

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:-

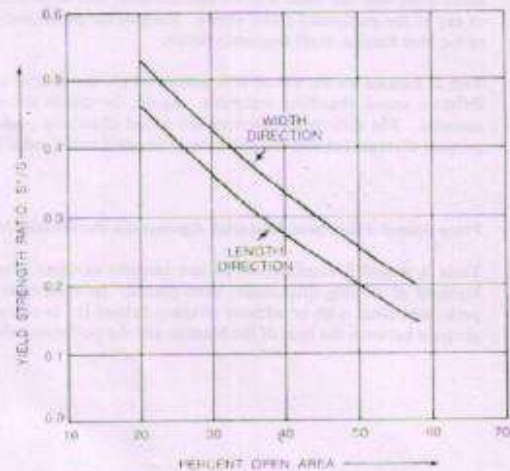
Strength of materials perforated with round holes in a standard staggered pattern:

| IPA # | Perforations | Centers | Holes Per sq. in. | Open Area | S*/S = Strength ¹ | |
|-------|--------------|---------|----------------------|--------------|------------------------------|---------------------|
| | | | | | Width Direction | 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 |

¹Notes: 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

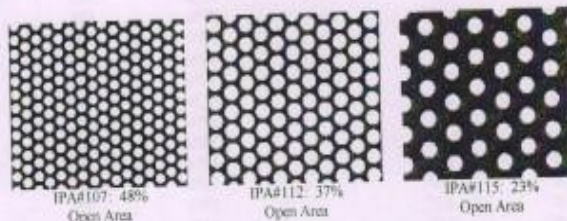


Summary of Tests Conducted by the Riverbank Acoustical Laboratories

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:

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



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:

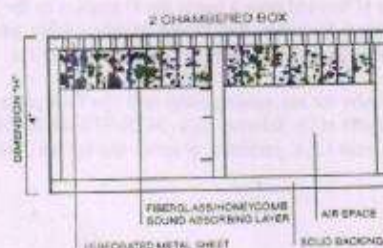
1. As a general rule, the thicker the absorbing blanket, the greater the sound absorbency. But, the thickness of the absorbing blanket showed its greatest effect below 500 Hz with the effect increasing towards the lower frequencies.
2. Placement of the absorbent blanket against the perforated metal with 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 aluminum sheet .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, $(e = t + .8d) = .080 + .125 \times .8 = .18"$
- 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" | 1/4" | 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" | 1/4" | 19 | 23% | Staggered |
| 116 | 5/32" | 7/32" | 24 | 46% | Staggered |
| 117 | 5/32" | 1/4" | 19 | 36% | Staggered |
| 118 | 3/16" | 1/4" | 19 | 51% | Staggered |
| 119 | 3/16" | 5/16" | 12 | 33% | Staggered |
| 120 | 1/4" | 5/16" | 12 | 58% | Staggered |
| 121 | 1/4" | 3/8" | 8 | 40% | Staggered |
| 122 | 1/4" | 7/16" | 6 | 30% | Staggered |
| 123 | 1/4" | 1/2" | 5 | 23% | Staggered |
| 124 | 3/8" | 1/2" | 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 | 1/2" | 11/16" | 2 | 47% | Staggered |
| 129 | 9/16" | 3/4" | 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 below 80 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.

| Gauge | Steel | | Galv. Steel | | Long Term | | Stainless - USS Gauge | | Monel | |
|-------|-----------|--------|-------------|------------------|-----------|------------------|-----------------------|---------------|-----------|------------------|
| | USS Gauge | Rev. | USS Gauge | lbs. Per sq. ft. | USS Gauge | lbs. Per sq. ft. | Chrome Alloy | Chrome Nickel | USS Gauge | lbs. Per sq. ft. |
| | Decimal | Thick. | Decimal | Thick. | Decimal | Thick. | Decimal | Thick. | Decimal | Thick. |
| 32 | .0100 | .0130 | .563 | | .0100 | .418 | .427 | | .0187 | 827. |
| 31 | .0110 | .0140 | .594 | | .0109 | .450 | .459 | | .0218 | 965 |
| 30 | .0120 | .0157 | .656 | | .0125 | .515 | .525 | | | |
| 29 | .0135 | .0172 | .719 | | .0140 | .579 | .591 | | | |
| 28 | .0149 | .0187 | .781 | | .0156 | .643 | .656 | | | |
| 27 | .0164 | .0202 | .844 | | .0171 | .708 | .721 | | | |
| 26 | .0179 | .0217 | .906 | | .0187 | .772 | .787 | | | |
| 25 | .0209 | .0247 | 1.031 | | .0218 | .901 | .918 | | | |
| 24 | .0239 | .0276 | 1.156 | | .0250 | 1.030 | 1.050 | | | |
| 23 | .0269 | .0306 | 1.281 | | .0281 | 1.158 | 1.181 | | | |
| 22 | .0299 | .0336 | 1.406 | | .0312 | 1.287 | 1.312 | | | |
| 21 | .0329 | .0366 | 1.531 | | .0343 | 1.416 | 1.443 | | | |
| 20 | .0359 | .0396 | 1.656 | | .0375 | 1.545 | 1.575 | | | |
| 19 | .0418 | .0456 | 1.906 | | .0437 | 1.802 | 1.837 | | | |
| 18 | .0478 | .0516 | 2.156 | | .0500 | 2.060 | 2.100 | | | |
| 17 | .0538 | .0575 | 2.406 | | .0562 | 2.317 | 2.362 | | | |
| 16 | .0598 | .0635 | 2.656 | | .0625 | 2.575 | 2.625 | | | |
| 15 | .0673 | .0710 | 2.969 | | .0703 | 2.896 | 2.953 | | | |
| 14 | .0747 | .0785 | 3.281 | | .0781 | 3.218 | 3.281 | | | |
| 13 | .0897 | .0934 | 3.906 | | .0937 | 3.862 | 3.937 | | | |
| 12 | .1046 | .1084 | 4.531 | | .1093 | 4.506 | 4.593 | | | |
| 11 | .1196 | .1233 | 5.156 | | .1250 | 5.150 | 5.250 | | | |
| 10 | .1345 | .1382 | 5.781 | | .1406 | 5.793 | 5.906 | | | |
| 9 | .1494 | .1532 | 6.406 | | .1562 | 6.437 | 6.562 | | | |
| 8 | .1644 | .1681 | 7.031 | | .1718 | 7.081 | 7.218 | | | |
| 7 | .1793 | .1832 | 7.656 | | .1875 | 7.590 | 7.752 | | | |

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

| Gage | Stainless Steel | | | Lbs. Per Square Foot | |
|------|-----------------|--------------|--------------|----------------------|----------------|
| | 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.....