SINGLE STAGE HORIZONTAL STEAM TURBINE FOR LUBE OIL PUMP

1.0.0 **SCOPE**:

This standard specifies the requirements of single stage horizontal steam turbine used for driving Centrifugal / Screw pumps of lube oil systems of Industrial Turbo sets and Compressor drives.

2.0.0 **TECHNICAL REQUIREMENTS** :

2.1.0 **General:**

2.1.1 Turbines shall be of the single - stage axial flow impulse type, designed for 3 years' continuous operation and 20 years' minimum service life. They shall be sufficient and economical in operation, substantially free of vibration and capable of being started automatically and quickly from cold condition.

2.1.2 The design shall be strictly as per API - 611 (Latest Edition). Customer / consultant documents are as per Annexure-I of purchase specification TC64515. Any deviation from the standard shall be indicated during quotation stage only.

2.2 **DESIGN PHILOSOPHY / CRITERIA – GENERAL:**

Selection of rotating equipment shall be based upon the following consideration.

- Suitability of the specified duty conditions.
- Standard models under vendor's regular range of manufacture.
- Proven track record in similar service.
- Optimum operating and maintenance costs.
- Maximum interchangeability of parts.
- Ease of operation and maintenance.

2.3 **THE ORDER OF PRECEDENCE IS TO BE FOLLOWED:**

- Customer / consultant Project orientated Turbine data sheets.
- Customer / consultant standard specification sent along with enquiry.
- BHEL purchase specifications.
- API standards.
- Applicable codes, standards

For design aspects not specifically covered by data sheets, specifications, codes and standards or regulations, the design shall be based on good engineering practices.

Vendor shall make all possible efforts to comply strictly with the requirements of this design basis. In case deviation is considered essential by the vendor (after exhausting all possible efforts), these shall be clearly brought out and consolidated under technical exception chapter at offer stage. However, vendor specific deviation (if any) to applicable codes / specifications shall be subject to Customer / consultant's approval during detail engineering.

Data sheets of auxiliaries indicating operating parameters, performance requirements, construction features, Instrumentation & controls, Inspection & testing etc. using respective API data sheet formats.

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2.3.0 **Technical requirements**:

2.3.1 The Turbine shall have the following features:

2.3.1.1 Stainless steel nozzle

2.3.1.2 Low friction carbon sleeves

2.3.1.3 Stainless steel stationary and rotating blades.

2.3.1.4 5000 hr-L. 10 life bearings.

2.3.1.5 Manual governor speed adjustments.

2.3.1.6 Trip and Throttle valve integral to steam chest unless otherwise specified as separate – R01

2.3.1.7 Built in removable steam strainer.

2.3.1.8 Suitable for Automatic start-up without warmup.

2.3.1.9 Self-contained oil ring lubrication with water cooling.

2.3.2 The Turbine shall be suitable for auto start, rapid start and shall be in a position to accelerate with 10 seconds from cold condition to operating speed and full load. Hence at the stand still condition of turbine, the turbine Trip and control valves shall be in open and ready to start – condition.

Vendor has to confirm the suitability of the turbine. The auto start equipment shall be in BHEL scope.

Site conditions : [x] Hazardous [-] Non Hazardous

2.3.3 Area of Classification : Zone 2, Gas Group IIC Temperature class T3

2.3.4 Ambient temperature in ºC : Max. 50

2.3.5 Type of Turbine required : [X] Horizontal [-] Vertical

Inlet Steam pressure in Kg/cm2(g) : As per variant table.

2.3.6 Min / Normal / Max / Design

Inlet Steam temperature in ºC) : As per variant table.

2.3.7 Min / Normal / Max / Design

Exhaust Steam pressure in Kg/cm^2(g): As per variant table.

2.3.8 Min / Normal / Max / Design

2.3.9 Output Power required : As per variant table.

2.3.10 Maximum power : As per variant table.

2.3.11 Normal continuous operation : As per variant table.

2.3.12 **The turbine shall be capable of delivering power at the min. inlet pressure and max. Exhaust pressure, also the turbine shall be capable of delivering 10% extra power over the rated power by opening valve.**

Speed in RPM : As per variant table.

2.3.13 Direction of rotation when viewing : ***Clockwise (CW)***

2.3.14 from Governor end.

Exhaust & inlet nozzle orientation : **Right hand side when viewed from coupling end.**

2.3.15 Installation : [-] Indoor [x] Outdoor

[-] Heated [x] Unheated

[-] With roof [x] without proof

Inspection Agency : [x] BHEL [x] EIL or Customer appointed agency.

2.3.16 **M/s Lloyds is the approved Inspection agency, if the item is procuring from imported organization. The Inspection charges shall be included in main equipment price.**

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2.3.17	Governor Type No. (Woodward)	: NEMA Class: D Mechanical type
2.3.18	End Seals & Make	: Carbon rings
2.3.19	Manufacturer's serial number and year of manufacture.	: Vendor to specify

2.4.0 **Materials:**

Materials shall be selected as per design requirement. However, materials indicated below are minimum requirement.

	Part description	Material
	Steam chest, Exhaust casing , Trip valve and Governor valve bodies	: Cast steel based on operating pressure and Temperatures
2.4.1	Shaft	: Alloy steel, hard chrome plated
	Nozzles, Hand valves	: Stainless steel
2.4.2	Wheel	: Steel
2.4.3	End seals	: **Carbon rings**
2.4.4	Strainer screen, Governor and Trip valve	
2.4.5	seats	: Stainless steel
2.4.6	All materials are used shall of copper free type.	
2.4.7	Interstage seals R01	: Labyrinth not applicable for Single stage Turbine.

2.5.0 **Scope of Inspection:** [x] As per API 611 (Latest edition)
[x] As per Customer / consultant Project orientated Turbine data sheets

2.6.0	Manufacturer's Name	: Vendor to specify
2.7.0	Turbine model number	: Vendor to specify
2.8.0	Inlet flange size and rating	: Vendor to specify
2.9.0	Outlet flange size and rating	: Vendor to specify
2.10.0	Steam consumption rate in Kg/KW/Hr	: Vendor to specify
2.11.0	Cooling water	: [ ] Required [ ] Not required
2.11.1	Quantity	: Vendor to specify
2.11.2	Temperature in ºC	: Vendor to specify
2.12.0	Tachometer model & make	: Vendor to specify

NOTES:

2.13.0 Vendor to fill the project orientated Customer / consultant Turbine data sheets sent along with enquiry and submit the same along with offer.

2.13.1 Shaft end seals shall be Carbon Rings with or without brush seals / Mechanical seal or as per project specific requirement. (refer Annexure-I). The same shall be past proven. - R01

2.13.2 Steam turbine with **open hand valve** in normal operating condition is not acceptable.

2.13.3 Pressure drops in suction strainer, control valve and flow element in Turbine inlet line shall be subjected to EIL / customer approval during detail engineering stage.

2.13.4 For inlet casing design: MAWP shall not be less than 24 Kg/cm²(g) /FV @ 285°C. Vendor to indicate the standard MAWP of the offered steam turbine model

2.13.5 For Outlet casing design: MAWP shall not be less than 10 Kg/cm²(g) /FV @ 225°C. Vendor to indicate the standard MAWP of the offered steam turbine model

2.13.6 Hydro test pressure shall be 1.5 times the standard casing MAWP.

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2.13.7 Turbine shall be designed to operate with entire range of inlet and exhaust conditions.

2.13.8 Steam turbine shall be fixed speed, back pressure type with Carbon rings. Any instrumentation, control etc., required to ensure the same is in vendor's scope of supply.

2.13.9 The steam turbine companion flanges, piping components and other instrumentation items shall be IBR certified

2.13.10 Vendor to furnish completely filled in ERP (if applicable) meeting all requirements of customer / EIL specification (If applicable) for BHEL/ EIL / customer approval / acceptance during offer stage.

2.13.11 Proper marking shall be provided for all loose parts.

2.13.12 General arrangement drawing to be submitted by connecting all loose parts supplying along the aux steam turbine.

2.13.13 Vendor to strictly follow the MAWP of Inlet & Outlet casing as per project specific datasheet (If applicable)

3.0.0 **SCOPE OF SUPPLY:**

3.1.1 Lube oil pump drive turbine along with seal (refer variant table for seal type), sentinel valve, Suction strainer with counter flange, Pressure gauges for Throttle steam, Nozzle Ring, Exhaust, Local gauge board/Instrument rack for mounting along with junction box of solenoid valve and proximity switch, Insulation cover, Remote trip solenoid, Remote start solenoid)

3.1.2 Required Instrumentation recommended by OEM with mounting board for local control panel.

3.1.3 Necessary tubing and cables to connect the instruments from turbine to local control panel.

3.1.4 Necessary fasteners along with gaskets for fixing loose items at BHEL's works.

3.1.5 Steam Consumption is to be guaranteed at site by the vendor. Make good is acceptable.

3.1.6 Others items in scope of supply as per enquiry.

3.2.0 **SCOPE OF SUPPLY FOR COMMISSIONING SPARES:**

3.2.1 Spare set of Gaskets (Casing Sealant - Copaltite) & "O" rings (Thread Sealant- Temptite) for lube oil pump drive turbine – 1 Set – R01

3.3.0 **SCOPE OF SUPPLY FOR MADATARY SPARES (If Applicable):**

3.3.1 Mandatory spares for lube oil pump drive turbine shall be as per enquiry.

3.4.0 **2-YEAR NORMAL OPERATIONAL SPARES:**

Vendor to submit offer for 2-year normal operational spares for lube oil pump drive turbine & its control equipment along with offer. The prices shall be quoted individually in the price format. Un priced bid format shall be sent along with offer.

The validity of spare price shall be one year after placement of main equipment order. The spare prices are to be considered while evaluating price comparative statement by BHEL

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4.0.0 **RATING PLATES**

A rating plate of non-corrosive material upon which shall be engraved manufacturer's name, Turbine type, Turbine model, Serial no. of Turbine, rating in KW, Speed in RPM, Steam consumption at operating condition, Inlet steam parameters, Exhaust steam parameters, Inlet steam temperature, Exhaust steam temperature and the essential parameters required.
These rating plates shall be of White non-hygroscopic material with engraved black lettering.

5.0.0 **CLEANING & PREPARATION FOR COATING:**

5.1.1 All coated surfaces shall be protected against abrasion impact, discoloration any other damages.

5.1.2 All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. The shaft ends of Turbine shall be properly sealed with suitable devices to protect them from damage The parts which are likely to get rusted due to exposure to whether, should also be properly treated and protected in a suitable manner. All primers / paints / coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be.

5.2.0 **PRESERVATIVE SHOP COATING**:

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces that will not be easily accessible after the shop assembly shall be treated beforehand and protected for the life of the equipment.
All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and pre heated in the shop.
The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.
All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of Customer / BHEL.

5.3.0 **PAINT AND FINISH**

5.3.1 Turbine external parts shall be finished and painted to produce a neat and durable surface, which would prevent rusting, and corrosion. The equipment shall be thoroughly degreased, all rust, sharp edges and scale removed and treated with one coat of primer and finished with two coats of final paint. The final paint shade will be informed during detailed engineering stage.

5.3.2 Material shall be properly packed to withstand mechanical damage and rust during transit.
Vendor to submit the cleaning & painting specification along with offer.

6.0.0 **SPECIAL NOTES:**

6.1.1 Final documents as per clause 6.2.1 & 6.2.2 of BHEL specification TC 6 4515 Rev 01 shall also be furnished in C.D compatible for using in AutoCAD (Latest)
O & M manuals shall also be furnished in C.D compatible for using in MS-Word (Latest).

6.1.2 Vendor to submit the duly signed & stamped Annexure I to TC64515 Rev 01 along with offer as the same is mandatory for technical evaluation.

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7.0.0 DOCUMENTATION:

The list of engineering data would be a comprehensive one including all engineering data / drawings / information for all brought out items and manufacturing items

All the drawings/ documents submitted by the vendor during detailed engineering stage shall be stamped "For Approval" or For Information" prior to submission.
After the approval of the drawing, further work by the vendor shall be in strict accordance with these approved drawings and no deviations shall be permitted without the written approval of customer.
All manufacturing, fabrication and execution of work in connection with the equipment / system. Prior to the. Shall be at the vendor's risk. The vendor is expected not to make any changes in the design of the approval of the drawings equipment / system, once they are approved by customer.

However, if some changes are necessitated in the design of equipment / system at a later date. The vendor may do so, but such changes shall promptly be brought to the notice of customer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the technical specification.

The no of copies / prints/CD/manuals to be furnished as follows:
Drawings, Data sheets, Curves for Information / approval .... 3 prints & 1 CD
Final Drawings, Data sheets, Curves for Information / approval .... 3 prints & 1 CD
Performance and functional guarantee test reports .... 10 prints & 1 CD

7.1.0 **DRAWINGS, DATA TO BE FURNISHED**

7.1.1 **Documents to be sent along with offer (2 copies)**
(Without following data, offers will not be considered.)

7.1.1.1 Technical data required as per BHEL & EIL/Customer/API Specifications.
7.1.1.2 General arrangement drgs. / Catalogues giving with full sectional views. (Including basic dimensions, flange & shaft end details, inlet, exhaust, drains, leak-off, and bearing housing connections.)
7.1.1.3 Cross-sectional drawing with bill of material.
7.1.1.4 Filled in EIL/ Customer data/API 611 datasheet of LOP drive Turbine.
7.1.2.2 Cross-sectional drawing with bill of material of LOP drive Turbine.
7.1.2.3 Filled in ERP of LOP drive Turbine.
7.1.2.4 Performance curve of the Turbine.
7.1.2.5 Quality assured plan.
7.1.2.6 Carbon Rings GA drawing.

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7.1.2.7 Foundation & fixing details.
7.1.2.8 Turbine allowable forces & moments / Thermal moment.
7.1.2.9 Turbine piping & Instrument diagram.
7.1.2.10 Detailed installation diagrams with dimensional details.
7.1.2.11 Calibration sheets & records.
7.1.2.12 Inspection & test procedures including material certificates.
7.1.2.13 Painting program (as specified by customer), including surface preparation, primer and paint material, and components affected, shall be described completely including preservation of the consignment as per customer specs.

7.1.2.0 **Documents to be sent after placement of order (5 copies)**

7.1.2.1 General arrangement drawings giving with full sectional views. (Including basic dimensions, flange & shaft end details, inlet, exhaust, drains, leak-off, and bearing housing connections.)
7.1.2.2 Cross sectional drawing along with Bill of Material.
7.1.2.3 API 611/Customer datasheet.
7.1.2.4 Cross-sectional drawing with bill of material of LOP drive Turbine.
7.1.2.5 Filled in ERP of LOP drive Turbine.
7.1.2.6 Performance curve of the Turbine.
7.1.2.7 Quality assured plan.
7.1.2.8 Carbon Rings GA drawing.
7.1.2.9 Foundation & fixing details.
7.1.2.10 Turbine allowable forces & moments / Thermal moment.
7.1.2.11 Turbine P & ID
7.1.2.12 Detailed installation diagrams with dimensional details.
7.1.2.13 Calibration sheets & Records.
7.1.2.14 Inspection & Test reports including MTC
7.1.2.15 Painting procedure

7.1.3.0 **Documents to be sent along with consignment (5 copies)**

7.1.3.1 General arrangement drawings giving with full sectional views. (Including basic dimensions, flange & shaft end details, inlet, exhaust, drains, leak-off, and bearing housing connections.)
7.1.2.2 Material Code wise Boxes indicating the items as per the order.
7.1.2.3 Test & Guarantee certificates.
7.1.2.4 Material test certificates.
7.1.2.5 O&M manuals for all the items covered in vendor's scope of supply.
7.1.2.6 Check list to start the lube oil pump drive turbine.

8.0.0 **TESTS & GUARANTEE CERTIFICATES:**

8.1.0 **TESTS CERTIFICATES:**
3 copies of performance test certificate of turbine & control equipment shall be supplied for each item of the consignment quoting BHEL Standard number, purchase order number and manufacturer's identification serial number.

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8.2.0 **GUARANTEE CERTIFICATES:**

8.2.1 A guarantee certificate for 18 months of trouble free performance from the date of shipment or 12 months from the date of commissioning whichever is earlier shall be supplied.

8.2.2 If any mal-performance or defects occur during the guarantee period, the vendor shall make all necessary alteration, repairs, or replacement free of charge

9.0.0 **PACKING:**

The equipment shall be properly packed to withstand mechanical damage and rust during transit. Packing and shipment shall be as per API - 611 Clause 4.4. Packing shall be suitable for 24 months' storage period.

10.0.0 **MARKING:**

10.1.0 In addition to the marking as per API - 611, BHEL 12-digit material code number shall be provided at suitable place.
All the items shall be properly marked with tag number provided the sketch enclosed to this specification.

10.2.0 The following details shall be marked on the packing case for each consignment.

a) Manufacture's Name
b) BHEL Order number.
c) BHEL Standard Number
d) BHEL Material Code Number.
e) Description of the item

11.0.0 **Enclosures to be followed:**

Annexure –I to Purchase Specification TC64515 Rev01
Annexure –II to Purchase Specification TC64515 Rev01
Annexure –III to Purchase Specification TC64515 Rev01
Annexure –IV to Purchase Specification TC64515 Rev01
Annexure –V to Purchase Specification TC64515 Rev01

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Var No	Nor/Max Power in KW	Inlet Steam pressure in Kg/cm^2(g) Min / Normal / Max / Design	Inlet Steam temperature in ºC) Min / Normal / Max / Design	Exhaust Steam pressure in Kg/cm^2(g) Min / Nor / Max / Design	Customer data sheet number	BHEL material code
	22 / 40.7	18.5/19.0/20.5/22	210/220/240/245	3.0/3.5/4.0/5.0	API 611 V Ed datasheet	
01	SGL STG ST TURB 1450RPM					TC9764515010
02	SET OF DYNAMICALLY BALANCED ROTOR FOR LOPDT					TC9764515029
03	SET OF COMPLETE SHAFT SEAL ASSY FOR LOPDT					TC9764515037
04	SET OF BEARINGS FOR LOPDT					TC9764515045
05	SET OF GASKETS & O RINGS FOR LOPDT					TC9764515053
06	SELF POWERED DIGITAL TACHOMETER FOR LOPDT					TC9764515061
07	EXPANDER/REDUCER & PIPE FITTINGS ALONG WITH COUNTER FLANGES TO SUIT THE INLET & EXHAUST SIZES OF LOPDT AS PER ANNEXURE – VI TO TC64515					TC9764515070
08	LEAK OFF/ DRAIN ALONG WITH COUNTER FLANGES & STEAM TRAP ASSY FOR LOPDT					TC9764515088
09	Pressure Gauge (20% of each type) --- 1 Set or Minimum 2 Nos(Whichever is higher)					TC9764515096
10	Temperature Gauge (20% of each type) --- 1 Set or Minimum 2 Nos(Whichever is higher)					TC9764515100
11	RTD's with Thermowell (20% of each type) --- 1 Set or Minimum 2 Nos(Whichever is higher)					TC9764515118
12	SGL STG ST TURB 1450RPM					TC9764515126

Var No	Nor/Max Power in KW	Inlet Steam pressure in Kg/cm2(g) Min /Nor. / Max / Design	Inlet Steam temp in ºC) Min / Normal / Max / Design	Exhaust Steam pressure in Kg/cm2(g) Min / Nor / Max / Design	Exhaust Steam temp in ºC) Min / Normal / Max / Design	Customer data sheet number	BHEL material code
	22 / 40.7	14.5/15.5/17.0/21	230/250/270/290	3.3/3.8/4.4/10	160/175/200/225	API 611 V Ed datasheet	**APL SYN Gas Turbine**
13	Lube oil pump Drive Turbine 1450RPM with Carbon Rings seal (22/40.7 KW)						TC9764515134
14	TACHOMETER (Self-powered) FOR LOPDT						TC9764515142
15	SPARE SET OF GASKETS & ORINGS FOR LOPDT						TC9764515150
16	Expander/Reducer & fittings to suit Inlet & Exhaust						TC9764515169
17	Leak off/Drain & Steam Trap Assy for LOPDT						TC9764515177
18	Cooling water inlet & outlet for LOPDT						TC9764515185
19	Spare set of dynamically balanced rotor for LOPDT with N2 container.						TC9764515193
20	Spare set of Carbon Rings Seal for LOPDT						TC9764515207
21	Spare set of Bearings (DE & NDE) for LOPDT						TC9764515215
22	Spare set of PRESSURE GUAGE (10% OF EACH TYPE)						TC9764515223
23	Spare set of TEMPERATURE GUAGE (10% OF EACH TYPE)						TC9764515231
24	Spare set of RTD's with THERMOWELL (10% OF EACH TYPE)						TC9764515240
25	Spare SOLENOID VALVE (10% OF EACH TYPE)						TC9764515258
26	Spare PROXIMITY SWITCH (10% OF EACH TYPE)						TC9764515266

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<table>
<tr><td>27</td><td>Lube oil pump Drive Turbine 2950RPM, 45/55KW rating and Carbon Rings as seal (refer clause 3.0.0 of TC64515), with the following parameters -
<table>
<tr><th>Nor/ Max Power in KW</th><th>Inlet Steam pressure in Kg/cm2(g) Min /Nor. / Max / Design</th><th>Inlet Steam temp in ºC) Min / Normal / Max / Design</th><th>Exhaust Steam pressure in Kg/cm2(g) Min / Nor / Max / Design</th><th>Exhaust Steam temp in ºC) Min / Normal / Max / Design</th><th>Customer data sheet number</th></tr>
<tr><td>45 / 55</td><td>12/13.5/16/20</td><td>275/300/325/ 335</td><td>1.0 to 3.0/4.0 / 5.0 /7.5</td><td>200/225/250/ 275</td><td>API 611 V Ed</td></tr>
</table></td><td>TC9764515274</td></tr>
<tr><td>28</td><td>Tachometer (powered) for LOPDT</td><td>TC9764515282</td></tr>
<tr><td>29</td><td>Spare set of Gaskets (Casing Sealant - Copaltite) & “O” rings (Thread Sealant - Temptite) FOR LOPDT</td><td>TC9764515290</td></tr>
<tr><td>30</td><td>Steam inlet and exhaust piping with Expander/Reducer & fittings to suit Inlet & Exhaust with companion flanges</td><td>TC9764515304</td></tr>
<tr><td>31</td><td>Leak off/Drain piping & Steam Trap Assy for LOPDT</td><td>TC9764515312</td></tr>
<tr><td>32</td><td>Cooling water inlet & outlet piping for LOPDT</td><td>TC9764515320</td></tr>
<tr><td>33</td><td>Spare set of Bearings (DE & NDE; Radial & Thrust) for LOPDT</td><td>TC9764515339</td></tr>
<tr><td>34</td><td>Spare set of Oil seals (Isolator), steam seals (set of Carbon Rings) & Interstage Seals (if applicable) for LOPDT</td><td>TC9764515347</td></tr>
<tr><td>35</td><td>Spare set of Complete Hydro-mechanical Governor for LOPDT</td><td>TC9764515355</td></tr>
<tr><td>36</td><td>Spare set of Pressure Gauge (10% of each type)</td><td>TC9764515363</td></tr>
<tr><td>37</td><td>Spare set of RTD’s with Thermowell (10% of each type) with provision for Transmitter</td><td>TC9764515371</td></tr>
<tr><td>38</td><td>Spare set of 3nos. of Speed probe (MPU’s) and 3nos. of Powered tachometer (local display) along with extension cable up to 10metres.</td><td>TC9764515380</td></tr>
</table>

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RECORD OF REVISIONS.

Rev. No	Date	Revision Details	Revised	Approved
00	20.03.17	First issue	----	----
01	03.12.19	Revised as marked.	Sunil B Jiwtode	P S V S K
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