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JAPANESE INDUSTRIAL STANDARD

Standard Form of Specifications of Shield Machine

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Standard Form of Specifications of Shield Machine A 8201-1986

1. General Rule

1.1 Scope This Japanese Industrial Standard specifies the standard form and gist of entry of specifications of shield machines⁽¹⁾.

Note ⁽¹⁾ The shield machine means the machine to advance with excavation by taking a reaction force by a propulsion jack attached to the body (see 3.6) with supporting the earth pressure by the machine body.

Remark: In this standard the units and numerical values shown in { } are in accordance with the International System of Units (SI) and are appended for reference.

1.2 Division This standard is divided into standard form of specifications and gist of entry of specifications.

2. Standard Form of Specifications

2.1 The specifications shall be in accordance with the form of Attached Table.

2.2 The specifications indicate elements and outline of performance of the shield machine, and at the time of entry, items may be selected adequately depending upon the purpose.

Furthermore, construction, materials, etc. of each part shall be appended as required.

2.3 To the specifications, whole assembly drawing, tail plate strength counting, etc. shall be appended as required.

Further, in the case of indicating the design conditions of shield machine, they shall be entered in accordance with Appendix and be appended to the specifications.

3. Gist of Entry of Specifications

The entry sequence and entry gist of specifications shall be as follows:

3.1 Name of Type Enter the type division such as hand-drilling type⁽²⁾, blind type⁽³⁾, shield machine with excavator type⁽⁴⁾, machine drilling type⁽⁵⁾, stabilized liquid pressurizing type⁽⁶⁾, earth pressure type⁽⁷⁾, muddy earth pressure type⁽⁸⁾ and others (enter concretely, for example, the limited pressure type, deformed type, etc.).

Notes ⁽²⁾ The hand-drilling type means the unit in which the facing is opened and partial sheathing is carried out, mainly manual excavation is carried out and the soil is discharged by conveyor and the like.

⁽³⁾ The blind type means the unit in which the facing is closed tightly, at its part an adjustable soil-sand discharge opening or equipment is provided, the shield machine is penetrated into natural ground and the soil is discharged while causing plastic flow in soil and sand in hood.

- (⁴) The shield machine with excavator type means the unit in which a power machine is used for excavation and loading soil and sand among hand-drilling shield, and which has the structure of no rotary cutter head to excavate with rotating over the whole facing section.
- (⁵) The machine drilling type means the unit which is provided with a rotary cutter head capable of excavating the whole facing section, excavates continuously, discharges soil by using belt conveyor, screw conveyor, etc. and has no partition wall for sealing in shield machine.
- (⁶) The stabilized liquid pressurizing type means the unit which excavates while carrying out sheathing the facing with mud film and pressurized mud water, and discharges the soil by slurry transportation.
- (⁷) The muddy earth pressure type means the unit which fills the soil and sand excavated by rotary cutter head between the facing and the partition wall, pressurizes with propulsion force of shield, and while processing for stabilization of facing by actuating the excavated earth pressure to the whole facing, discharges the soil by using a screw conveyor or the like.
- (⁸) The muddy earth pressure type means the unit which mechanically kneads the soil and sand excavated by rotary cutter head while pouring the additives to accelerate plastic flow of excavated soil and sand, and fills between the facing and the partition wall, pressurizes with the propulsion of shield and while processing for stabilization of the facing by actuating the muddy earth pressure to the whole facing, discharges soil by means of a screw conveyor or the like.

3.2 Manufacturer's Name

3.3 Dimensions (See Figure)

- (1) Outer Diameter Enter the outer diameter of body skin-plate.
- (2) Inner Diameter Enter the inner diameter of body tail part.
- (3) Total Length Enter the total length from the frontmost end part to the rearmost end part including the devices assembled in the body.
- (4) Maximum Dimensions of Unit Body Enter the maximum dimensions (length, width, height) of the divided load unit body at the time of transporting by disassembling of shield machine.

3.4 Mass

- (1) Total Mass Enter the total sum of design masses of the body, propulsion device, sheathing device, work floor, attitude control device, measuring instrument, erector, true circle holding device, excavation and loading machine, cutter, agitator, inner tube for feeding and discharging mud, gravel treating device, screw conveyor, rotary feeder, belt conveyor, power unit, oil-hydraulic jack, oil-hydraulic motor, electric motor (for driving cutter head), electric appliances and wiring materials, oil-hydraulic appliances and piping materials (including working oil) and trailing truck.
- (2) Mass of Body Enter the total sum of design masses of the body and devices assembled in the body.
- (3) Mass of Trailing Facilities Enter the total sum of design masses of trailing facilities other than the body mass.
- (4) Maximum Mass of Unit Body Enter the maximum mass of divided load unit bodies at the transportation of disassembled shield machine.

3.5 Performance

- (1) Outer Diameter of Shield Enter the outer diameter of skin-plate of the body.
- (2) Total Thrust Enter the total sum of design thrust of shield jack.
- (3) Equipment Torque Enter the maximum equipment torque on design.

3.6 Body⁽⁹⁾ Enter the following items (See Figure).

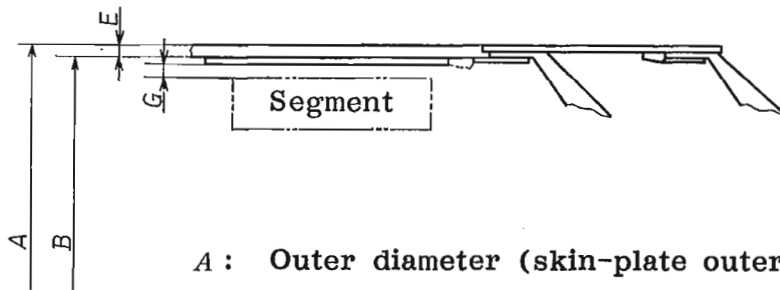
Note ⁽⁹⁾ It means the structure constituted of skin-plate and supporting frame.

- (1) Skin-Plate Outer Diameter Enter the outer diameter of skin-plate of the body.
- (2) Skin-Plate Total Length Enter the total length of skin-plate of the body.
- (3) Skin-Plate Total Length Enter the plate thicknesses of the hood, ring girder part, tail part.
- (4) Tail Part Inner Diameter Enter the skin-plate inner diameter at the segment assembly part.
- (5) Tail Part Length Enter the length from the rear end of web of ring girder to the rear end of skin-plate.
- (6) Tail Clearance Enter the clearance between the skin-plate and the segment of segment assembly part.

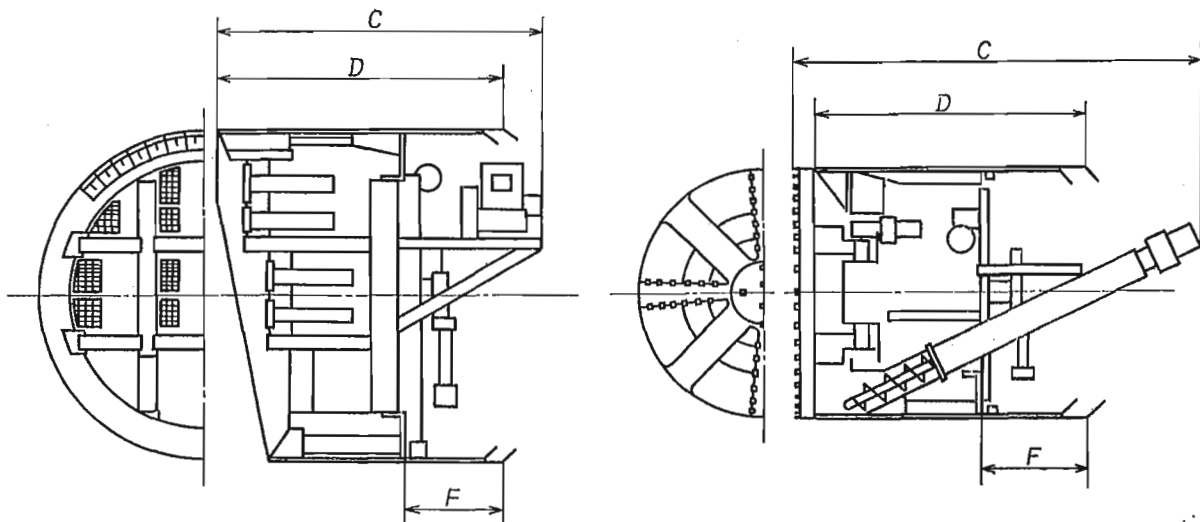
Furthermore, when there exists lining on the skin-plate, enter the clearance between the lining and the segment.

- (7) Tail Seal Enter the materials and the number of fitting steps.
- (8) Friction-Cut Plate Enter the plate thickness and the angle of fitting range.
- (9) Intermediate Folding Device Enter the number of foldings and the maximum folding angle when provided with intermediate folding device.
- (10) Number of Divisions Enter the number of divisions of body at the disassembly transportation.

Figure



- A: Outer diameter (skin-plate outer diameter)
 B: Inner diameter (tail part inner diameter)
 C: Total length
 D: Skin-plate total length
 E: Skin-plate thickness
 F: Tail part length
 G: Tail clearance



(Example of hand-drilling type) (Example of earth-pressure type)

3.7 Propulsion Equipment

- (1) Shield Jack Enter the maximum thrust, stroke and number of pieces equipped.
- (2) Equipment Thrust of Shield Jack per Facing Unit Enter the value obtained by dividing the thrust of all jacks (thrust x number of pieces) by the sectional area of shield, rounded off to an integer.
- (3) Elongation Speed of Shield Jack Enter the value obtained by dividing discharge quantity of oil-hydraulic pump by inner diameter sectional area of all jacks and rounded off up to one place of decimal.
- (4) Segment Force Attaching Point Enter the pitch circle diameter at a point where the thrust of shield jack is transmitted to the segment.
Further, in the case where the cylinder is eccentric with spreader, enter the value of diameter of pitch circle for attaching shield jack added by twice the eccentric quantity.

3.8 Sheathing Equipment

- (1) Movable Hood (For Poling) Enter the number of movable hoods equipped.
- (2) Half Moon Enter the number of half moons equipped.
- (3) Face Enter the number of faces equipped.
- (4) Blind Describe clearly the existence of blind.
- (5) Others Enter the name and number of other sheathing equipments equipped.

3.9 Work Floors

- (1) Fixed Floors Enter the number of fixed floors equipped which are enclosed by hand-rails or partition plates.
- (2) Movable Floors Enter the number of movable floors equipped.
- (3) Working Stand for Segment Assembly Enter the number of working stands for segment assembly equipped.
- (4) Chutes (Hoppers) Enter the number of chutes for discharging soil equipped in the shield machine.

3.10 Attitude Control Equipment

- (1) Stabilizer
 - (a) Type Enter the division of manual type or oil-hydraulic type.
 - (b) Fitting Position Enter the fitting position viewed from the rear of shield machine.
- (2) Resistance Plate
 - (a) Type Enter the division of manual type or oil-hydraulic type.
 - (b) Fitting Position Enter the fitting position viewed from the rear of shield machine.

(3) Sleds

- (a) Type Enter the division of fixed type or movable type.
- (b) Equipped Number Enter the equipped number of sleds.
- (4) Others Enter the name of other equipped attitude control equipment, fitting position, number of equipments, etc.

3.11 Instrumentation Equipment

- (1) Pitching-Rolling Meter Enter the division such as electric type, U-tube type, plumb bob type, level (air bubble type), etc.
- (2) Shield Jack Stroke Meter Enter the type and quantity of stroke meter. In case of no equipment, enter "absence". Furthermore, in case where a scale is adhered at the tail, enter "absence".
- (3) Others Enter the name and type of other equipped instrumentation equipment.

3.12 Erector Equipment

- (1) Type Types of slewing motion shall be divided into ring gear type, hollow axle type, centre drive type, etc. Furthermore, the segment locating equipments (erector arm) shall be divided into portal type, cantilever type, pantograph type, etc. Entering shall be carried out, for example, as ring gear portal type and the like.
- (2) Number of Revolutions In the case of high speed and low speed switching type, enter the respective rotary speed, and in the case of continuous variable type, enter the range of the speed.
- (3) Rotary Angle Enter the right-and-left rotatable angle.
- (4) Pressing force Enter the pressing force of segment by the numerical value without considering of the mechanical loss.
- (5) Hanging-Up Force Enter the hanging-up force of segment by the numerical value without considering of the mechanical loss.
- (6) Travel Stroke Enter the travel stroke of erector.
- (7) Rotary-Handling Mass Enter the maximum mass of segment piece.
- (8) Effective Space Enter the diameter of inner space which does not interfere with muck conveyor, feed-and-discharge mud tube, oil-hydraulic piping, etc., even if during the rotary actuation of erector equipment.

- (9) Grip-Slide Amount Enter the slide amount of grip and the division of manual type or oil-hydraulic type of slide device.
- (10) Support Jack Enter the existence of support jack for prevention of run-out of segment.
- (11) Operation Type Enter the division of wire type or wireless type.
- (12) Others Enter special description items such as existence of cable reel, hose reel, grip device, etc. and details of operation type, and the like.

3.13 True Circle Holding Equipment(¹⁰)

Note (¹⁰) The true circle holding equipment means the auxiliary mechanism for segment assembly which prevents the segments during assembling from being deformed by earth pressure or self-weight and corrects it.

- (1) Type Enter the division of upper-and-lower expansion type(¹¹), upper-part expansion type(¹²), or others (enter the type of correction).

Note (¹¹) The upper-and-lower expansion type is the generic term for the unit having the structure to add expansion force to the upper part and lower part of segment at the same time.

- (¹²) The upper-part expansion type is the generic term for the unit having the structure to add expansion force only to the upper part of segment.

- (2) Jack Expansion Force Enter the total sum of expansion forces to be added to the assembled segment.

3.14 Excavation and Loading Machine Enter the type and performance of excavation and loading machine. As for the excavation type, enter the division such as shovel type, rotary cutter type, breaker type or the like, and as for the exclusive loader, enter the division such as screw conveyor, gathering or the like.

Furthermore, as for the capacity of excavation and loading machine, enter the excavation range, blade tip penetration force, amount of excavation per hour, loading amount per hour, etc.

3.15 Cutter Equipment

- (1) Support Type Enter the division of centre shaft type, periphery support type or intermediate support type.
- (2) Cutter Head Outer Diameter Enter the outer diameter of cutter head.
- (3) Excavation Outer Diameter Enter the outer diameter of excavation by a cutter bit attached to the cutter head.
- (4) Cutter Head Type Enter the division of face plate type(¹³) or spoke type(¹⁴).

Notes (¹³) The face plate type means the unit provided with the support plate to support earth pressure and the cutter at the front face of cutter head.

(¹⁴) The spoke type means the unit of which the front face of cutter head is composed of spoke state cutter only.

- (5) Face Plate Opening Percentage Enter the percentage of opening part area to the total area of front face of cutter head. However, neglect the projection area of bit contained in slit opening part.
- (6) Rotary Direction Enter the division of rightward rotation, leftward rotation, or right and left variable rotation.
- (7) Driving Type Enter the division of oil-hydraulic motor drive or electric motor drive.
- (8) Number of Revolutions Enter the number of revolutions at ordinary torque and that at the maximum torque.
- (9) Equipped Torque In the case of the equipment of oil-hydraulic drive, enter the ordinary torque and the maximum torque together with the respective oil-hydraulic pressure values. In the case of the equipment of electric motor drive, enter the cutter torque at the continuous rating of the electric motor in the rated torque, and enter the cutter torque at 150 % rating of electric motor in the instantaneous maximum torque.

Enter the equipment torque without considering the losses of oil-hydraulic motor, oil-hydraulic piping resistance and the like, nor the mechanical loss.

Append the cutter torque coefficient α calculated according to the following formula to each indication of torque.

$$\alpha = \frac{T}{D^3}$$

where α : cutter torque coefficient
 T : equipment torque tf·m
 D : shield outer diameter m

(10) Overcut Equipment

- (a) Type Enter the division of copy cutter (¹⁵) or overcutter(¹⁶).

Notes (¹⁵) The copy cutter means the unit which overcuts only an arbitrary part of outer periphery of excavation.

(¹⁶) The overcutter means the unit which overcuts the whole periphery.

- (b) Equipped Number Enter the equipped number of the equipment.
- (c) Overcut Amount Enter the maximum depth of overcut, taking the outer surface of skin plate as the reference.