manufactured, tested and supplied from the proposed manufacturing plant in the last TEN (10) years and the reference unit shall have completed ONE year of satisfactory operation at site, as on the bid due date.

In case all the above parameters are not available from single past reference, more than one reference can be cited / considered to satisfy the above qualification requirement.

As an alternative vendor may show to the satisfaction to the purchaser, that the equipment offered comprises of components each of which individually satisfies the requirements specified above.

- 1.3.6 Proven Track Record (PTR)
The vendor shall complete the Experience Record Proformas as enclosed in the inquiry specification to amply prove that the Equipments offered meet the EQC for technical acceptance. Vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for all the above equipments shall also be furnished alongwith the proposal.

SECTION 2 - BASIC DESIGN

2.3 CASINGS

2.3.1 Pressure Casings

2.3.1.2 (Modification)

Unless otherwise specified, vendor will furnish system protection.

2.11 NAMEPLATE AND ROTATION ARROWS

2.11.2 (Modification)

Replace the last sentence by "MKS Units shall be used".

SECTION 3 - ACCESSORIES

3.4 CONTROLS & INSTRUMENTATION

3.4.2 Control Systems

3.4.2.1 (Modification)

Unless otherwise specified, control valve shall be in vendor's scope of supply.

3.4.7 Vibration, Position, and Bearing Temperature

3.4.7.2 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.4.7.3 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.4.7.5 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.5 PIPING AND APPURTENANCES

3.5.2.1 (Modification)

The vendor shall also supply interconnecting piping between equipment groupings and off-base facilities.

SECTION 4 - INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

4.3 TESTING

4.3.3 Optional Tests (Modification)

Performance test shall be carried out on each compressor.

4.3.3.1 Performance Test

4.3.3.1.1 (Addition)

(a) The compressor shall be performance tested in accordance with ASME PTC-10, Type 1, wherever feasible. The test procedure containing following information shall be made available at least 12 weeks prior to test for Purchaser's approval.

1. Interpretation of performance specifications and a detailed statement of the test

objectives.

2. Identification of the Type of test (type-1 or type-2) required to meet objectives and selection of operating conditions to satisfy the limitations outlined in ASME PTC-10.
 3. The nature of the test gas, if the design or specified gas cannot be used, and the means for establishing its physical and thermodynamic properties.
 4. Piping arrangement and location of instrumentation.
 5. Deviations from Code rules to be applied.
 6. Procedure to be used for adjusting test results to specified operating conditions with respect to test type-1 or type-2.
 7. Estimates of possible error in the measurements and methods selected.
 8. Test acceptance criteria.
- (b) Within two weeks after successful completion of the test, a test report shall be submitted by the vendor in accordance with section 6 of ASME PTC-10. Performance data for 75%, 80%, 85%, 90%, 95%, 100% and 105% of the speed for variable speed and at 100% speed for constant speed, as established on the basis of test results shall form part of the test report.

The test report shall end with a discussion about the test results and final conclusion.

4.3.3.1.2 (Substitution)

Unless otherwise specified, the rated point shall be the guarantee point. Head and capacity shall have zero negative tolerance at the guaranteed point and the horsepower at this point shall be guaranteed with zero positive tolerance including instrument and measuring tolerances. Surge shall comply with provisions of clause 2.1.1.1.

For variable-speed compressors, a speed other than the vendor's originally estimated speed may be used to achieve the guaranteed performance and performance tolerance provided that:

1. This adjusted speed meets the criteria specified in clause 2.6, chapter 1.
2. The adjusted speed does not exceed the 100% speed of the compressor i.e. the adjusted speed does not encroach on the margin of 5% between 100% speed and maximum continuous speed, and therefore does not affect in any way the requirements of impeller overspeed as per clause 4.3.3, chapter 1.

4.3.3.1.3 (Substitution)

For constant speed compressors, the guaranteed capacity shall have zero negative tolerance. The head shall be within the range of 100% to 102% of the guaranteed head. Beyond 102% head and upto 105% head, at purchaser's option, the impellers shall be trimmed, but the test need not be repeated. Beyond 105% head, the impellers shall be trimmed and the complete test shall be repeated. The horsepower based on measured head at guaranteed capacity shall not exceed the value as given by

$$BKW_{Test} \leq BKW_{Guaranteed} \times [\text{Measured Head} / \text{Guaranteed Head}]$$

4.3.3.1.5 (Substitution)

For compressors with intermediate process stream pressures, the additional tolerance on individual sectional pressures shall be specified in the data sheets. But notwithstanding the individual sectional tolerance, the overall tolerances as in clauses 4.3.3.1.2 and 4.3.3.1.3 shall govern.

Chapter 4

Expander-Compressors

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SECTION 1 - GENERAL

1.3 EQUIPMENT QUALIFICATION CRITERIA (New)

- 1.3.1 Unless otherwise specified elsewhere, the Equipment Qualification Criteria (EQC) specified vide para 1.3.2 to 1.3.5 of this specification shall be applied for acceptance of the offered expander-compressor model and its manufacturer.
- 1.3.2 The vendor for the complete unit shall be an established manufacturer of Expander-Compressors and he shall also be the manufacturer of the proposed expander-compressors having adequate design, engineering, manufacturing & testing facilities for the same.
- 1.3.3 The vendor shall have designed, engineered, packaged, tested and supplied in the last TEN (10) years, from the proposed manufacturing plant, at least ONE (1) Expander - Compressor which is from the same model series having similar driver power as offered. As a minimum, this package shall have completed ONE year of satisfactory operation at site, as on the bid due date.
- 1.3.4 The vendor besides satisfying the requirements of clause 1.3.2 & 1.3.3 above shall also be the packager of the complete system proposed and shall have the SINGLE POINT RESPONSIBILITY for the entire package.
- 1.3.5 The expander-compressor model offered shall be from the existing expander-compressor model series and shall be from the regular manufacturing range of the vendor. The offered expander-compressor model shall meet the following minimum service and manufacturing experience requirements as specified below:
Expander Compressors shall be identical in Model no./frame size and similar in terms of Power rating, Inlet and discharge pressures, Inlet temperatures, Expander outlet temperature, Actual Inlet flow, Process Gas, Rotor Speeds(Tip speeds), Number of stages, Type of Impellers, Type of Sealing System, Rotor dynamics, Mechanical Design, Materials etc. as compared to at least ONE (1) unit designed, manufactured, tested and supplied from the proposed manufacturing plant in the last TEN (10) years and the reference unit shall have completed ONE year of satisfactory operation at site, as on the bid due date.
- In case all the above parameters are not available from single past reference, more than one reference can be cited / considered to satisfy the above qualification requirement.
- As an alternative vendor may show to the satisfaction to the purchaser, that the equipment offered comprises of components each of which individually satisfies the requirements specified above.
- 1.3.6 **Proven Track Record (PTR)**
The vendor shall complete the Experience Record Proformas as enclosed in the inquiry specification to amply prove that the Equipments offered meet the EQC for technical acceptance. Vendor may furnish additional information to justify that the EQC is being met. In addition, manufacturer's catalogue and general reference list for all the above equipments shall also be furnished alongwith the proposal.

SECTION 2 - BASIC DESIGN

2.1 GENERAL

2.1.1 Performance

2.1.1.1 (Substitution)

The compressor shall be guaranteed for head and capacity at normal operating point & at other operating points, if specifically asked for in the inquiry. The expander-compressor shall give satisfactory performance at all the specified operating points. In addition, the BKW at normal operating point shall be guaranteed for both the expander (-0% tolerance) and the compressor (+0% tolerance).

2.1.2 (New)

Unless otherwise specified, vendor shall supply with each expander-compressor stage a spare centre-section assembly consisting of the assembled rotor with its bearings, seals and their housing along with metal container for vertical storage. Where two or more assemblies are identical, only one common spare assembly shall be supplied.

2.3 CASINGS

2.3.1 Pressure Casings

2.3.1.1.2 (Modification)

Unless otherwise specified, vendor will furnish system protection.

2.11 NAMEPLATE AND ROTATION ARROWS

2.11.2 (Addition)

MKS Units shall be used.

SECTION 3 - ACCESSORIES

3.4 CONTROLS & INSTRUMENTATION

3.4.2 Vibration, Position, and Bearing Temperature Detectors

3.4.2.3 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.4.2.5 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.4.2.7 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.4.3 Overspeed Shutdown System

3.4.3.1.2 (Modification)

The words "when specified" shall be read as "Unless otherwise specified".

3.4.3.4 Permanent Strainer

3.4.3.4.1 (Modification)

The words “when specified” shall be read as “Unless otherwise specified”.

3.4.3.4.2 (Modification)

The words “when specified” shall be read as “Unless otherwise specified”.

3.5 PIPING AND APPURTENANCES

3.5.1 General

3.5.1.1 (Modification)

The vendor shall also supply interconnecting piping between equipment groupings and off-base facilities.

SECTION 4 - INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

4.3 TESTING

4.3.5 Optional Tests (Modification)

The words “when specified” and “/or” stand deleted.

4.3.5.1 Performance Test

4.3.5.1.1 (Modification)

Performance test shall be carried out on each expander.

Vendor shall furnish his standard test procedure for purchaser’s approval at least 12 weeks prior to test:

Expander efficiency at the normal point shall be guaranteed with zero negative tolerance including instrument, measuring & test tolerances.

4.3.5.1.2 (Modification)

- (a) Performance test shall be carried out on each compressor.
- (b) Unless otherwise specified, the compressor shall be performance tested in accordance with ASME PTC-10, Type 1, wherever feasible.
- (c) Head and capacity shall have zero percent negative tolerance at normal operating point and the compressor BkW shall be guaranteed at the normal operating point with zero percent positive tolerance including instrument, measuring & test tolerances. Surge shall comply with provisions of clause 2.1.1.2.

4.3.5.1.3 (Delete)

4.3.5.1.5 (New)

The test procedure containing following information shall be made available at least 12 weeks prior to test for Purchaser’s approval.

1. Interpretation of performance specifications and a detailed statement of the test objectives.
2. Identification of the type of test (Type-1 or Type-2) required to meet objectives and selection of operating conditions to satisfy the limitations outlined in ASME PTC-10.
3. The nature of the test gas, if the design or specified gas cannot be used, and the means for establishing its physical and thermodynamic properties.
4. Piping arrangement and location of instrumentation.
5. Deviations from Code rules to be applied.
6. Procedure to be used for adjusting test results to specified operating conditions with

respect to test type-1 or type-2.

7. Estimates of possible error in the measurements and methods selected.
8. Test acceptance criteria.

Within two weeks after successful completion of the test, a test report shall be submitted by the vendor in accordance with section 6 of ASME PTC-10. Performance data for 75%, 80%, 85%, 90%, 95%, 100% and 105% of the speed, as established on the basis of test results shall form part of the test report.

The test report shall end with a discussion about the test results and final conclusion.