SPECIAL CONDITIONS FOR NON-SCHEDULE ITEMS

NS-2:- The specifications for Polycarbonate Sheets are as per IS code 14443:1997 (Amended up to date).

NS-3:- The specifications for Perforated Sheets are as under:-

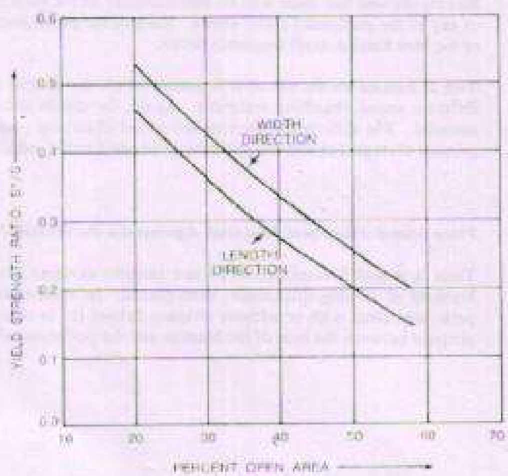
Strength of materials perforated with round holes in a standard staggered pattern:

IPA #	Perforations	Centers	Holes Per sq.in.	Open Area	S*/S= Strength[1] Width Direction	S*/S= Strength[1] Length Direction
100	.020"	-	625	20%	.530	.465
106	1/16"	1/8"	-	23%	.500	.435
107	5/64"	7/64"	-	46%	.286	.225
108	5/64"	1/8"	-	36%	.375	.310
109	3/32"	5/32"	-	32%	.400	.334
110	3/32"	3/16"	-	23%	.500	.435
112	1/10"	5/32"	-	36%	.360	.296
113	1/8"	3/16"	-	40%	.333	.270
114	1/8"	7/32"	-	29%	.428	.363
115	1/8"	1/4"	-	23%	.500	.435
116	5/32"	7/32"	-	46%	.288	.225
117	5/32"	1/4"	-	36%	.375	.310
118	3/16"	1/4"	-	51%	.250	.192
119	3/16"	5/16"	-	33%	.400	.334
120	1/4"	5/16"	-	58%	.200	.147
121	1/4"	3/8"	-	40%	.333	.270
122	1/4"	7/16"	-	30%	.428	.363
123	1/4"	1/2"	-	23%	.500	.435
124	3/8"	1/2"	-	51%	.250	.192
125	3/8"	9/16"	-	40%	.333	.270
126	3/8"	5/8"	-	33%	.400	.334
127	7/16"	5/8"	-	45%	.300	.239
128	1/2"	11/16"	-	47%	.273	.214
129	9/16"	3/4"	-	51%	.250	.192
130	5/8"	13/16"	-	53%	.231	.175
131	3/4"	1"	-	51%	.250	.192

[1]Notes: S* = Yield strength of perforated material
S* = Yield strength of unperforated material

Length Direction = parallel to straight row of closely spaced holes (see Fig. 1)

Width Direction = direction of stagger

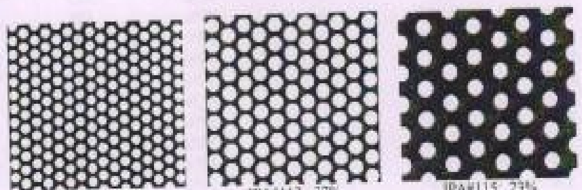


Summary of Tests Conducted by the Riverbank Acoustical Laboratories

These tests were sponsored by the IPA to validate data developed by Theodore J. Schultz, Ph.D. and presented in his book ACOUSTICAL USES FOR PERFORATED METALS published by the Industrial Perforators Association. The perforation patterns tested are shown below.

The test's objectives were:

a. Determine which perforated metal specifications would provide a high degree of sound transparency.
b. Demonstrate the theories regarding Tuned Resonant Absorbers set forth by Dr. Schultz.



IPA#107: 48% Open Area   IPA#112: 37% Open Area   IPA#115: 23% Open Area

Wide Range of Perforations Provide High Transparency

Test 1. compared the sound absorption performance of a bare, unprotected 4" blanket of glass fiber with the same material protected by perforated metal sheets of the specifications shown above.

Results showed that there was no diminishment of the glass fiber blanket's absorption performance by the presence of any of the perforated metal sheets. Each of the perforated-protected tests followed very closely the performance of the bare blanket at all frequency levels.

Test 2. focused on the use of IPA pattern #115, the pattern with the least Open Area (23%) in conjunction with 4 different sound-absorbing materials. Again, the results demonstrated a high degree of transparency for the #115 material. The differences between the sound absorbing performances of the various materials were small at their greatest divergences and the presence of the perforated metal had no effect on their performances.

Place Sound Absorbent Material Against the Perforated Metal for Maximum Transparency and Absorbency

Tests 3, 4 and 5 employed #115 test samples mounted over a frame having a rigid back into which glass fiber blankets of varying thicknesses were placed. In some tests the sound-absorbing blanket was placed against the perforated sheet with or without airspace behind it. In others the blanket was placed against the back leaving an airspace between the face of the blanket and the perforated sheet.

The tests clearly demonstrated:

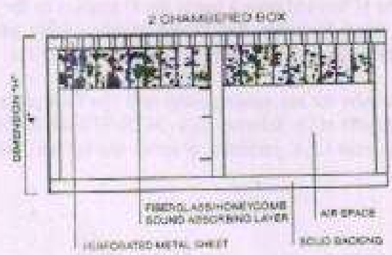
1. As a general rule, the thicker the absorbing blanket, the greater the sound absorbency. But, the thickness of the absorbing blanket showed its greatest effect below 500 Hz with the effect increasing towards the lower frequencies.
2. Placement of the absorbent blanket against the perforated metal with an airspace behind it does not diminish sound absorbency. On the other hand, the airspace behind does not contribute to sound absorbency.
3. Placement of the sound absorbent blanket away from the perforated metal-leaving an airspace between noticeably reduced sound absorbency. To achieve maximum transparency of the perforated metal sheet and the greatest sound absorbing efficiency requires that the absorbent material be placed against the perforated sheet.

Test 6 demonstrated that when a polyethylene film was placed as a protective cover between the absorbent blanket and the perforated sheet, there was a substantial loss in absorbency at frequencies above 500 Hz and the loss increased as frequencies went up. Below 500 Hz, the absorbency loss was negligible. Loss also increased with the thickness of the polyethylene film.

Dr. Schultz's Calculations Relating to Tuned Resonant Absorbers were Clearly Demonstrated

(Refer to explanations of Tuned Resonant Absorber on page 17.)

Riverbank's test device comprised the basic elements of a tuned Resonant Absorber with the notable exception that the perforated metal sheet was backed by a layer of aluminum honeycomb with 1" cells.



For the tests, glass fiber was pressed into the cells to varying thicknesses from 1" to 4". This assembly was placed at the top of a box which was 4" deep from the underside of the perforated sheet to the bottom of the box.

Dr. Schultz explained the need for this design:

"When the airspace is continuous, the behavior of the absorber changes greatly at different angles of incidence of the sound. As the sound direction changes from perpendicular to the surface of the absorber (angle of incidence = 0) to the grazing incidence of 90, the resonance frequency changes drastically, rising away from the intended frequency to as much as three octaves higher."

"By contrast, with the partitioned backstructure, not only does the resonance frequency remain the same as the angle of incidence increases, but the bandwidth of high sound absorption actually becomes broader."

The chart on page 22 illustrates a test which used an aluminumsheet.080" thick perforated with 1/8" (.125") holes on 2 1/4" straight row centers providing an unusually small percentage of open area, .2437%. The target frequency was a low 125 Hz. Clearly the Tuned Resonant Absorber performed as expected with a Sound-Absorbing Coefficient of 1.0, very close to 100% efficiency.

Calculating the Resonance Frequency of a Tuned Resonant Absorber (TRA)

To determine the resonance frequency of the TRA used in the test discussed above, Dr. Schultz's nomogram for doing so is shown on the next page. The elements of the TRA are as follows:

t thickness of the sheet = **.080"**
e = the effective throat length of the holes in the sheet, (e = t + .8d) = .080 + .125 x .8) = **.18"**
h = distance from the perforated sheet to the back of TRA = **4"**
P = Percentage of open area = **.2437%**

Using a ruler, connect the point .18 on the "e" scale with the point .2437 on the P scale. Now place your ruler on the point where this line crosses the M line and draw a line to the 4" position on the "h" scale. Where this line crosses the "f" scale, you'll find the target frequency that should be most highly attenuated by this Tuned Resonant Absorber. The target frequency for this TRA has been determined to be 125 Hz.

You can use this nomograph to solve for any missing component of a TRA you are designing. Clean copies of this nomogram are found in the Appendix of Dr. Schultz's book. ACOUSTICAL USES FOR PERFORATED METALS, available from the I.P.A. or ask your I.P.A. perforator to secure one for you. It can be reproduced on any copying machine.

IPA Standard Perforations

The enormous number of perforating patterns possible with round holes, squares, slots and other special perforations make it impractical to list every combination. The following IPA numbered perforations listed and illustrated here are common to all members and considered Standard. The die banks of IPA members hold tooling for literally thousands of additional patterns so, if your requirements cannot be met with a Standard perforation, consult with your IPA members supplier.

Round Holes:

IPA Numbers	Perforations	Centers	Holes per sq. in.	Open Area	Line
100	.020"	.043"	625	20%	Staggered
101	.023"	.0415"	576	24%	Straight
102	.027"	.050"	400	23%	Straight
103	.032"	.055"	324	26%	Straight
104	.040"	.066"	335	30%	Straight
105	.045"	.066"	334	37%	Straight
106	1/16"	1/8"	74	23%	Staggered
107	5/64"	7/64"	97	46%	Staggered
108	5/64"	1/8"	74	36%	Staggered
109	3/32"	5/32"	47	32%	Staggered
110	3/32"	3/16"	33	23%	Staggered
111	3/32"	¼"	19	12%	Staggered
112	1/10"	5/32"	47	36%	Staggered
113	1/8"	3/16"	33	40%	Staggered
114	1/8"	7/32"	24	29%	Staggered
115	1/8"	¼"	19	23%	Staggered
116	5/32"	7/32"	24	46%	Staggered
117	5/32"	¼"	19	36%	Staggered
118	3/16"	¼"	19	51%	Staggered
119	3/16"	5/16"	12	33%	Staggered
120	¼"	5/16"	12	58%	Staggered
121	¼"	3/8"	8	40%	Staggered
122	¼"	7/16"	6	30%	Staggered
123	¼"	½"	5	23%	Staggered
124	3/8"	½"	5	51%	Staggered
125	3/8"	9/16"	4	40%	Staggered
126	3/8"	5/8"	3	33%	Staggered
127	7/16"	5/8"	3	45%	Staggered
128	½"	11/16"	2	47%	Staggered
129	9/16"	¾"	2	51%	Staggered
130	5/8"	13/16"	2	53%	Staggered
131	3/4"	1"	1	51%	Staggered

Checklist of Perforating Cost Influences

1. **Material type** – Remember the least expensive material may not be the lowest cost; a higher strength alloy may allow reducing thickness. Keep hardness below80 Rb.
2. **Material thickness** – Thinner materials perforate easier and faster.
3. **Hole shape and pattern** – Round holes are the most economical, 60" staggered round hole pattern strongest and most versatile.
4. **Hole size** – Do not go below 1-to-1 ratio with sheet thickness. Stay at 2-to-1 or larger if possible.
5. **Bar size** – Do not go thinner than 1 -to-1 ratio with sheet thickness.
6. **Center distance** – It controls feed rate and thereby the production rate. if possible, choose a pattern with longer center distance.
7. **Open areas** – Extreme open area proportions tend to increase distortion; if possible, stay under 70%.
8. **Margins** – Keep side margins to a minimum to reduce distortion. Use standard Unfinished End Margins if you can.
9. **Blank areas** – Consider the die pattern when locating them. Consult with your IPA metal supplier.
10. **Stick to standards** – specify standard hole patterns, materials dimensions and tolerances whenever possible. Before specifying a "Special," consult with your IPA member supplier; he can work wonders with existing tooling.
11. Accept normal commercial burrs unless otherwise specified.

Table of Gauges and Weights

Weights and Gauges have been computed subject to standard commercial tolerances.

	Steel		Galv. Steel		Long Terne		Stainless – USS Gauge			Monel	
	USS Gauge Rev.		USS Gauge		USS Gauge			lbs. Per sq. ft.		USS Gauge	
Gauge	Decimal	lbs. Per sq. ft.	Decimal Thick.	lbs. Per sq. ft.	Decimal Thick.	lbs. Per sq. ft.	Decimal Thick.	Chrome Alloy	Chrome Nickel	Decimal Thick.	lbs. Per sq. ft.
32	.0100		.0130	.563			.0100	.418	.427		
31	.0110		.0140	.594			.0109	.450	.459		
30	.0120	.500	.0157	.656	.012	.518	.0125	.515	.525		
29	.0135	.563	.0172	.719	.014	.581	.0140	.579	.591		
28	.0149	.625	.0187	.781	.015	.643	.0156	.643	.656		
27	.0164	.688	.0202	.844	.017	.706	.0171	.708	.721		
26	.0179	.750	.0217	.906	.018	.768	.0187	.772	.787	.0187	827.
25	.0209	.875	.0247	1.031	.021	.893	.0218	.901	.918	.0218	.965
24	.0239	1.000	.0276	1.156	.024	1.018	.0250	1.030	1.050	.0250	1.148
23	.0269	1.125	.0306	1.281	.027	1.143	.0281	1.158	1.181	.0281	1.286
22	.0299	1.250	.0336	1.406	.030	1.268	.0312	1.287	1.312	.0312	1.424
21	.0329	1.375	.0366	1.531	.033	1.393	.0343	1.416	1.443	.0343	1.562
20	.0359	1.500	.0396	1.656	.036	1.518	.0375	1.545	1.575	.0375	1.700
19	.0418	1.750	.0456	1.906	.042	1.768	.0437	1.802	1.837	.0437	1.975
18	.0478	2.000	.0516	2.156	.048	2.018	.0500	2.060	2.100	.0500	2.297
17	.0538	2.250	.0575	2.406	.054	2.268	.0562	2.317	2.362	.0562	2.572
16	.0598	2.500	.0635	2.656	.060	2.518	.0625	2.575	2.625	.0625	2.848
15	.0673	2.812	.0710	2.969	.068	2.831	.0703	2.896	2.953	.0703	3.216
14	.0747	3.125	.0785	3.281	.075	3.143	.0781	3.218	3.281	.0781	3.583
13	.0897	3.750	.0934	3.906	.090	3.768	.0937	3.862	3.937	.0937	4.272
12	.1046	4.375	.1084	4.531	.105	4.393	.1093	4.506	4.593	.1093	5.007
11	.1196	5.000	.1233	5.156	.120	5.018	.1250	5.150	5.250	.1250	5.742
10	.1345	5.625	.1382	5.781	.134	5.643	.1406	5.793	5.906	.1406	6.431
9	.1494	6.250	.1532	6.406			.1562	6.437	6.562	.1562	7.166
8	.1644	6.875	.1681	7.031			.1718	7.081	7.218	.1718	7.855
7	.1793	7.500					.1875	7.590	7.752	.1875	8.590

Table of Gauges and Weights (continued)

	Brass		Copper		Aluminum		Zinc		Monel		
	B&S Gauge.		B.W. Gauge		B&S Gauge		Zinc Gauge		USS Gauge		
Gauge	Decimal	lbs. Per sq. ft.	Decimal Thick.	lbs. Per sq. ft.	Decimal Thick.	lbs. Per sq. ft.	Decimal Thick.	lbs. Per sq. ft.	Decimal Thick.	lbs. Per sq. ft.	Old Symbol
32	.0080	.353	.009	.418	.008	.115			.0061"	55	
31	.0089	.392	.010	.464	.009	.130			.0066"	60	
30	.0100	.441	.012	.557	.010	.144			.0072"	65	
29	.0113	.498	.013	.603	.011	.158			.0077"	70	
									.0083"	75	
28	.0126	.555	.014	.650	.012	.173			.0088"	80	
27	.0142	.626	.016	.742	.014	.202			.0094"	85	
26	.0159	.700	.018	.835	.016	.230			.0099"	90	
25	.0179	.789	.020	.928	.018	.259			.0105"	95	
									.0110"	100	ICL
24	.0201	.886	.022	1.022	.020	.286	.125	4.70	.0118"	107	IC
23	.0226	.996	.025	1.162	.022	.331	.100	3.75	.0123"	112	
22	.0254	1.115	.028	1.302	.025	.360	.090	3.37	.0130"	118	
21	.0285	1.256	.032	1.484	.028	.403	.080	3.00	.0141"	128	IXL
20	.0320	1.410	.035	1.627	.032	.461	.070	2.62	.0149"	135	IX
19	.0359	1.582	.042	1.952	.036	.518	.060	2.25	.0153"	139	DC
18	.0403	1.776	.049	2.280	.040	.576	.055	2.06	.0163"	148	2XL
17	.0453	1.996	.058	2.695	.045	.648	.050	1.87	.0171"	155	2X
16	.0508	2.238	.065	3.020	.050	.734	.045	1.68	.0185"	168	3XL
15	.0571	2.516	.072	3.338	.056	.821	.040	1.50	.0193"	175	3X
14	.0641	2.825	.083	3.860	.063	.992	.036	1.35	.0198"	180	DX
13	.0720	3.173	.095	4.410	.071	1.040	.032	1.20	.0207"	188	4XL
12	.0808	3.560	.109	5.065	.080	1.170	.023	1.05	.0215"	195	4X
11	.0907	3.997	.120	5.575	.090	1.310	.024	.90	.0229"	208	5XL
10	.10195	4.490	.134	6.225	.100	1.470	.020	.75	.0231"	210	D2X
9	.1144	5.041	.148	6.875	.112	1.640	.018	.67	.0237"	215	5X
8	.1285	5.662	.165	7.660	..125	1.760	.016	.60	.0251"	228	6XL
7	.1443	6.358	.180	8.360	.140	1.980	.014	.52	.0259"	235	6X
6	.1620	7.138	.203	9.420	.160	2.254	.012	.45	.0264"	240	D3X
5	.1819	8.015	.220	10.220	.190	2.685	.010	.37	.0273"	248	7XL

STAINLESS STEEL - Not Resquared

COMMERCIAL QUALITY- Hot rolled and cold rolled sheets and cold rolled sheets produced from coils.

Width Tolerance

Thickness	Up To 60" Wide
30GA-16GA	+3/8" -0"
Over 16GA-7GA	+1/2" -0"

Length Tolerance

Thickness	Length	Tolerance
30GA-7GA	0"-120"	+2"
	Over 120"	+2-1/4"

COMMERCIAL QUALITY - Sheared Mill and Universal Mill Plates.

		Thickness		
		3/16"-3/8"	Over 3/8"-1/2"	Over 1/2"-1"
Width	Length	Width Tolerances		
0"-60"	-	-1/4"+1/2"	-1/4"+5/8"	-1/4"+3/4"
Over 60"-84"	-	-1/4+11/16"	-1/4+13/16"	-1/4+15/16
		Length Tolerances		
-	0"-144"	-1/4"+2-1/4"	-1/4"+2-1/4"	-1/4"+2-1/4"

THICKNESS TOLERANCES PLATE

Permissible Variation in Thickness for Rectangular Carbon, High-Strength Low Alloy, and Alloy-Steel Plates, When Ordered to Thickness.

Note 1 – Permissible variation under specified thickness, 0.01 inch.

Note 2 – Thickness to be measured at 3/8 to 3/4 inch from the longitudinal edge.

Note 3 – For thickness measured at any location other than that specified in Note 2, the permissible maximum over tolerance shall be increased by 75%, rounded to the nearest 0.01 inch.

Tolerance Over Specified Thickness for Width in Inches

Specified Thickness Inches	Wt. Per Sq. Ft. In Lbs	To 84" Excl.	84" To 96" Excl.	96" To 108" Excl.
3/16"	7.66	.03"	.03"	.03"
1/4"	10.21	.03"	.03"	.03"
5/16"	12.76	.03"	.03"	.03"
3/8"	15.32	.03"	.03"	.03"
7/16"	17.87	.03"	.03"	.03"
1/2"	20.42	.03"	.03"	.03"
9/16"	22.97	.03"	.03"	.03"
5/8"	25.53	.03"	.03"	.03"
3/4"	30.63	.03"	.03"	.04"
7/8"	35.74	.03"	.04"	.04"
1"	40.84	.06"	.06"	.07"

Source: ASTM A6, Table 1.

Sheet Thickness Tolerances

Stainless Steel				Lbs. Per Square Foot	
Gage	Mean of Gage	Min. of Gage	Max. of Gage	All 300 Series	All 400 Series
7	0.1874	0.1735	0.2015	7.871	7.7
8	0.165	0.151	0.179	6.93	6.78
9	0.15	0.136	0.164	6.3	6.165
10	0.135	0.129	0.141	5.67	5.562
11	0.12	0.115	0.125	5.04	4.944
12	0.1054	0.1004	0.1104	4.427	4.342
13	0.09	0.086	0.094	3.78	3.708
14	0.0751	0.0711	0.0791	3.154	3.094
15	0.0673	0.0643	0.0703	2.826	2.766
16	0.0595	0.0565	0.0625	2.499	2.451
17	0.0538	0.0508	0.0568	2.259	2.211
18	0.048	0.045	0.051	2.016	1.978
19	0.042	0.039	0.045	1.764	1.726
20	0.0355	0.0335	0.0375	1.491	1.463
21	0.0324	0.0304	0.0344	1.36	1.33
22	0.0293	0.0273	0.0313	1.231	1.207
23	0.0264	0.0249	0.0279	1.1088	1.085
24	0.0235	0.022	0.025	0.987	0.968
25	0.0209	0.0194	0.0224	0.8778	0.8589
26	0.0178	0.0163	0.0193	0.748	0.7315
27	0.0165	0.015	0.018	0.693	0.6781
28	0.0151	0.0136	0.0166	0.634	0.6206
29	0.0138	0.0123	0.0153	0.5796	0.5671
30	0.0125	0.011	0.014	0.525	0.5137

NS-3:- Manufacturing, supplying & fixing of pr-fabricated RCC coping stone of size 530mm x 1125mm x 100mm thick as per top face designed and approved by site Engineer with M-30 grade RCC with 8 mm dia. tor steel at 150mm c/c both ways and manufactured by vibro compaction process using joint less FRP/GRP steel moulds of required size, shape & design. The item includes cost of cement, Reinforcement, transportation etc. (Note: Under layer of cement mortar to be laid as per site conditions & should be paid for separately).

Date- **Signature of tenderer/s**

Place- **Address…………………**