भारतीय मानक **IS 7156 : 2024**

Indian Standard

विपरीत परिसंचरण वेधन रिग्स — सामान्य अपेक्षाएँ

(पहला पुनरीक्षण)

Reverse Circulation Drilling Rigs — General Requirements

(First Revision)

ICS 53.100; 73.100.30

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July 2024 **Price Group 5**

Diamond Core and Waterwell Drilling Sectional Committee, MED 21

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Diamond Core and Waterwell Drilling Sectional Committee had been approved by the Mechanical Engineering Division Council.

The standard was first published in 1974. This standard is being revised again to keep pace with the latest technological developments and international practices. Also, in this revision, the standard has been brought into the latest style and format of Indian Standards, and references of Indian Standards, wherever applicable have been updated. The following major modifications have been incorporated in this revision of the standard:

a) The reference standards have been updated; and
b) Safety requirement has been added.

In this standard, certain minimum technical requirements are specified for satisfactory performance of the rigs. Among the various requirements covered in this standard are those pertaining to the constructional details of the drill in general.

Water well drilling means the construction of bore wells, for the supply of water for drinking, industrial, and agricultural purposes. The capacity of the wells shall be according to the needs and the availability of aquifer.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

REVERSE CIRCULATION DRILLING RIGS — GENERAL REQUIREMENTS

(*First Revision*)

1 SCOPE

This Indian standard covers the general requirements for reverse circulation drilling rigs.

2 REFERENCES

The standard listed in below contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards:

IS No.	*Title*
IS 1161 : 2014	Steel tubes for structural purposes — Specification (*fifth revision*)
IS/ISO 18758-2 : 2018	Mining and earth-moving machinery — Rock drill rigs and rock reinforcement rigs: Part 2 Safety requirements

3 FUNCTIONS AND CONSTRUCTIONAL DETAILS

3.1 The reverse circulation drill is used to construct larger diameter wells, the hole being of any size up to 1 500 mm (≈ 60 inch) in certain cases, under soft to medium and hard soil conditions for bore wells. The sand formations and sticky clay form, the soft and hard strata conditions. This type of drill is not suitable for hard rocky conditions. The characteristics of this type of drill is to clear the cuttings by pumping them along with the water through the drill rod string, the water being circulated via the annulus from the water storage pit to the hole through a flume and back to the pit again (*see* Fig. 1).

3.2 The functions and the constructional details of various units are given in Fig. 2. They are intended to be typical only and do not constitute a specific recommendation but are only a guideline for the manufacturer and the user of the drilling rig.

3.2.1 *Draw Works*

The draw works shall consist of not less than two drums to hold the drilling string and to handle auxiliary equipment and shall have individual controls either through clutches or any other acceptable method with brake bands of the required capacity. The drive shafts shall be mounted on antifriction bearings on either side and shall rotate freely on them. Proper lubrication shall be ensured for longer bearing life. The brake bands should prevent any foreign material or the lubricants to come in contact with the linings. The drive shall be through the transmission to give varying speeds for the pull. The draw works shall be complete with sufficient lengths and capacity of tested steel wire rope rolled on both the drums.

3.2.2 *Mast*

Mast shall be constructed either of structural steel conforming to IS 1161. The material shall be capable of handling the maximum desired load without distortion, the factor of safety being not less than 2.2 in any case. The mast shall be made up of horizontal sections with cross-bars tied together to the sections at an interval of not more than 3 m to 3.5 m. They shall be properly welded with no cracks in welding. The final shape of the mast shall be correct to the requirement with the clear working height to handle the drilling string and with sufficient width to accommodate handling of drilling bits and casing pipes. The mast shall be actuated by one or more double acting hydraulic cylinders with safety checks, to either raise or lower it. A mechanical lock shall be provided to hold the mast in vertical position. There shall be adjustable leg supports for the mast to take up the loads without any disturbance to its position. The hydraulic cylinders shall be operated by means of a suitable hydraulic pump driven by the main power unit or by a separate power unit and controlled by valves. The mast shall have the necessary attachments for all the hydraulic and water connection joints, the crown pulleys and the wire string. Necessary lubricating arrangements shall be made for all the moving parts. Suitable electrical wiring arrangements shall also be made for lighting.

3.2.3 *Rotary Table*

The rotary table shall give a positive rotation to the drill string in different speeds through the transmission for the different strata conditions. Whereas the hard sticky clay formation requires

faster rotational speeds to pass through, the sand formation requires lesser speed. The selection of the correct speed shall be the driller's job according to the prevailing conditions. The rig shall have at least 4 speeds or 5 speeds to select from. The rotary drive to the drill string shall be provided by means of a straight or spiral steel gear and pinion properly machined to close tolerances. The pinion shaft shall be mounted on heavy duty taper roller bearings. An independent clutch for the rotary table shall also be provided. The entire unit shall be mounted on a cast or fabricated oil bath casing, dust-proof and leak-proof. The drive to the drill string from the table shall be through a two-piece master bushing. In case of smaller rotary tables provision either to remove it or to keep it in the vertical position while lowering of casing and while shifting, shall be provided.

3.2.4 *Transmission*

Provision shall be made for effecting different rotational speeds for the rotary table according to the soil conditions and different hoisting speeds according to the load on the hook. As mentioned earlier, hard sticky clay formations require faster speeds and the hoisting speed is inversely proportional to the hoisting load. For this a gear box with not less than 4 forward speeds and one reverse speed with the required gear reduction shall be provided. This unit shall be coupled to the power unit through the main clutch. Individual clutches shall be provided for all the subunits. Transmission unit shall be filled with suitable grade of lubricating oil and shall be leakproof.

3.2.5 *Pump*

The pump shall remove the cuttings as the drilling progresses quickly and efficiently to obtain maximum rate of drilling. A suitably designed pump delivering the maximum quantity of water and with the maximum requisite pressure, driven by either the main power unit through suitable drives and with an independent control, or by an auxiliary power unit with controls, shall be provided in the rig. A suitable priming system shall also be provided.

3.2.6 *Power Unit*

All the above units shall be driven by one or more power units. It shall either be a high speed industrial type diesel engine or an electric motor or motors of adequate capacity. In the case of the diesel engine, it shall be continuously rated and be free from troubles, shall be provided with suitable lubricating and cooling systems and shall be easily accessible for repairs. In the case of an electric motor it shall be a continuous rated motor with starter, switchgear and cable arrangements and enclosed in a suitable weatherproof cabin. The motor shall be suitable for operation in 400 V a.c. mains. In either case, namely, the diesel engine or the electric motor, they shall develop adequate power at the rated speed to meet all requirements. In the case of the diesel engine a fuel tank of suitable capacity shall be provided.

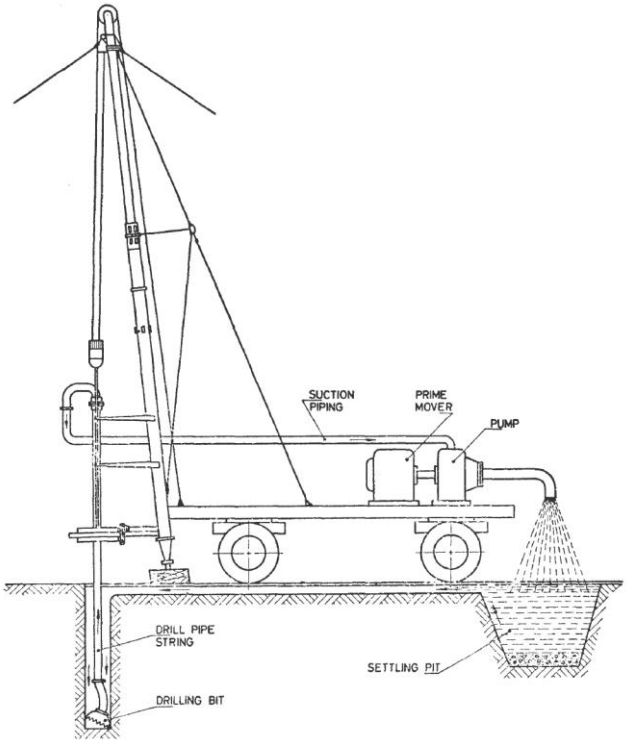

FIG. 1 REVERSE CIRCULATION DRILLING SYSTEM

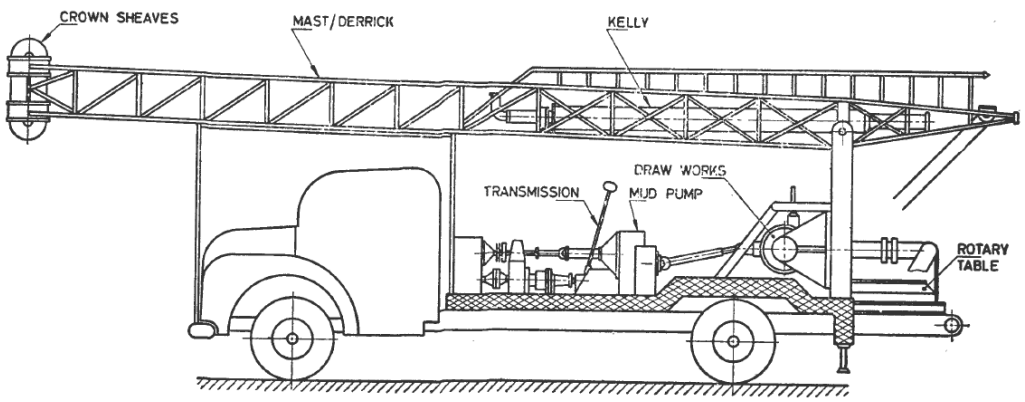

FIG. 2 REVERSE CIRCULATION DRILLING RIG

3.2.7 *Controls*

The following controls should be provided as follows:

a) To start the power unit;

b) Erection of the main supporting jacks;

c) Raising and lowering of mast;

d) Hoisting and lowering the main line;

e) Hoisting and lowering the auxiliary line;

f) To give rotary drive to the drilling string;

g) To drive the pump; and

h) Control switches for the lighting unit.

All the above controls shall be grouped together and placed at the driller's place within reach for quick and easy operation and the entire operation shall be done by a single operator and the operations shall be fully visible to him. In addition to this, the drill shall have the following gauges, namely, vacuum gauge, ammeter, voltmeter, etc.

3.2.8 *Lighting System*

Generally drilling operations are carried out during day and night. To enable round-the-clock operation, the entire rig shall be adequately illuminated. In the case of the rig mounted with a diesel engine, the power for lighting shall either be from the main engine or from any auxiliary equipment. In the other case where the electric power is available and the rig equipped with electrical motors, the power for the lights shall be tapped from the electrical main and in the case of rigs supplied to mines the voltage shall be either 110 V or 240 V. Panel lights for the gauges may also be provided. Suitable control switches shall be provided.

3.2.9 *Mounting*

All the above units put together form the drilling rig. The whole system shall be grouped and mounted as a single unit on an all steel welded structure with structural members running lengthwise forming a solid foundation for the entire machinery. The mounting shall be of either a truck-mounted or a trailer-mounted one. All the individual units shall be assembled on the chassis in a compact manner and shall have sufficient space for carrying out repairs easily to the different parts. In the case of the truck-mounted chassis it shall be self-propelled, driven by the main power unit with suitable drive arrangements. In a trailer-mounted chassis it shall be handled by an external unit, that is, a tractor.

3.2.10 *Tools and Accessories*

The drilling rig shall be provided with the complete set of all operating equipment's such as drilling bits, drill rods, handling tools, etc and also small hand tools for carrying out repairs to both power units and other equipment's. The following tools and accessories that are ordinarily to be supplied along with the drill shall be included but this is variable according to the need of the user of the drilling rig:

a) Drill bits of various sizes and types, with appropriate substitute connections to drill through the different soil formations;

b) Sufficient numbers of drill rods to cover the rated capacity of the drill;

c) Drill rod hoisting flange;

d) Drill rod slip;

e) Spirit level;

f) Chain wrenches;

g) Adjustable wrench;
h) Set of files-flat, round, half-round, etc (rough and smooth);
j) Cold chisel;
k) Centre punch;
m) Hammer;
n) Pliers;
p) Screw driver;
q) Adjustable spanner;
r) Set of double ended spanners;
s) Set of ring spanners;
t) Set of box spanners;
u) Grease gun;
v) Oil can;
w) Steel tape;
y) Hacksaw frame with blades; and
z) Set of allen keys.

4 INFORMATION TO BE SUPPLIED BY THE PURCHASER

4.1 When enquiring or ordering drilling rigs, the user shall furnish the following information:

a) Geographical history, in general, of the location of sites where drilling has to be carried out;
b) Height with reference to mean sea level that is, + ... M.S.L. or . . . . . M. S L.;
c) Static water level at the place of location;
d) Anticipated formation of strata where the hole is to be drilled;
e) Maximum diameter and depth to be drilled;
f) Mobility for the entire unit (truck, trailer);
g) The available power to drive the rig that is whether electric power is available or not; and
h) Special features required, if any.

5 INFORMATION TO BE FURNISHED BY THE SUPPLIER

5.1 The following information shall be furnished by the supplier:

a) Performance of the drilling rig in respect of the following:
    1) Maximum diameter and depth that can be drilled;
    2) The approximate rate of drilling under normal specified conditions;
    3) The pump capacity, namely, the maximum discharge and pressure; and
    4) Any special features in construction to drill through hard soil conditions.
b) The maximum load handling capacity, the maximum and working height and width and the constructional details of the drill mast;
c) The type and capacity of the wire ropes;
d) The capacity of the main line and auxiliary line brakes;
e) The number of variable rotational and hoisting speeds;
f) The number and capacity of the mast raising cylinders;
g) The prime-mover and its transmission ratios;
h) Mobility of the drilling rig with reference to alternate arrangements that can be made while effecting delivery of the rig; and
j) Any other special features that are incorporated in the design and construction which shall give increased performance characteristics to the drilling rig.

6 TESTING

6.1 Object

The object of testing the drilling rig is to determine the efficiency of the drill in terms of the maximum diameter and depth of drilling and rate of penetration under specified soil conditions. This shall be subject to agreement between the supplier and the purchaser.

6.2 Duration of Test

The duration of the test shall be sufficient to obtain accurate and consistent results.

6.3 Observation during the Test

During the whole period of the test, careful observation shall be made in regard to the following:

a) Mobility of the drilling rig from one site to another;
b) The quickness in erection of drill and commencing the drilling operations without loss of time;
c) The diameter of the hole drilled and its depth;
d) The rate of drilling at different formations. The depths at an interval of at least 15 min shall be noted and the relative time taken shall be observed for every unit of depth;

e) The capacity of the mast and the draw works;
f) The capacity of the pump to the extent of its quick clearance of the cuttings, the pressure and discharge;
g) Undue shock, hammering, vibrations or other mechanical defects;
h) Lubrication of all the units; and
j) Operational suitability and the controls.

7 SAFETY

7.1 Safety shall be as per IS/ISO 18758-2.

7.2 Protective equipment such as ear plugs or ear muffs, respiratory masks, safety footwear, hard hats, industrial work gloves are recommended while use.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Diamond Core and Waterwell Drilling Sectional Committee, MED 21

Organization	*Representative(s)*
Geological Survey of India, New Delhi	SHRI AJAY AGARWAL **(*Chairperson*)**
Aqseptence Group (India) Pvt Ltd (Formaly Known as Johanson Screens India Pvt Ltd), Sanand	SHRI SHIV NARAYAN SINGH SHRI SHIVEN AMIN (*Alternate*)
Atlas Copco (I) Ltd, Pune	SHRI SHUDHANSHU NIGAM SHRI S. DATTA MAJUMDAR (*Alternate*)
Central Ground Water Board, Faridabad	SHRI G. L. MEENA SHRI NIDHISH VERMA (*Alternate*)
Central Mine Planning and Design Institute, Ranchi	SHRI ANIL SAVANUR SHRI A.V. RAMAKRISHNA (*Alternate*)
Epiroc Mining India Limited, Nashik	SHRI SUJEET KUMAR SHRI CHANDAN GHOSH (*Alternate*)
Geological Survey of India, Kolkata	SHRI ANUP KUMAR JOHRI SHRI C. B. TIWARI (*Alternate* I) SHRI S. SHANKAR (*Alternate* II)
Indian Institute of Technology (ISM), Dhanbad	MOHAMMED HAMID SIDDIQUE SHRI PAWAN GUPTA (*Alternate* I) SHRI VINAY KUMAR RAJAK (*Alternate* II)
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In Personal Capacity (*D-5/10, Rail Vihar, Indirapuram, Ghaziabad*)	SHRI P. C. DEWLI
In Personal Capacity (*90 Mayur Vihar, Sec 48, Chandigarh*)	SHRI MAHESH CHANDRA JINDAL
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Member Secretary
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SCIENTIST 'C'/DEPUTY DIRECTOR
(MECHANICAL ENGINEERING), BIS

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This Indian Standard has been developed from Doc No.: MED 21 (22231).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi