



# Permeability Tester

# NKP

for molding sand

● sold separately



This apparatus is for quick and precise measurement of permeability of green sand mold, dry sand mold, and other sand molds following the standard set by the molding sand research committee of Japan Foundrymen's Society (NIK).

An air supply tube stands vertically upwards at the center of a water tank bottom. The top of the tube is above the water level in the tank. Air is supplied through a three way valve and the tube to an air chamber, which has a vertical tube from the top which slides inside the air supply tube.

The outside of the air chamber is marked with lines designated as "W" at the lowest position, and "0", "1000", and "2000" at higher positions, where "W" corresponds to the standard water level, and other figures correspond to the volume of air discharge at the respective height of the air chamber. In other words, the air volume between the "0" line and "2000" line is 2000 cc. The three way valve is installed in a casing and manipulated by a manually moved handle. Three positions of the valve are indicated; "Close" is for stopping the air flow, "Measure" is for discharging air for measurement, and "Open" is for introducing air to push up the air chamber.

A rubber stopper is attached above the three way valve, and an orifice is attached at its top. A cylinder containing the test sand can be screwed above the stopper.

A water column is attached on the front side and connected to the test sand cylinder for measuring air pressure.

# Sand Mold Permeability Tester

## ● How to use the tester

### Quick method

The apparatus is placed on a horizontal desk. The three-way valve is turned to "Open" to introduce water so that the air chamber is floated to the mark "W". Then the valve is turned to "Measure" to introduce air so that the air chamber is lowered to a position slightly below the "0" line, and then the valve is turned to "Close" to stop air flow. An orifice, either the small one or the large one, depending on the sand grain fineness, is screwed in the rubber stopper after inserting a rubber ring for preventing air leak. The test sand is rammed using a sand rammer into a test piece cylinder of a standard shape, and the cylinder with the sand is tightly pushed in the rubber stopper.

The valve is turned to "Measure" to raise air pressure in the sand cylinder.

After reading the value of the pressure gauge, the valve is turned to "Close". Table.1 gives the permeability value corresponding to the pressure value thus measured.

### Standard method

$$\text{Permeability} = \frac{V \times H}{P \times A \times T}$$

V = air volume passed through the test piece (cc) 2000cc

P = pressure difference between the upper side and lower side of the specimen (Pa) (P = Pa ÷ 98)

A = sectional area of the specimen (A=19.635cm<sup>2</sup>)

H = height of the specimen (cm) (5.0 ± 0.1cm)

T = time necessary for the air of 2000cc to pass the specimen (min).

### Testing of dry sand mold

A standard specimen (50mm in diameter and 50mm in height) is prepared with a sand rammer and is taken out with a push rod for drying. A weak specimen is taken out on a disc of 50mm diameter and sent to drying on the disc.

The specimen is dried at 105 to 115 degree C for one to two hours and taken out for cooling. After cooling, it is inserted in a dry sand permeability specimen cylinder. The valve on the cylinder is opened and air is sent from the rubber bulb to the rubber sheath in the cylinder for ensuring pressure tight support of the specimen. The cylinder is inserted into the rubber stopper, and permeability is measured in the same way as the case of the green sand.

### Calibration of orifice

The air chamber should be lifted very slowly not to disturb water in the tank. Orifice should be kept clean. The holes should not be deformed, and hence, they must be checked occasionally. Size of the holes can be checked in the following manner. Attach an orifice to the apparatus and let the air in the air chamber flow out through the orifice without attaching a test piece cylinder. Time is measured while the air chamber sinks from the level of "0" to "2000". If the time value does not fit the standard shown below, the hole size of the orifice must be corrected.

Air pressure in chamber	=	Large orifice: 30s
Time necessary for discharging air of 2000cc		Small orifice: 4m30s (allowance: 2%)

Precautions: The orifice with the hole diameter of 1.5 mm is used for permeability above 36, and the orifice with the hole diameter of 0.5mm is used for permeability below 49.

### Permeability test of mold surface

An attachment is provided for measuring permeability of a manufactured mold or core. One end of the rubber tube is inserted to the rubber stopper of the permeability tester, and the rubber receptacle at the other end is pressed against the mold surface to be measured. Then the test is performed in the same manner as in the case of test pieces.

Though the precision of this method is not as high as the other tests, it is a convenient way of knowing the approximate permeability of mold or core as manufactured.

Table.1 The relation between air pressure and permeability

- Use the small orifice for medium to fine sand grains.
- Use the large orifice for medium to coarse sand grains.

pressure (Pa)	permeability		pressure (Pa)	permeability	
	0.5mm small orifice	1.5mm large orifice		0.5mm small orifice	1.5mm large orifice
10	—	—	510	14.5	132
20	—	—	520	14.1	128
30	—	—	530	13.7	124
40	—	2434	540	13.3	120
50	—	1944	550	12.9	117
60	—	1614	560	12.5	114
70	—	1378	570	12.1	109
80	—	1186	580	11.7	106
90	—	1050	590	11.3	103
100	—	941	600	11.0	100
110	—	852	610	10.7	97
120	—	776	620	10.4	94
130	—	708	630	10.1	91
140	—	654	640	9.8	88
150	—	607	650	9.4	85
160	—	567	660	9.2	83
170	—	529	670	8.9	80
180	—	495	680	8.6	78
190	—	466	690	8.3	75
200	48.6	440	700	8.1	72
210	46.0	417	710	7.8	70
220	43.6	394	720	7.5	68
230	41.3	374	730	7.3	65
240	39.4	357	740	7.0	63
250	37.5	340	750	6.8	61
260	35.8	325	760	6.5	58
270	34.2	310	770	6.2	56
280	32.6	296	780	6.0	54
290	31.3	283	790	5.8	52
300	30.1	272	800	5.5	50
310	28.9	262	810	5.3	47
320	27.6	251	820	5.1	45
330	26.7	242	830	4.8	43
340	25.7	232	840	4.6	41
350	24.8	224	850	4.4	39
360	23.9	216	860	4.0	37
370	23.0	208	870	3.8	33
380	22.1	201	880	3.7	31
390	21.4	194	890	3.3	—
400	20.7	188	900	3.2	—
410	20.1	181	910	2.6	—
420	19.3	176	920	2.6	—
430	18.8	170	930	2.3	—
440	18.2	165	940	—	—
450	17.6	160	950	—	—
460	17.0	155	960	—	—
470	16.4	149	970	—	—
480	15.9	144	980	—	—
490	15.5	140	990	—	—
500	15.0	136	1000	—	—



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