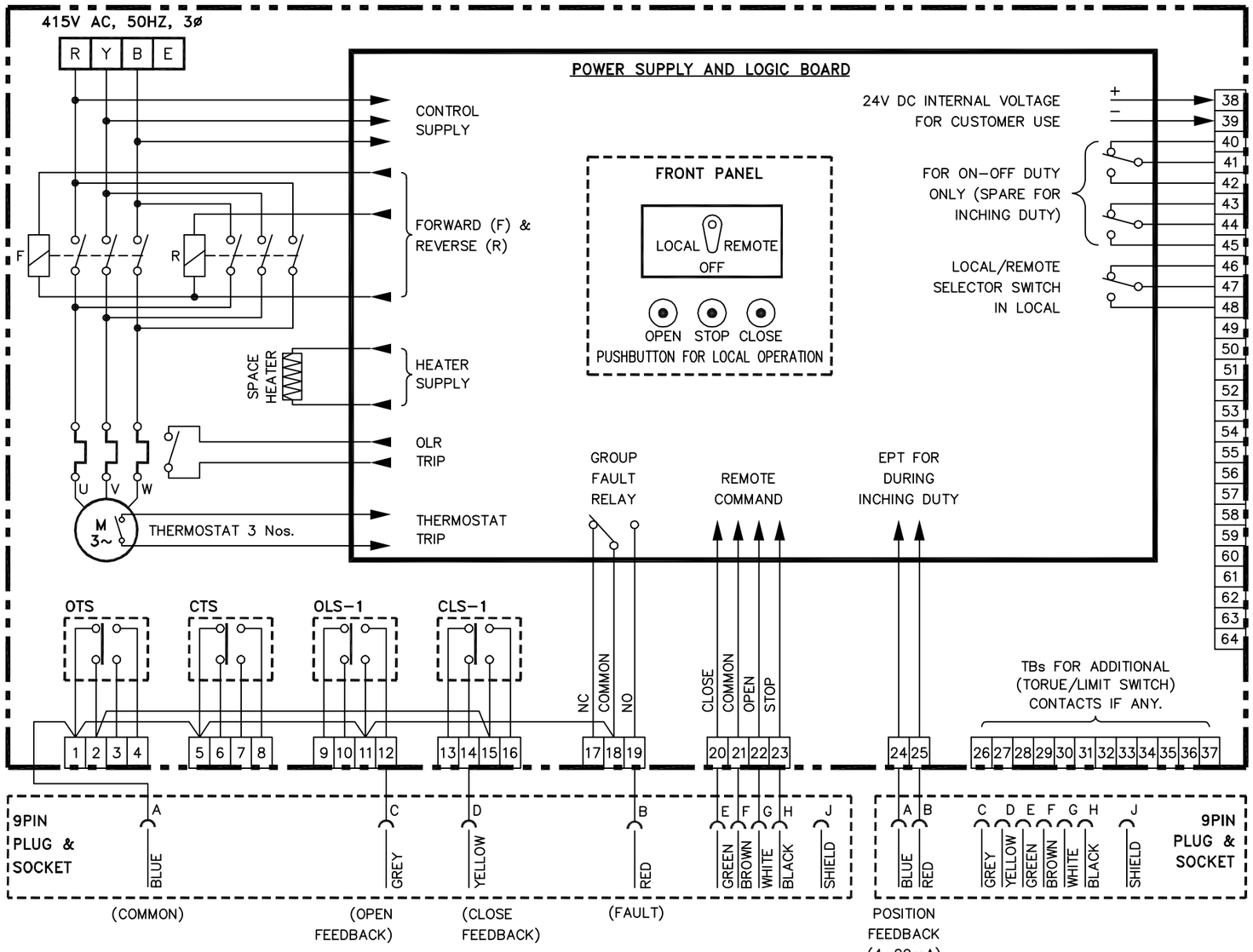
Sl. No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
8 PS1A1	**Miscellaneous and casing sheets** 07-409,431,460,461,462,502,503,509,531,560; 12-506,906,907; 17-919; 21-601,604,606; 24-350,351,354, 801,804,805,806,808,809, 24-810,815,817,821,825,826,835,840,841,855, 24-950,955,960;30-233,234; 36-396,611, 999; 38-611; 39-302; 04-147, 547 Fuel firing: 41-350,390,500; Steam blowing piping 42-001,002,005,010,046,065,070,120,152,154, 42-157; 43-004,104, 200; 45-200,801,802, 804,805,806,858; 47-281,283, 858; Duct plates, expansion joints 48-911,912; Coal Feeding 65-736; 67-204,272,276, 283,801,802,803; 95-088,089,091,485;96-186;97-585, 592; $Handling equipment:99-099,100,300,400,600; **Impulse lines: 24-800** **Seal air ducting: 43-005, 105;** Cold Air duct:48-012,014, 112,114, 141 Tempering Air: 48-142,144	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µm per coat	2	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µm per coat	2	Smoke Grey Shade No: 692 of IS5	100

$ - Final Shade is Golden yellow for Under hung crane, Chain Pulley Block, Ratchet Lever and Trolley with hoist. Black shade for Hook.

DRAWING NO: 3-96-588-12091

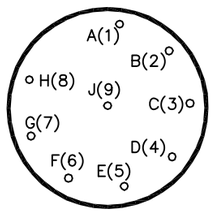


CONTACT	LIMIT SWITCH CONTACT TERMINAL No.	POSITION OF DAMPER: FULL OPEN	INTER MEDIATE	FULL CLOSE	
OLS-1	9-10	–	X	X	THESE LIMIT SWITCH CONTACTS ACT ON DAMPER REACHING RESPECTIVE POSITION
	11-12	X	–	–	
CLS-1	13-14	X	X	–	
	15-16	–	–	X	
OTS	1-2	–	X	X	THESE LIMIT SWITCH CONTACTS ACT ON THE TORQUE SET BEING REACHED.
	3-4	X	–	–	
CTS	5-6	X	X	–	
	7-8	–	–	X	

'X' CONTACT CLOSED, '–' CONTACT OPEN

N O T E

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1, CLS1) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1–16, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 26–37
2. CTS – CLOSE TORQUE SWITCH
3. OTS – OPEN TORQUE SWITCH
4. OLS–1 – LIMIT SWITCHES FOR POSITION OPEN.
5. CLS–1 – LIMIT SWITCHES FOR POSITION CLOSE.
6. EPT – 4–20mA FEEDBACK, LVDT TYPE ELECTRONIC POSITION TRANSMITTER (FOR INCHING DUTY)
7. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24V DC OR EXTERNAL SUPPLY OF 24V DC CAN BE USED.
8. M – MOTOR 3ø 415V 50 Hz AC SUPPLY.
9. NO. AND SIZE OF CABLE GLANDS/PLUG AND SOCKETS
   1. POWER CABLE GLAND – 1 No.
   2. 3 Nos. 9PIN PLUG & SOCKET TO SUIT 4PAIRx0.5SQ.MM TYPE–G INSTRUMENTATION CABLE (OD MAX. 18.5mm (FRLS OUTER SHEATH CABLE)) WITH SOCKETS MOUNTED ON THE LIMIT SWITCH COMAPRTMENT ITSELF. (PLUGS ARE SUPPLIED AS LOOSE)
10. TERMINAL BLOCK NOS. AND WIRING HAS TO BE MATCHED AS INDICATED IN THIS DRAWING.



9 PIN PLUG & SOCKET ARRANGEMENT (3 Nos.) (ONE SET IS SPARE)

REV	DATE	ALTERED :	REV	DATE	ALTERED :
02	140714	CHD./APPD. :	01	170710	CHD./APPD. : Sd./KRS–SRC
ZONE	REVISED TO CHANGE DESCRIPTION IN LEGEND.		ZONE	GENERAL REVISION	

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STANDARD (FOR NTPC PROJECT)

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPPALLI – 620014

	NAME	SIGNATURE	DATE	NO. OF VAR
DRN	A.Thambu raj	270410	27-04-10	—
CHD	K.Rathnasekar	Sd. / KRS	27-04-10	
APPD	S.Ramachandran	Sd. / SRC	27-04-10	

DEPT. : C & I	ALL DIMENSIONS ARE IN MM	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG	ITEM NO	No OF ITEMS
CODE : 392		NTS	———	—	—	—

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ELECTRICAL ACTUATOR WITH INTEGRAL STARTER
Sheet 01 of 01

CARD CODE: U 01

DRAWING NO : 3-96-588-12091

REV: 02

File Name : NTPISW02

Memorandum of Understanding

M/s BHEL
Trichy – 620014

and

M/s:

Address:

(Vendor Code:)

For supplying

Electric Rotary Actuators

MOU NO : MOU / TPBHEL / ACTUATORS REV.00
Date :
Valid upto :

Contents

Intent of specification

This specification is bifurcated in two broad sections, one is the “standard section” another is “project specific section”.

By this MOU, The standard section of the specification is mutually agreed and applicable for the purchase orders finalized against requirements from BHEL/Trichy during the period of validity of this MOU.

Project specific section is the variable part of the specification. It contains all the requirements of a specific project over and above the requirements of the standard section.

Memorandum of Understanding (MOU) for supplying ELECTRIC ROTARY ACTUATORS

1.0 GENERAL:

1.1 Sections 1.0, 2.0, 3.0 and 4.0 are standard and Section 5 alone will be sent with the enquiry.

1.2 It is agreed that no deviations will be taken by the vendors while submitting their offers against future enquiries.

1.3 Since the specifications are standardized and an understanding has been reached, the future enquiries will be floated on "SINGLE BID SYSTEM" only. Hence, if any offer is found with deviations, the same will be totally rejected and will not be considered for further evaluation.
If any differences are found between the details given in Section 5.0 and other sections, Section 5.0 shall be considered as final and the vendors shall meet this requirement for that particular project.

1.4 The validity of this MOU is for TWO years from the date of signing. After the expiry of the period, the same can be extended further with or without any modifications. However, in case any changes are required, the MOU may be amended before the expiry of the validity.

1.5 Pre commissioning spares (if applicable) with price break up as per the list shall be supplied along with the equipment.

1.6 Two years recommended Spares list with price break up, if required, shall be enclosed.

1.7 If any special or non-standard tools are required for installation, operation or maintenance, the same shall be supplied along with the equipment.

1.8 Trouble-free operation of the equipment shall be guaranteed for a period of 12 months from the date of commissioning OR 18 months from the date of dispatch whichever is earlier.

1.9 Materials shall be dispatched on "Door Delivery with or without Consignee Copy attached basis to avoid demurrage at transporter's go down".

1.10 Since the vendors works alone is approved by BHEL, it is agreed the vendor will manufacture this item in their own works only and will not off-load the jobs to any other suppliers without the written approval by BHEL

. All components shall be packed in such a way that they should not get damaged during transport.

1.11 BHEL and the Vendor shall have an involvement which will commence at bid stage and follow through the completion and acceptance, thus ensuring total conformity to Purchaser's requirements.

2.0 SPECIFICATIONS

2.1 Scope

This specification covers design, manufacture, inspection, testing, marking, identification, packing and supply of **Torque limiting Electric Rotary Actuators** and it's necessary accessories like position indicators, position transmitters, torque limit switches, travel limit switches, space heaters etc as per the specification given**.**

These actuators are used to control Plate type coal gate operated by rack and pinion arrangement.

Technical parameters for equipment design are furnished in Section-1 to 4.
Special requirements, if any, are furnished in Section -5.
This is a general specification dealing with technical requirements as specified under scope.

The extent of supply stated herein is not necessarily exhaustive and shall not relieve the vendor from his responsibility to provide goods and services necessary to satisfy the performance criteria and guarantees specified.

2.2 Codes & Standards:

The equipment shall be designed to meet the governing standards as applicable and also meet with the local standards where the equipment is installed. In case of any information not specified in this technical delivery conditions these standards will be binding.

2.3 Actuator type:

2.3.1 Actuator shall be of non-rising stem type.
2.3.2 Thrust load, if any, should not be transferred from the actuator to driven Equipment.
2.3.3 Actuators are of inching duty, foot mounting (lever operated) type. (chain wheel driven)
2.3.4 Actuators shall be with self-locking worm.
2.3.5 For isolating service three successive open- close operations or 15mins.whichever Is higher.
2.3.6 Starter shall fall under any one of the following variants.
~~Type I : Electric Rotary Actuators without integral starter.~~
~~Type II : Electric Rotary Actuators with integral starter~~.
Type III : Electric Rotary Actuators with integral starter and 9 pin plug & socket arrangement

2.4 Actuator output shaft :

2.4.1 Actuator output shaft speed 12 rpm.
2.4.2 No. off revolutions of output shaft for full travel from open to close and vice- versa shall be 13.5 Revolutions.
2.4.3 Tripping torque to be set at factory 22Kgm - for 36" coal valve at the shaft.
2.4.4 Tripping torque range required on the torque switch 12 To 31 Kgm. (Setting procedure required to reset in the field, if required, should be furnished by supplier). Torque range nearer to the above as per vendors standard is also acceptable.
2.4.5 Output shaft shall be designed with bore and slot for feather key (Ref. Sketch-2)
2.4.6 Direction of rotation and orientation of shaft shall be as shown in (Ref.Sketch-1)

2.5 Type of mounting:

2.5.1 Direct - Horizontal.

2.6 Working condition:

2.6.1 Actuator should be suitable to operate in damp, dusty, polluted atmospheres of 100% relative humidity at an ambient temperature of -20° C to + 70° C.

2.7 Manual operation:

2.7.1 Chain wheel to be provided instead of hand wheel for manual operation with declutch lever and chain guide.
2.7.2 Chain wheel shall declutch automatically upon energizing actuator motor.
2.7.3 Chain wheel should be suitable for chain pitch 36mm - ∅6 - t=18.
2.7.4 The direction of rotation for gate open/close shall be clearly indicated (should be visible to a distance of 8m) on the chain wheel.

2.8 Technical requirements – (Electrical) of Actuator:

2.8.1 Vendor shall confirm compliance to the technical requirements of specification **TCI:318/Rev.00**, which is enclosed as **annexure-1** to this MOU specification.

2.9 Wiring:

2.9.1 Internal wiring shall be done as per BHEL diagram. As per the variant selected, applicable wiring drawing has to be referred.

- ~~3-96-588-12092 Rev 02 for type –1 actuators…..Annexure-2~~
- ~~3-96-588-12090 Rev 04 for type –2 actuators….Annexure-3~~
- 3-96-588-12091 Rev 02 for type-3 actuators….Annexure -4

2.20 General:

2.20.1 Colour of the actuator shall be smoke grey shade 692 of IS: 5 OR as per the colour specified, in Section-5.

2.20.2 The gear boxes supplied shall be guaranteed for operation even under worst condition like dynamic stall torque.

2.20.3 Vendor shall highlight the deviations from the specification (if any) or special features of the Actuators, which are not covered in the specification during the offer stage itself.

2.20.4 The gear box of the actuator shall preferably be oil filled. The actuator shall have proper seals to prevent leakage of oil into the limit switch compartments, terminal box and motor. Actuators shall be designed for mounting in any position without lubricant leakage or other operational difficulty.

2.21 Data Sheet:

2.21.1 Supplier shall fill up this information and furnish along with offer in the following format only. Absence of any detail result in incomplete offer and will not be considered.

DATA SHEET

Actuator model:			
Sl. No.	**DESCRIPTION**	**UNITS**	**DATA**
	Actuator Manufacturer		
	Torque Range & speed	Kgm & rpm	
	Starting Torque (approx.)	Kgm	
	Stall Torque (min.)	Kgm	
	Duty Cycle		
	Enclosure (Type & Protection)		
	Admissible Ambient Temperature	Deg C	
	Cable Gland : (Double Compression) a. Size for power cable -1 No b. Size for control cable - 3 Nos.	 3/4'' 1.25''	
	Position Limit Switches (Nos.)		
	Torque Switches (Nos.)		
	Ratings of Switches		
	Position Transmitter		
	Space Heater		
	Thermostat (Nos.)		
	Internal Wiring		
	Terminal Plan		
	Contact Development Diagram		
	Painting		
	Weight	Kgs	

Motor:

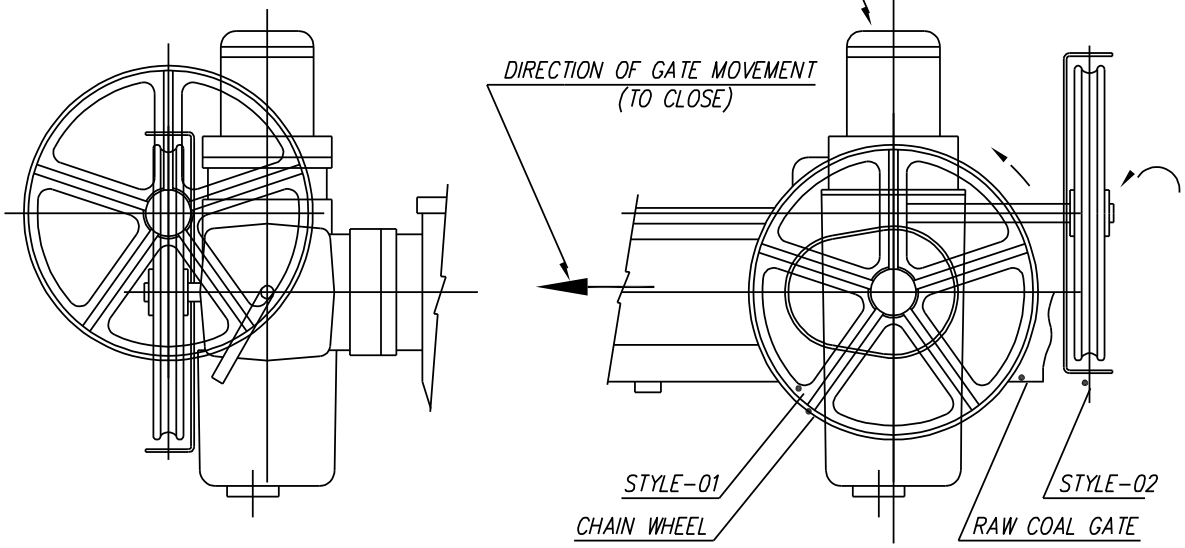
Sl. No.	DESCRIPTION	UNITS	DATA
1.	Nominal Output	KW	
2.	Rated Voltage	V	
3.	Rated Frequency	Hz	
4.	No. Of Phases		
5.	Admissible Voltage Fluctuation	%	
6.	Admissible Frequency Fluctuation	%	
7.	Admissible Voltage & Frequency Fluctuation	%	
8.	Full load torque	Kgm	
9.	Starting torque	Kgm	
10.	Run torque	Kgm	
11.	Nominal Current	A	
12.	Starting Current	A	
13.	Stall Current	A	
14.	Full Load Speed	rpm	
15.	Insulation Class (B / F)		
16.	Power Factor	%	
17.	Full Load Efficiency		
18.	Temperature rise over ambient temperature 40° C	Deg C	
19.	Type of Starter		
20.	Motor Type & Ref. Standard		
21.	OLR Value		

Gear Box

1	Primary gear box type		
2	Gearbox ratio.		
3	Gear box efficiency	%	
4	Max. Operating torque.	Kgm	
5	Gearbox lubrication.		

Supplier Signature With Stamp

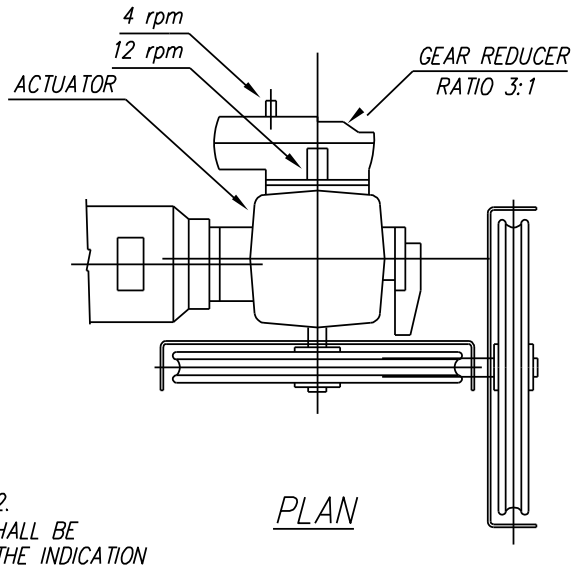
SKETCH-1: Direction of rotation and orientation of shaft



END VIEW

ELEVATION

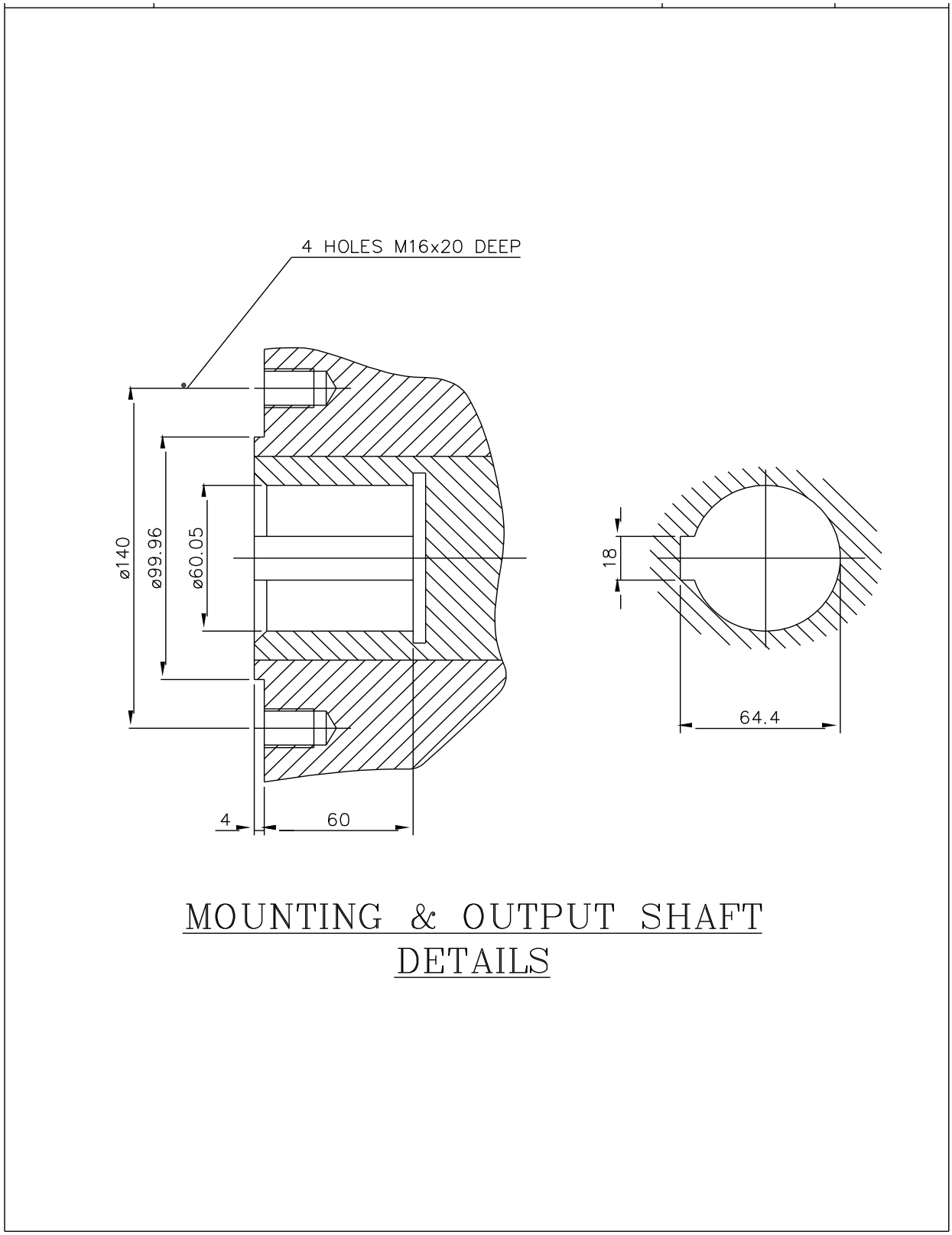
DIRECTION OF ROTATION :-
ACTUATOR OUTPUT SHAFT SHOULD ROTATE IN CLOCKWISE DIRECTION FOR CLOSING.
(WHILE FACING THE ACTUATOR OUTPUT SHAFT BY STANDING IN FRONT OF THE OUTPUT SHAFT, THE ACTUATOR OUTPUT SHAFT SHOULD ROTATE IN CLOCKWISE DIRECTION.)



PLAN

NOTE :-
1. CHAIN WHEEL MOUNTING STYLE-01 OR STYLE-02.
2. A NAME PLATE WITH OPEN/CLOSE INDICATION SHALL BE FIXED ON THE OUTSIDE OF THE CHAIN WHEEL. (THE INDICATION SHOULD BE CLEARLY VISIBLE TO A DISTANCE OF 8m)

SKETCH-2: Output shaft with bore and slot for feather key



2.12 APPLICABLE DRAWINGS/DATA SHEETS

The equipment will be manufactured, tested and supplied as per the following approved documents only. However in case of any revision/modifications required the same document will be revised and submitted for BHEL's approval.

2.12.1 Manufacturers' GA Drg.No(s).
2.12.2 Manufacturers wiring drawing No(s).
2.12.3 QP No.
2.12.4 Unit weight of actuator assembly.

The above standard drawings and documents shall be approved by BHEL and as long as the future supplies are as per the above, separate document approvals for future purchase orders are not required.

However project wise separate drawings/datasheets shall be prepared and submitted to BHEL for information/ onward transmission to customers.

3.0 DOCUMENTS TO BE SUBMITTED

3.1 Along with the offer:
3.1.1 Acceptance of MOU

3.2 After placement of PO
3.2.1 Project wise drawings/documents/quality plan for information

3.3 Along with the equipment
3.3.1 6 sets of O&M manual with all relevant catalogues/drawings/spare part nos etc
3.3.2 Soft copy/CD of O&M manual

4.0 QUALITY REQUIREMENTS -***Testing, Inspection And Packing***

4.1 Purchaser's and End user's representative shall have access to the works of Vendor at all reasonable times for the purpose of witnessing the purchased equipment being tested.

4.2 Inspection shall be done as per the approved QP and vendors standard practice..

4.3 All test certificates duly countersigned by BHEL/Authorized inspector shall be furnished.

4.4 Painting, Protection, Packing, Supply and Identification:

4.4.1 Surface Preparation

Weld slag & spatter shall be removed and the surfaces to be coated shall be free from contamination. Surface defects shall be removed by suitable methods.

Sharp edges shall be smoothened by grinding. Prior to surface preparation oil, grease, drilling emulsions, cutting emulsions and preservative agents shall be carefully removed by suitable solvents. The surface shall be carefully dried with clean cloths to prevent the dissolved impurities from spreading over the entire surface. The surface shall be cleaned by wire brush and shot blasting if required. Proper adhesiveness of paint to the surface shall be ensured.

4.4.2 Painting

Painting shall be done as per the manufacturer's standard procedure using epoxy paint.

However the painting shall be done such that it protects the equipments during transport, storage, erection and commissioning.

4.5 Packing

4.5.1 After completing painting and marking, actuators shall be properly packed in such a way to prevent ingress of water and dust and all the openings shall be firmly closed.

The Actuator shall be packed in such a way that it does not get damaged during transport. It shall be properly covered with thick tear proof polythene sheet and dispatched in suitable moisture proof wooden crates.

5.0 PROJECT RELATED INFORMATIONS

Project Name :

Enquiry No. :

5.1 Actuator type : Type-1/Type-2/Type-3

5.2 Colour of the actuator :
(if different from cl 2.20 It will be given by BHEL)

5.3 Any other special requirements :

5.4 Wiring Diagram : Compliance by vendor

5.5 GA Drawing No : (To be submitted by vendor)

5.6 Applicability of diagnostic tool :

5.7 Data sheet : Project specific data sheet is required to be Submitted, wherever customer approval is involved

Note:
1. Deviation in the above requirements shall reject the offer.
2. If required, please add more sheets.
3. Vendor shall highlight the deviations from the specification (if any) or special features of the system offered, which are not covered in the specification during the offer stage itself. If there is no separate list of deviations submitted by vendor, it will be deemed that there is no deviation to the specification requirements.

BHARAT HEAVY ELECTRICALS LIMITED,
THIRUCHIRAPALLI-620 014

CONTROLS & INSTRUMENTATION/FOSSIL BOILERS

Technical specification
for Electrical Actuator
(Open/Close duty & Inching duty applications)

Specification Number :- TCI : 318/Rev. 00

Revision History

Rev. No.	Date	Description	Prepared	Reviewed	Approved	
					Engineering	QA
			M. Muruga Prabu	V.M. Selvaraaj	D. Mahendrababu	R.M Vairavan
00	09-12-2013	Initial release	-sd-	-sd-	-sd-	-sd-

SL. No.	Details	Requirements			Vendor's compliance
1	Site Conditions	Ambient Temperature : -20° C to +50° C Relative Humidity : 95% Atmosphere : Tropical, dusty, salty, corrosive and highly polluted			
2	Actuator Application	Open/Close duty, suitable for Valve applications. Suitable gearboxes shall be coupled (if required) to achieve the torque requirements of the load. Actuator mounting shall be suitable to the load requirement.			
3	Actuator type	Type 1	Type 2	Type 3	
		Electrical Actuator with integral starter. The Starter shall be as per technical specification.	Electrical Actuator without integral starter	Electrical Actuator with integral starter and 9 pin plug and socket arrangement. The Starter shall be as per technical specification.	
4	Actuator Construction	Totally enclosed weatherproof construction meeting IP 65 protection class requirements. All the gears available in the actuator shall be of metal (Fibre gears are not acceptable). Actuator shall have self locking facility.			
5	Manual operation through Hand-wheel	Shall have a lever and hand wheel mechanism for manual operation. The hand wheel mechanism shall be designed such that it is declutched automatically when the power supply to the motor, is restored.			

SL. No.	Details	Requirements	Vendor's compliance
6	Torque requirement	Shall be designed to meet with the required torque at the output shaft as per the load requirement. The adjustable range of run torque and starting torque of actuator shall be indicated (in kgm) for the actuator offered.	
7	Operating time	The operating time of the actuator required for the complete travel has to match with the load requirement.	
8	Supply voltage	415 V, 3 phase AC supply, 50Hz.	
9	Power supply variation	The actuator shall operate without any trouble under power supply voltage variation of ± 10% of the rated value, power supply frequency variation of ± 5% of the rated value, combined voltage and frequency variation of 10% of the rated value.	
10	Motor construction	Shall be of Totally Enclosed, Self Ventilated construction with weather proof enclosure conforming to IP-65. Shall have double shielded, grease lubricated anti-friction bearings.	
11	Motor Insulation	Shall have class F insulation with temperature rise of the motor winding limited to Class B. Motor winding shall be tropicalised suitable for the site conditions indicated above. Temperature rise over ambient temperature of 50° C shall be 70° C.	

SL. No.	Details	Requirements	Vendor's compliance
12	Motor duty cycle	The duty cycle of the motor shall be short time S2 duty cycle rated for the period of operation of 15 minutes or rated for 3 successive open-close operations whichever is longer. For inching duty, motor shall be suitable for 150 starts/hour.	
13	Motor Starting	Motor shall be suitable for direct on-line starting. Starting current shall be limited to 6 times the full load current exclusive of tolerance. Shall be capable of starting at 85% of rated voltage and Running at 80% of rate voltage for a period of 5 minutes.	
14	Standards	Actuator shall be conforming to IS-9334 or any other equivalent international standard for all requirements. Motor shall be conforming to IEC-60034, IS-325 or any other equivalent international standard for all requirements.	
15	Motor Thermostat	Motor winding shall be provided with inbuilt thermostat connected in series (one thermostat in each phase) and shall be wired to terminal box.	
16	Space heater for Motor	Shall have a space-heater with suitable rating and the power supply shall be derived internally from the main power supply.	

SL. No.	Details	Requirements	Vendor's compliance
17	Earth terminals	2 Nos. of earth terminals shall be provided on the body of the motor.	
18	Torque & position limit switches	2 numbers of adjustable torque limit switches (one for open and one for close), each with 2 NO and 2 NC potential free contacts. The torque limit switches shall have calibration in Kg-m (for whole actuator including gear box if supplied), so that the switches could be easily set to any desired value, within the range specified for each actuator. Torque switches shall be bypassed in both the end positions using the position Limit switches available at the other end of the travel. Actuators shall have provision for bypassing the torque switch during initial 5% opening of valves. 4 numbers of position limit switches, rotary drum type capable of being set at any position (2 nos. for open and 2 nos. for close) each with 2 NO & 2 NC potential free contacts. All Gear train mechanism shall be made of suitable metal only. Shall be enclosed in a dust & weather proof compartment and the compartment shall have enough space suitable for calibration. Contacts of limit and torque switches shall be Silver plated having high conductivity and non -corrosive type. Contact rating of all the above limit switches shall be 5 A at 240 V AC and 0.5 A at 220 V DC.	
19	Local position indicator	Shall be provided to indicate 0 to 100% travel.	

SL. No.	Details	Requirements	Vendor's compliance
20	Position Feedback transmitter	For inching duty applications, position feedback transmitter has to be supplied. Shall be 2 wire, non-contact type (LVDT) electronic position transmitter with an output of 4-20 mA DC and shall be loop powered from external power supply. The output shall also be capable of driving minimum 500 ohms load in the control circuits.	
21	Internal wiring	Shall be done with 1.5 sq.mm PVC insulated, stranded copper wire of 650V grade for control signals. For Power circuits, internal wiring shall be done using suitable size of stranded cables, taking care of the motor current rating. Ferrules should be used for easy identification. Internal wiring and the terminal block drawing shall be neatly pasted on the internal side of the terminal box.	
22	Terminal box	All terminals of the position limit switches, torque limit switches, space heaters shall be terminated in the terminal box. The terminals shall be of cage clamp type suitable for the cables of size 2.5sq.mm. Minimum 6 numbers of spare terminals shall be made available in the terminal board. Terminal box of actuator shall be weatherproof conforming to IP 65 and shall have enough space for connecting cable glands/plug and sockets. Terminal box shall be fitted with a removal front cover-plate.	
23	Cable Termination philosophy	Vendor to refer respective terminal block drawing (Type 1/Type 2/Type 3).	
		Power Cable :- (Common to Type1/Type 2/Type 3)) Double compression type, Brass with Nickel plated cable glands shall be provided for the termination of power cable. Motor terminals shall be of stud type. Cable gland along with blanking washers shall be	

SL. No.	Details	Requirements	Vendor's compliance
		selected suitable for the power cable sizes as indicated below. a) Upto 3 kW – 3C x 2.5 sq.mm. Copper, OD – 17 mm ± 2 mm. b) > 3 kW & upto 7 kW - 3C x 6 sq.mm, Aluminium, OD – 19 mm ± 2 mm. c) > 7 kW & upto 13 kW - 3C x 16 sq.mm., Aluminium, OD – 22 mm ± 2 mm. d) > 13 kW & upto 24 kW - 3C x 35 sq.mm., Aluminium, OD-25 mm ± 2 mm.	
		Termination of Control Cable (Type 1 & Type 2) :- For Type 1 and Type 2 actuators, 3 Nos. of Double Compression type, Brass with Nickel plated cable glands have to be supplied for the termination of the control/instrumentation cables suitable for a cable OD of 18mm.	
		Termination of Control Cable (Type 3) :- For Type 3 actuator, 9 Pin plug & sockets (2 Nos. wired + 1 No. spare as loose supply) shall be provided to suit 4 pair 0.5 sq.mm. Copper overall shielded (16 mm OD), instrumentation cable. The socket shall be fixed on the terminal board and wired to the terminal blocks as per the wiring drawing.	
24	Fasteners	All fasteners used in the equipment shall be of a corrosion resistant material.	
25	Paint & finish	All external Parts shall be finished and painted to produce a neat and durable surface which would prevent Corrosion & Rusting.	
26	Lubricant	The gear box of the actuator shall be either oil filled or grease filled.	
27	Inspection & Testing	For the purpose of inspection & testing of electrical actuator, Quality Plan Ref. QA:CI:STD:QP:13 has to be referred.	

SL. No.	Details	Requirements	Vendor's compliance
Technical Description of the Electronic Integral Starter (Has to be referred, if applicable)			
1	Integral starter	Control logic of the starter shall be designed using suitable electronic control circuit. The starter shall have the following minimum features : • Power supply isolation switch & fuses of suitable rating. • Thermal Over load relay. • Lockable Local- Off -Remote selector switch. • Push buttons for Local Operation (OPEN, CLOSE, STOP) • Indication lamps (OPEN, CLOSE, TRIP) • Remote Signal interface • Output Contacts • Status/Fault annunciation	
2	Open/Close Command	Interposing relays of coil burden <=2.5VA shall be provided to initiate opening and closing using 24V DC signal from the external control system. Actuator shall also be suitable for remote operation by potential free contacts for Open/Close & Stop, the necessary 24V DC power supply shall be derived internally. Open/Close command termination logic with position and torque limit switches shall be suitably built inside the starter Electrically & mechanically interlocked contactors shall be provided for forward and reverse operation. Contactor rating shall be sufficient to withstand the extreme conditions like valve jamming and instantaneous reversal of motor.	

SL. No.	Details	Requirements	Vendor's compliance
3	Protection Features in Starter	Shall have various protection features such as Single Phasing prevention, Wrong phase sequence protection, Overheating protection through thermostat, Short Circuit protection, Overload, Supply Under Voltage, over and above other standard protection features as per manufacturer's design.	
4	Control Supply	Control supply voltage of the starter shall be 24V DC. If other control voltage rating is used, then the same shall be derived internally by the manufacturer. Necessary primary and secondary fuses shall be provided. Opto isolation circuit shall be provided with suitable coupling relays for 24V DC commands from external control system.	
5	Local Operation	Provision shall be available to operate the actuator locally. Lockable local/remote selection shall be provided on the front panel of the actuator.	
6	Status indication	The following status indication signals shall be provided in the actuator over and above the standard signals available in the actuator as per the manufacturer's standard • Actuator Open • Actuator Close • Actuator in travel	

SL. No.	Details	Requirements	Vendor's compliance
7	Output Contacts	A Common potential free contact for collective fault annunciation of following faults such as Thermal Overload trip, Motor Thermostat trip, Control supply failure, Power Supply Failure/Single Phasing, Local/Remote switch in LOCAL/OFF, Torque Switch acted along with Other protections acted shall be provided for customer use. Potential free contacts shall be provided for Local/Remote/Off positions of the selector switch.	
8	Fault Annunciation	The following fault annunciation signals shall be provided in the actuator over and above the standard signals available in the actuator as per the manufacturer's standard • Open Torque Switch/Close Torque Switch acted • Motor thermostat trip • Motor Overload relay acted Actuator shall have necessary provision for diagnosing the fault locally.	
9	General features to be provided in the actuator	Open Torque Switch shall be bypassed initially for 3 seconds or 5% of the valve travel. It should be possible to reverse the direction of travel for inching duty application. Automatic phase correction facility and single phasing prevention shall be provided.	

SL. No.	Details	Requirements	Vendor's compliance
10	Details to be furnished	The ratings of the various components of the starter, various signal exchanges to/from the starter and the wiring interconnections shall be clearly indicated in the wiring drawing of the actuator.	

CONTROLS AND INSTRUMENTATION/QA/FB

STANDARD QUALITY PLAN FOR

ELECTRIC ACTUATOR

(OPEN / CLOSE AND REGULATING)

REV	DATE	PREPARED	REVIEWED	APPROVED	REVISION HISTORY
00	06/08/1990	Sd/-	Sd/-	Sd/-	Initial release.
01	16/06/1997	Sd/-	Sd/-	Sd/-	Format revised
02	21/03/2002	Sd/-	Sd/-	Sd/-	Department name changed, CTQ requirements added & general revisions
03	08/01/2004	Sd/-	Sd/-	Sd/-	Revised to include the comments / feedback of internal discussion
04	05/12/2015	V.AVINASH	RM.VAIRAVAN	S.DAKSHINAMOORTHY	Format changed. Revised to update latest standards. Quantum of check modified.

Sl. No	Component & Operation	Characteristics	Class	Type of Check	Quantum of check		Ref Doc. & Acceptance STD	Format of record	AGENCY			REMARKS
					M	B/C			M	B	C	
A	**FINISHED PRODUCT INSPECTION**											
01	Routine test	a) Verification of name plate details for motor & actuator	Major	MEAS	100%	20%	P.O. Specification, Drawing	IR	P	W	-	
		b) Mounting dimensions	Major	MEAS	100%	20%	P.O. Specification, Drawing	IR	P	W	-	
		c) Verification of paint shade, thickness and finish	Major	VISU	100%	20%	P.O. Specification Drawing	IR	P	W	-	
		d) Verification of Limit & Torque switch rating and contact combination	Major	PHYS	100%	-do-	P.O. Specification	IR	P	W	-	As applicable
		e) Verification of input supply voltage requirement	Critical	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	
		f) Actuator bore, keyway and output lever dimension	Major	MEAS	100%	20%	P.O. Specification, IS 9334	IR	P	W	-	
		g) In-built starter check	Major	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	As applicable
		h) Position controller – type & functional check	Critical	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	As applicable
		i) Position transmitter – type & functional check	Critical	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	
		j) Check for oil / grease leakage	Major	MECH	100%	-do-	No leakage	IR	P	W	-	
		k) Manual operation check	Major	MECH	100%	-do-	P.O. Specification	IR	P	W	-	
		l) Operational check for limit & torque switches	Major	MECH	100%	-do-	P.O. Specification	IR	P	W	-	
		m) Direction of rotation check	Major	VISU	100%	-do-	P.O. Specification Drawing	IR	P	W	-	
		n) Total number of turns check	Major	MECH	100%	-do-	P.O. Specification	IR	P	W	-	
		o) HV and IR test for assembled actuator	Major	ELEC	100%	-do-	2 KV for 1 Minute	IR	P	W	-	No flash over
		p) Measurement of operating time	Major	PHYS	100%	- do -	P.O, Specification, IS 9334	IR	P	W	-	
		q) Minimum starting torque	Major	MECH	- do -	20%	P.O. Specification	IR	P	W	-	

Sl. No	Component & Operation	Characteristics	Class	Type of Check	Quantum of check		Ref Doc. & Acceptance STD	Format of record	AGENCY			REMARKS
					M	B/C			M	B	C	
		r) Minimum 15 minute torque	Major	MECH	100%	1 No./ each type	P.O. Specification	IIR	P	V	-	As applicable
		s) Functional test with load for rated torque	Major	MECH ELEC	100%	10%	P.O. Specification	IR	P	W	-	For each type
		t) Secondary gear box i) Self-locking worm gear ii) Key way dimension iii) Splined / removable bush and dimension	Major	PHYS	100%	1 No./ each type	P.O, Specification	IIR	P	V	-	As applicable
02	Type Tests	a) Measurement of noise	Major	MECH	One of design	One of design	P.O, Spec, IS 325, IS 12075, BS 4999	TC	lab	V	-	for each type
		b) Measurement of vibration	Major	MECH	- do -	- do -	- do -	- do -	P	V	-	
		c) Rated torque test	Major	MECH	- do -	- do -	- do -	- do -	P	V	-	
		d) Stall torque test	Major	MECH	- do -	- do -	- do -	- do -	P	V	-	
		e)Temperature rise test	Major	ELEC	- do -	--	- do -	- do -	P	V	-	
		f) Enclosure protection test for total actuator	Major	ENVI	- do -	- do -	IS 60529 Or IEC Equivalent	- do -	P	V	-	
		g) Gear box sturdiness test	Major	MECH	- do -	- do -	EN15714	- do -	P	V	-	As applicable
		h) Endurance test for actuator	Major	MECH	- do -	- do -	EN15714	- do -	P	V	-	

B. NOTES

1. LEGEND:

ELEC	:	Electrical	MECH	:	Mechanical
MEAS	:	Measurement	ENVI	:	Environmental
VISU	:	Visual	PHYS	:	Physical
IR	:	Inspection report	TC	:	Test certificate
IIR	:	Internal Inspection Report			

2. All the testing facilities shall be arranged by the vendor at their works.

3. All measuring and test instruments must be periodically calibrated at recognized test laboratories and test certificates shall be made available during inspection for verification.

4. Test certificates for routine & type tests are to be furnished by the vendor. Type test certificate shall not be earlier than 5 years from the date of Purchase enquiry. If any changes are made in the design, material and process, the type tests shall be repeated, irrespective of the validity of existing type test certificate.

5. Packing shall be as per the " PACKING PROCEDURE " indicated in the Specification.

6. Packing shall be as per the ' PACKING PROCEDURE ' indicated in the Specification. Any loose supply items for the purpose of 'Safe transit' shall be clearly indicated in the packing slip.

7. Vendor to give tentative inspection programme in advance & confirm exact date two weeks in advance for arranging BHEL's inspection

C. REFERENCE STANDARDS:

(For the Indicated Standards refer the latest revision)

IS 325	:	Specification for three phase induction motor
IS 9334	:	Specification for Electric motor operated actuator
IS 12075	:	Vibration measurement on rotating Electrical machine
BS 4999	:	General requirement for rotating Electrical machinery
IS 60529		Degrees of protection provided by Enclosures
EN 15714	:	Industrial Valves. Actuators. Electric Actuators For Industrial Valves. Basic Requirements

CONTROLS AND INSTRUMENTATION/QA/FB

STANDARD QUALITY PLAN FOR

ELECTRIC ACTUATOR

(OPEN / CLOSE AND REGULATING)

REV	DATE	PREPARED	REVIEWED	APPROVED	REVISION HISTORY
00	06/08/1990	Sd/-	Sd/-	Sd/-	Initial release.
01	16/06/1997	Sd/-	Sd/-	Sd/-	Format revised
02	21/03/2002	Sd/-	Sd/-	Sd/-	Department name changed, CTQ requirements added & general revisions
03	08/01/2004	Sd/-	Sd/-	Sd/-	Revised to include the comments / feedback of internal discussion
04	05/12/2015	V.AVINASH	RM.VAIRAVAN	S.DAKSHINAMOORTHY	Format changed. Revised to update latest standards. Quantum of check modified.

Sl. No	Component & Operation	Characteristics	Class	Type of Check	Quantum of check		Ref Doc. & Acceptance STD	Format of record	AGENCY			REMARKS
					M	B/C			M	B	C	
A	**FINISHED PRODUCT INSPECTION**											
01	Routine test	a) Verification of name plate details for motor & actuator	Major	MEAS	100%	20%	P.O. Specification, Drawing	IR	P	W	-	
		b) Mounting dimensions	Major	MEAS	100%	20%	P.O. Specification, Drawing	IR	P	W	-	
		c) Verification of paint shade, thickness and finish	Major	VISU	100%	20%	P.O. Specification Drawing	IR	P	W	-	
		d) Verification of Limit & Torque switch rating and contact combination	Major	PHYS	100%	-do-	P.O. Specification	IR	P	W	-	As applicable
		e) Verification of input supply voltage requirement	Critical	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	
		f) Actuator bore, keyway and output lever dimension	Major	MEAS	100%	20%	P.O. Specification, IS 9334	IR	P	W	-	
		g) In-built starter check	Major	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	As applicable
		h) Position controller – type & functional check	Critical	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	As applicable
		i) Position transmitter – type & functional check	Critical	ELEC	100%	-do-	P.O. Specification	IR	P	W	-	
		j) Check for oil / grease leakage	Major	MECH	100%	-do-	No leakage	IR	P	W	-	
		k) Manual operation check	Major	MECH	100%	-do-	P.O. Specification	IR	P	W	-	
		l) Operational check for limit & torque switches	Major	MECH	100%	-do-	P.O. Specification	IR	P	W	-	
		m) Direction of rotation check	Major	VISU	100%	-do-	P.O. Specification Drawing	IR	P	W	-	
		n) Total number of turns check	Major	MECH	100%	-do-	P.O. Specification	IR	P	W	-	
		o) HV and IR test for assembled actuator	Major	ELEC	100%	-do-	2 KV for 1 Minute	IR	P	W	-	No flash over
		p) Measurement of operating time	Major	PHYS	100%	- do -	P.O, Specification, IS 9334	IR	P	W	-	
		q) Minimum starting torque	Major	MECH	- do -	20%	P.O. Specification	IR	P	W	-	

Sl. No	Component & Operation	Characteristics	Class	Type of Check	Quantum of check		Ref Doc. & Acceptance STD	Format of record	AGENCY			REMARKS
					M	B/C			M	B	C	
		r) Minimum 15 minute torque	Major	MECH	100%	1 No./ each type	P.O. Specification	IIR	P	V	-	As applicable
		s) Functional test with load for rated torque	Major	MECH ELEC	100%	10%	P.O. Specification	IR	P	W	-	For each type
		t) Secondary gear box i) Self-locking worm gear ii) Key way dimension iii) Splined / removable bush and dimension	Major	PHYS	100%	1 No./ each type	P.O, Specification	IIR	P	V	-	As applicable
02	Type Tests	a) Measurement of noise	Major	MECH	One of design	One of design	P.O, Spec, IS 325, IS 12075, BS 4999	TC	lab	V	-	for each type
		b) Measurement of vibration	Major	MECH	- do -	- do -	- do -	- do -	P	V	-	
		c) Rated torque test	Major	MECH	- do -	- do -	- do -	- do -	P	V	-	
		d) Stall torque test	Major	MECH	- do -	- do -	- do -	- do -	P	V	-	
		e)Temperature rise test	Major	ELEC	- do -	--	- do -	- do -	P	V	-	
		f) Enclosure protection test for total actuator	Major	ENVI	- do -	- do -	IS 60529 Or IEC Equivalent	- do -	P	V	-	
		g) Gear box sturdiness test	Major	MECH	- do -	- do -	EN15714	- do -	P	V	-	As applicable
		h) Endurance test for actuator	Major	MECH	- do -	- do -	EN15714	- do -	P	V	-	

B. NOTES

1. LEGEND:

ELEC	:	Electrical	MECH	:	Mechanical
MEAS	:	Measurement	ENVI	:	Environmental
VISU	:	Visual	PHYS	:	Physical
IR	:	Inspection report	TC	:	Test certificate
IIR	:	Internal Inspection Report			

2. All the testing facilities shall be arranged by the vendor at their works.

3. All measuring and test instruments must be periodically calibrated at recognized test laboratories and test certificates shall be made available during inspection for verification.

4. Test certificates for routine & type tests are to be furnished by the vendor. Type test certificate shall not be earlier than 5 years from the date of Purchase enquiry. If any changes are made in the design, material and process, the type tests shall be repeated, irrespective of the validity of existing type test certificate.

5. Packing shall be as per the " PACKING PROCEDURE " indicated in the Specification.

6. Packing shall be as per the ' PACKING PROCEDURE ' indicated in the Specification. Any loose supply items for the purpose of 'Safe transit' shall be clearly indicated in the packing slip.

7. Vendor to give tentative inspection programme in advance & confirm exact date two weeks in advance for arranging BHEL's inspection

C. REFERENCE STANDARDS:

(For the Indicated Standards refer the latest revision)

IS 325	:	Specification for three phase induction motor
IS 9334	:	Specification for Electric motor operated actuator
IS 12075	:	Vibration measurement on rotating Electrical machine
BS 4999	:	General requirement for rotating Electrical machinery
IS 60529		Degrees of protection provided by Enclosures
EN 15714	:	Industrial Valves. Actuators. Electric Actuators For Industrial Valves. Basic Requirements