NAAMM STANDARD **EMMA 557** -25

STANDARDS FOR EXPANDED METAL

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EMMA Expanded Metal Manufacturers Association

Division of

NAAMM NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS

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EMMA Division of NAAMM

The Expanded Metal Manufacturers Association (EMMA) is a Division of NAAMM, the National Association of Architectural Metal Manufacturers. NAAMM, established in 1938, represents manufacturers and fabricators of metal products used chiefly for commercial and industrial applications.

NAAMM publishes and distributes technical information and specifications for a wide range of metal products. Current information on all NAAMM publications may be obtained by calling or by visiting our website at naamm.org.

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National Association of Architectural Metal Manufacturers
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Introduction

Versatile is the key word which describes Expanded Metal. New applications are found for it every day in industry, stores, offices and the home.

Common terminology, manufacturing techniques and tolerances, specifications for standard products, and some uses of these products are covered in detail in this guide.

This manual shows you how to put this extraordinary material to work. However, the manual is designed as an introductory guide only, and the figures and specifications are not to be construed as product or performance guarantees or as warranties for fitness for any particular purpose. For answers to specific questions regarding properties and applications of Expanded Metal, consult an Expanded Metal manufacturer.

The basic types of Expanded Metal products are standard (regular or raised), flattened, grating, architectural (or decorative) meshes, and fine meshes. These products have thousands of applications for *enclosure, protection, support, decoration, and filtration, including grills, fencing, walkways, furniture, etc.*

These products may be produced from carbon steel, galvanized and stainless steel, aluminum, a variety of copper, nickel, silver and titanium alloys, and many other ferrous and non-ferrous metals.

There are approximately 120 Expanded Metal designs considered “standard” by the metal consuming trade; many are depicted in this manual and in other literature published by the **Expanded Metal Manufacturers Association (EMMA) Division of the National Association of Architectural Metal Manufacturers (NAAMM).**

The Expanded Metal industry represented by EMMA, its North American Trade Association, produces the broadest range of Expanded Metal products in the world.

In addition to standard designs, member firms are continually adding to their respective tool banks in order to satisfy the specific needs of their customers.

Collectively, member companies manufacture Expanded Metal products ranging from foil up to 5/16-in. plate. Product designers, engineers and purchasing agents can easily find a member firm which can render the design assistance and production capability to make virtually any end product.

Certain manufacturers are specialists in particular fields – such as laminated materials, electrical, and nuclear applications – and in the expanding of the many ferrous and non-ferrous alloys. For particular product needs – EMMA companies can assist in developing the exact Expanded Metal to fit.

Before examining specific Expanded Metal products and applications, there are several basic characteristics and advantages of Expanded Metal to consider.

Expanded Metal is formed in an expanding press. The basic metal is simultaneously slit and cold-formed, which expands the slits into diamond shaped openings of uniform size and regularity. The diamonds typically range from 3⁄16 to 2-in. wide and 1⁄4 to 6-in. long.

Today, energy conservation is vital to everyone.

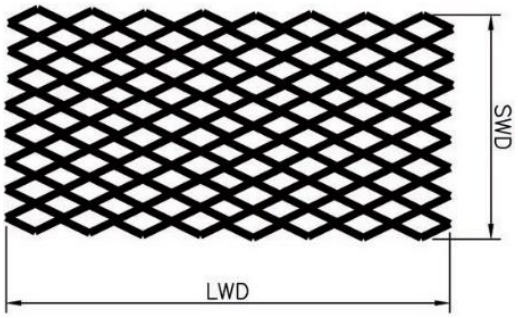
Expanded Metal saves energy, by conserving material – by making metal, which requires energy for milling and fabrication, go further and do more.

The material contained in this “Standards For Expanded Metal” Manual is for general information purposes only. None of it is intended to nor does it constitute an express or implied warranty by the Expanded Metal Manufacturers Association Division of NAAMM, its members individually or collectively of any kind whatsoever, including, but not limited to, any warranty, as to the suitability of Expanded Metal for a particular use or application.

Product Selection Considerations

The basic types of Expanded Metal products are listed below along with many of their primary applications.

Standard or Regular
Expanded Metal offers high rigidity in a variety of sizes and weights.



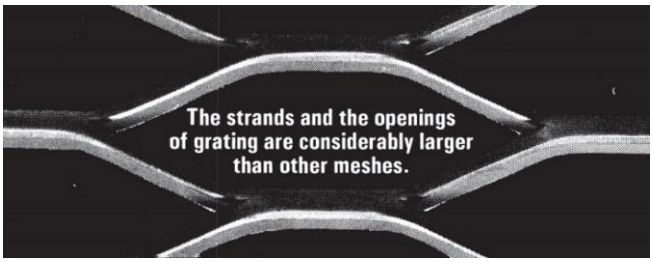
The angles of the diamond strands allow maximum air circulation and distribute load on the metal to supporting frames.

The light weight and strength of Expanded Metal make it an ideal material for a wide variety of commercial and industrial security applications. Storefront protectors, stairway and warehouse enclosures, lockers and tool room partitions are among its many uses.

It is also particularly valuable in the construction of safety guards for equipment with high heat buildup or where ventilation is required.

Expanded Metal partitions and enclosures provide workers and equipment with protection, permit surveillance of critical plant areas, and act as barriers for in-plant traffic flow. Noise baffles made of sound absorbing material often use Expanded Metal for rigidity.

Another common use is in filtration applications. Expanded Metal retains the media for filtering air, oil and many other liquids.



Grating is fabricated from low carbon steel plates and is ideal for use wherever a strong, durable, lightweight surface is needed - platform flooring or stairs and walkways for example.

The open design provides good traction, minimizes dirt, grease and snow accumulation; and reduces maintenance costs. Although used primarily for pedestrian traffic, grating can accommodate heavier loads if properly supported.

Typical uses include machinery platforms, storeroom and truck body floors, exterior and interior catwalks, mine quarry and refinery walkways, stair treads, grilles, headache racks and other heavy duty protection.

Flattened Expanded Metal is manufactured by passing the standard expanded sheet through a cold-roll reducing mill. The result is a smooth, flat and level sheet. Flattened Expanded Metal is used in a variety of specialty applications, such as lawn furniture, book and storage shelves, lamps and lamp shades, fireplace screens, many types of grilles, occasional tables, folding screens, room dividers, and air filtration filters.

Architectural or Decorative meshes are used to provide privacy, reduce air conditioning requirements, and to control light and air while allowing visibility. Sun screens, room dividers, and building facades are only a few of the design possibilities.

Decorative meshes are available in many styles and weights, ranging from delicate thin-strand designs to heavier patterns which approximate the appearance of considerably more expensive cast and wrought iron products.

Material as thin as 0.002 in. (0.05 mm) can be expanded. Usually referred to as fine mesh, these are precise miniature versions of standard Expanded Metal. Available in a variety of metals and alloys including gold, silver and platinum, they are often used for retaining filtration material, custom decoration for small appliances, and as battery electrodes.

Stock-size sheets of most catalogued Expanded Metal products are immediately available in quantity from steel distributors or from manufacturers. Practically any special design, size or shape can be produced to customer specification. Some patterns are available in coil as well as flat sheets.

Product Selection Considerations

The first step in the design of a product or fabricated assembly incorporating Expanded Metal is to select the appropriate Expanded Metal pattern, keeping in mind various product characteristics.

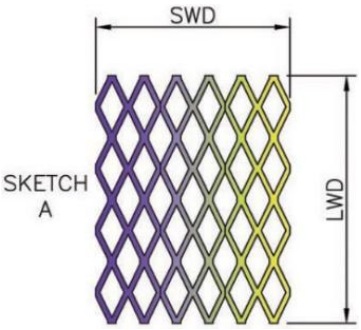
The strength and rigidity of Expanded Metal material is determined by Long Way of Diamond. On a walkway, for example, the LWD should run perpendicular to the walkway support.

Diamond direction also affects air deflection and diffusion, concealment properties and aesthetic appearance. Consult supplier for suggestions.

Once the style designation has been determined, the next consideration is the sheet size. When the quantity is relatively small and when there are no special qualifications regarding the edge configuration, it is nearly always best – in terms of both cost and lead-time – to select one of the many sheet sizes offered as “standard” by the manufacturer.

However, most manufacturers can and do routinely furnish Expanded Metal in special (non-standard) sheet sizes when requested and when the quantity justifies. In this event, it is important for the specifier to give some consideration to the edge configuration of the sheet as it relates to any particular requirement since the cost may be affected by the manufacturing operations necessary to shear the edge desired.

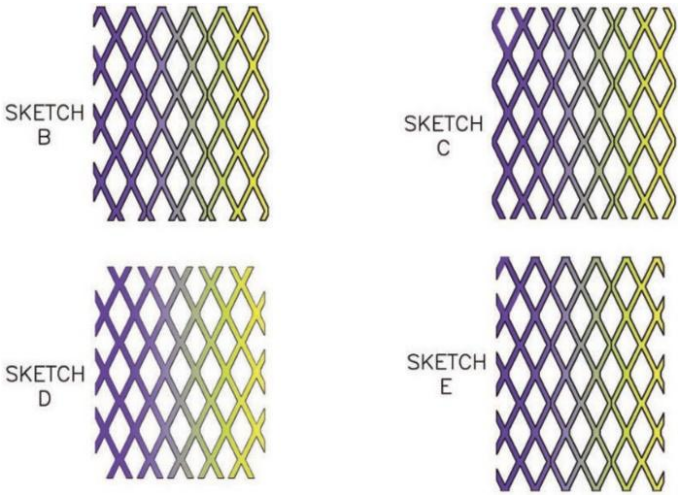
The sketches (page 18) indicate the five main edge considerations, which can be provided (circles, trapezoids and other non-rectangular shapes are also available).



Sketch A (Machine Run Sheets) typifies the edge conditions of a “normal” standard size sheet as it emerges from the expanding press. It is simply expanded to size and is characterized by closed diamonds on all four sides.

Special size sheets can be furnished in a similar condition, provided the sheet dimensions represent even multiples of the dimension (both LWD and SWD) of the diamond pattern specified and provided that normal manufacturing tolerances will be acceptable.

The remaining four sketches represent various edge configurations resulting from shearing operations performed on Machine Run (sketch A) sheets. The shearing of Expanded Metal sheets will normally result in open diamonds (as shown in sketches B, C, D, and E) on one or more sides.



In general, because of the additional operations involved, sheared-to-size Expanded Metal and Expanded Metal Grating will cost more than stock size sheets (machine run closed diamonds). Shearing allows for tighter tolerances, but will create open diamonds on any edge that is being sheared. See page 18 for various tolerances and edge conditions.

The designer’s decision as to the edge conditions and tolerances is an important one. A consultation with a manufacturer, before a particular design is finalized, is recommended. This will assist in evaluation and comparison of the various alternatives and can provide specific manufacturing and cost information.

Expanded Metal Uses

Uses of Expanded Metal products fall into five principal areas: enclosure, protection, support, decoration and filtration. Here are some common applications.

Product Selection Considerations

Enclosure:
Tool storage
Walls
Partitions and cages

Support:
Walkways
Furniture
Catwalks

Protection:
Machinery
Security fencing
Ceilings

Decoration:
Stair and balcony rail
Building Exteriors
Fixtures

Filtration:
HVAC Filter
Retainer
Auto and truck filters

Terminology

Glossary of Expanded Metal Terms

Architectural Mesh: See Decorative Mesh.

Base Metal: Original metal before it is expanded.

Bond: The solid intersection of two strands.

Decorative Mesh: Specialty Expanded Metal products used for decorative or architectural applications. Usually specified by the manufacturer's brand name. Available in carbon steel, aluminum, or other alloys in a wide range of openings and thickness.

Design Designations:

SWD – Nominal dimension, Short Way of Diamond.

LWD – Nominal dimension, Long Way of Diamond.

DESIGN SIZE – Actual dimension SWD and LWD.

Measured from a point to a corresponding point on the adjacent diamond.

SWO – Short Way of Opening.

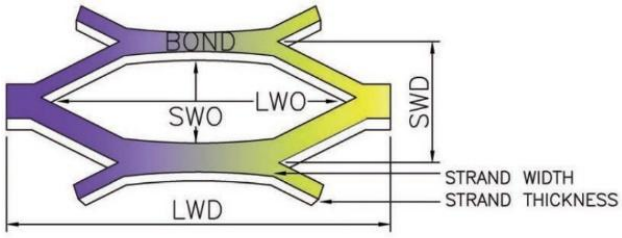
LWO – Long Way of Opening.

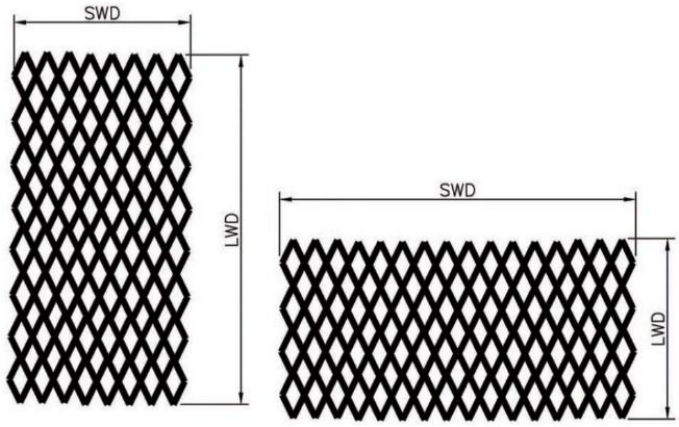
STRANDS – The sides of the Expanded Metal design.

STRAND THICKNESS – Thickness of the base metal.

STRAND WIDTH – Amount of metal fed under dies to produce one strand.

STRAND THICKNESS AND WIDTH – Can be varied to create different openings. The width of the strand should equal or exceed the thickness of the base metal.





Diamonds: Open area of metal after expanding. Most Expanded Metal patterns are diamond shaped but may also be hexagonal, louvered, asymmetric, etc.

Edge Configuration: Condition of the edge of an Expanded Metal sheet. Usually refers to “open” (random) or “closed” (bond) diamond edges produced from shearing.

Expanded Metal: A rigid piece of metal which has been slit and drawn into an open mesh pattern in a single operation. Conventional mesh is formed in a diamond pattern.

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Fine Mesh: A precise, miniature version of standard Expanded Metal. Under 0.140 in. (3.55 mm) openings SWD. Manufactured from a wide range of metals including nickel, platinum, silver, and base metals down to 0.002 in. (0.05 mm) thickness.

Flattened (abbreviated **F**): Expanded Metal that has been cold-rolled after expansion, to provide a smooth, flat, and level sheet. The flattening process reduces the original thickness of the base metal.

Grating: Expanded Metal that is produced from heavier plate, usually. low-carbon steel, with larger diamonds. It is typically used for walkways and platforms.

Meshes: A term used to describe special Expanded Metal products. (see Architectural, Decorative, and Fine Meshes.) Also used generically and in the singular (“mesh”), to describe the diamond design.

Order Procedure: Give the supplier a complete specification to avoid possible error. SWD dimension is always given before LWD dimension:

Example:

1⁄4" #18 Standard Expanded Metal, Carbon Steel 4'
SWD x 8' LWD

Regular or Raised (abbreviated **R**): same as standard.

Shearing: Cutting Expanded Metal to produce various sizes and shapes. (See Manufacturing Process.)

Standard (abbreviated **S**) (Same as Regular or Raised): Expanded Metal as it comes from the press. The strands and bonds are set at a uniform angle to the plane of the sheet. This gives added strength and rigidity, as well as skid-resistant surface.

Style Designation Format:
A combination of numbers, letters and abbreviations – in a standard format – permitting proper specification of dimension, thickness, style and weight of most commonly used Expanded Metal products. (See Recommended Nomenclature.)

Terminology

Recommended Nomenclature

An explanation of this nomenclature as it is applied to the most commonly ordered Expanded Metal types, sizes, shapes, and materials follows:

1. Industrial Diamond Patterns

CARBON STEEL – The first numerals express the Style or Design.

Example: 3/4" # 9

The letter **S** or **F** following the Style or Design designates “Standard” or “Flattened” Expanded Metal.

Example: 3/4" # 9F

STAINLESS STEEL – Same as carbon steel except that the type must be specified (*Example:* 304, 316, etc.).

Example: 3/4" # 9F 304SS

ALUMINUM – Same as carbon steel except the exact decimal equivalent is used to specify thickness.

Example: 3/4" - .125F

2. Small Diamond Designs – up to 3/16 in.

Same as Industrial Diamond Patterns except that strand width is designated.

3. Grating

Designated by weight of finished product per square foot. Available in carbon steel, stainless steel, aluminum, or other alloys.

Example: 4.0 lb

4. Decorative Mesh

Usually designed and specified by manufacturer. Consult the manufacturer for available patterns.

5. Fine Mesh

Usually designed and specified by manufacturer. Consult the manufacturer for available patterns.

Table A NOMINAL WEIGHTS AND DIMENSIONS*

Style	Minimum Strand Thickness (inches)[D]	Nominal Weight in Lbs. per 100 Sq. Ft.[B]	Design Size (inches)[C] SWD	Design Size (inches)[C] LWD	Opening Size (inches)[C] SWO	Opening Size (inches)[C] LWO	Strand Size (inches)[C] Width	Strand Size (inches)[C] Thickness	Overall Thickness (inches)[C]	No. of Diamonds per Ft. SWD	No. of Diamonds per Ft. LWD	Open Area (%)
STANDARD-CARBON STEEL												
¼" #20	0.032	85	0.250	1.000	0.157	0.718	0.072	0.036	0.146	48	12	42
¼" #18	0.042	113	0.250	1.000	0.146	0.718	0.072	0.048	0.151	48	12	42
½" #20	0.032	42	0.500	1.200	0.407	0.938	0.072	0.036	0.146	24	10	71
½" #18	0.042	69	0.500	1.200	0.382	0.938	0.088	0.048	0.180	24	10	65
½" #16	0.053	85	0.500	1.200	0.372	0.938	0.087	0.060	0.183	24	10	65
½" #13	0.083	141	0.500	1.200	0.337	0.938	0.096	0.090	0.212	24	10	62
¾" #16	0.053	54	0.923	2.000	0.783	1.750	0.101	0.060	0.208	13	6	78
¾" #14	0.068	63	0.923	2.000	0.775	1.725	0.095	0.075	0.204	13	6	79
¾" #13	0.083	77	0.923	2.000	0.760	1.688	0.096	0.090	0.212	13	6	79
¾"#13 HVY	0.083	115	0.923	2.000	0.718	1.625	0.144	0.090	0.300	13	6	69
¾" #12	0.097	109	0.923	2.000	0.823	1.600	0.117	0.105	0.214	13	6	75
¾" #11	0.112	142	0.923	2.000	0.810	1.600	0.134	0.120	0.243	13	6	71
¾" #9	0.127	178	0.923	2.000	0.675	1.562	0.150	0.134	0.329	13	6	67
1" #16	0.053	43	1.000	2.400	0.872	2.062	0.087	0.060	0.183	12	5	83
1½" #18	0.042	20	1.330	3.000	1.229	2.625	0.068	0.048	0.144	9	4	90
1½" #16	0.053	40	1.330	3.000	1.184	2.625	0.108	0.060	0.221	9	4	84
1½" #13	0.083	58	1.330	3.000	1.160	2.500	0.105	0.090	0.228	9	4	84
1½"#13 HVY	0.083	76	1.330	3.000	1.132	2.500	0.138	0.090	0.288	9	4	79
1 ½" #12	0.097	76	1.330	3.000	1.135	2.500	0.118	0.105	0.258	9	4	82
1 ½" #11	0.112	99	1.330	3.000	1.107	2.500	0.134	0.120	0.294	9	4	80
1½" #9	0.127	119	1.330	3.000	1.087	2.375	0.144	0.134	0.318	9	4	78
1½" #6	0.184	247	1.330	3.000	0.979	2.313	0.203	0.198	0.452	9	4	69
2" #13	0.083	65	1.850	4.000	1.630	3.438	0.164	0.090	0.335	7	3	82
2" #9	0.127	88	1.850	4.000	1.603	3.375	0.149	0.134	0.327	7	3	84
STANDARD-STAINLESS STEEL												
½" #18	0.044	60	0.500	1.200	0.392	0.913	0.076	0.048	0.158	24	10	70
½" #16	0.055	76	0.500	1.200	0.382	0.962	0.076	0.060	0.163	24	10	70
½" #13	0.085	145	0.500	1.200	0.337	0.817	0.097	0.090	0.214	24	10	61
¾" #18	0.044	45	0.923	2.000	0.791	1.650	0.105	0.048	0.211	13	6	77
¾" #16	0.055	57	0.923	2.000	0.780	1.632	0.105	0.060	0.216	13	6	77
¾" #13	0.085	85	0.923	2.000	0.753	1.494	0.105	0.090	0.228	13	6	77
¾" #9	0.128	170	0.923	2.000	0.683	1.484	0.140	0.135	0.311	13	6	70
1½" #16	0.055	38	1.330	3.000	1.190	2.461	0.101	0.060	0.208	9	4	85
1½" #13	0.085	57	1.330	3.000	1.163	2.517	0.101	0.090	0.221	9	4	85
1½" #9	0.128	127	1.330	3.000	1.080	2.366	0.151	0.135	0.331	9	4	77
STANDARD-ALUMINUM												
½"-.050	0.045	26	0.500	1.20	0.376	0.937	0.093	0.050	0.190	24	10	63
½"-.080	0.074	43	0.500	1.20	0.346	0.937	0.096	0.080	0.208	24	10	62
¾"-.050	0.045	17	0.923	2.00	0.786	1.750	0.109	0.050	0.219	13	6	76
¾"-.080 LT	0.074	31	0.923	2.00	0.741	1.680	0.129	0.080	0.268	13	6	72
¾"-.080 HVY	0.074	40	0.923	2.00	0.711	1.680	0.165	0.080	0.333	13	6	64
¾"-.125	0.118	64	0.923	2.00	0.667	1.680	0.169	0.125	0.359	13	6	63
1½"-.080	0.074	22	1.33	3.00	1.149	2.500	0.128	0.080	0.266	9	4	81
1½"-.125	0.118	43	1.33	3.00	1.080	2.500	0.162	0.125	0.346	9	4	76

[A] 1 lb. = 0.454 kg; 1 in. = 25.4 mm.

[B] A variation in weight per square ft. of ±10% is permissible, based on the weight of any sheet or bundle. No combination of tolerances can be combined to yield weight per SF below - 10 % tolerance range; the minimum weight per SF of -10 % is absolute.

[C] A tolerance of ±10% is permitted in dimensions, except for minimum strand thickness.

[D] The minimum thickness is absolute, not subject to minus variation.

Table B

NOMINAL WEIGHTS AND DIMENSIONS*

Style	Minimum Strand Thickness (inches)[D]	Nominal Weight in Lbs. per 100 Sq. Ft.[B]	Design Size (inches)[C] SWD	Design Size (inches)[C] LWD	Opening Size (inches)[C] SWO	Opening Size (inches)[C] LWO	Strand Size (inches)[C] Width	Strand Size (inches)[C] Thickness	Overall Thickness (inches)[C]	No. of Diamonds per Ft. SWD	No. of Diamonds per Ft. LWD	Open Area (%)
FLATTENED-CARBON STEEL												
¼" #20	0.026	74	0.250	1.050	0.092	0.715	0.079	0.029	0.029	48	11.4	37
¼" #18	0.034	100	0.250	1.050	0.090	0.715	0.080	0.038	0.038	48	11.4	36
½" #20	0.026	37	0.500	1.260	0.342	1.000	0.079	0.029	0.029	24	9.5	68
½" #18	0.034	61	0.500	1.260	0.306	1.000	0.097	0.038	0.038	24	9.5	61
½" #16	0.043	77	0.500	1.260	0.304	1.000	0.098	0.048	0.048	24	9.5	61
½" #13	0.066	126	0.500	1.260	0.286	1.000	0.107	0.072	0.072	24	9.5	57
¾" #16	0.043	47	0.923	2.100	0.701	1.750	0.111	0.048	0.048	13	5.7	76
¾" #14	0.054	56	0.923	2.100	0.713	1.760	0.105	0.060	0.060	13	5.7	77
¾" #13	0.066	67	0.923	2.100	0.711	1.781	0.106	0.072	0.072	13	5.7	77
¾"#13 HVY	0.066	102	0.923	2.100	0.603	1.755	0.160	0.072	0.072	13	5.7	65
¾" #12	0.077	95	0.923	2.100	0.666	1.725	0.129	0.084	0.084	13	5.7	72
¾" #11	0.089	125	0.923	2.100	0.628	1.700	0.147	0.096	0.096	13	5.7	68
¾" #9	0.101	157	0.923	2.100	0.593	1.688	0.165	0.108	0.108	13	5.7	64
1" #16	0.043	38	1.000	2.520	0.804	2.250	0.098	0.048	0.048	12	4.8	80
1½" #16	0.043	35	1.330	3.150	1.092	2.750	0.119	0.048	0.048	9	3.8	82
1½" #13	0.066	51	1.330	3.150	1.098	2.750	0.116	0.072	0.072	9	3.8	83
1½"#13 HVY	0.066	67	1.330	3.150	1.026	2.725	0.152	0.072	0.072	9	3.8	77
1½" #12	0.077	67	1.330	3.150	1.070	2.700	0.130	0.084	0.084	9	3.8	80
1½" #11	0.089	87	1.330	3.150	1.035	2.650	0.147	0.096	0.096	9	3.8	78
1½" #9	0.101	105	1.330	3.150	1.014	2.563	0.158	0.108	0.108	9	3.8	76
1½" #6	0.147	218	1.330	3.150	0.883	2.500	0.223	0.158	0.158	9	3.8	66
2"#13	0.066	57	1.850	4.200	1.489	3.713	0.180	0.072	0.072	7	2.9	80
2" #9	0.101	78	1.850	4.200	1.517	3.645	0.164	0.108	0.108	7	2.9	82
FLATTENED-STAINLESS STEEL												
½"#18	0.037	57	0.500	1.260	0.332	0.955	0.084	0.041	0.041	24	9.5	66
½" #16	0.047	71	0.500	1.260	0.332	1.000	0.084	0.051	0.051	24	9.5	66
½" #13	0.072	136	0.500	1.260	0.286	0.854	0.107	0.076	0.076	24	9.5	57
¾"#18	0.037	43	0.923	2.100	0.691	1.813	0.116	0.041	0.041	13	5.7	75
¾" #16	0.047	53	0.923	2.100	0.691	1.729	0.116	0.051	0.051	13	5.7	75
¾" #13	0.072	80	0.923	2.100	0.691	1.653	0.116	0.076	0.076	13	5.7	75
¾" #9	0.108	159	0.923	2.100	0.615	1.622	0.154	0.114	0.114	13	5.7	67
1½" #16	0.047	35	1.330	3.150	1.108	2.610	0.111	0.051	0.051	9	3.8	83
1½" #13	0.072	53	1.330	3.150	1.108	2.613	0.111	0.076	0.076	9	3.8	83
1½" #9	0.108	119	1.330	3.150	0.998	2.594	0.166	0.114	0.114	9	3.8	75
FLATTENED-ALUMINUM												
½"-.050	0.034	22	0.500	1.26	0.292	1.000	0.104	0.038	0.038	24	9.5	58
½"-.080	0.056	35	0.500	1.26	0.290	1.000	0.105	0.060	0.060	24	9.5	58
¾"-.050	0.034	14	0.923	2.10	0.679	1.812	0.122	0.038	0.038	13	5.7	74
¾"-.080 LT	0.056	26	0.923	2.10	0.637	1.750	0.143	0.060	0.060	13	5.7	69
¾"-.080 HVY	0.056	33	0.923	2.10	0.561	1.750	0.181	0.060	0.060	13	5.7	61
¾"-.125	0.089	53	0.923	2.10	0.549	1.750	0.187	0.094	0.094	13	5.7	59
½"-.080	0.056	18	1.330	3.15	1.044	2.750	0.143	0.060	0.060	9	3.8	78
½"-.125	0.089	36	1.330	3.15	0.968	2.750	0.181	0.094	0.094	9	3.8	73

[A] 1 lb. = 0.454 kg; 1 in. = 25.4 mm.

[B] A variation in weight per square ft. of ±10% is permissible, based on the weight of any sheet or bundle. No combination of tolerances can be combined to yield weight per SF below - 10 % tolerance range; the minimum weight per SF of -10 % is absolute.

[C] A tolerance of ±10% is permitted in dimensions, except for thickness.

[D] The minimum thickness is absolute, not subject to minus variation.

Table C

NOMINAL WEIGHTS AND DIMENSIONS*

Style	Nominal Weight in Lbs. per 100 Sq. Ft.[B]	Design Size (inches)[C] SWD	LWD	Opening Size (inches)[C] SWO	LWO	Strand Size (inches)[C] Width	Thickness	Overall Thickness (inches)[C]	No. of Diamonds per Ft. SWD	LWD	Open Area (%)
SMALL DIAMOND DESIGNS-CARBON STEEL-STANDARD											
3/32" #24	56	0.140	0.240	0.084	0.135	0.040	0.024	0.083	86	50	43
1/8" #24	52	0.150	0.300	0.094	0.155	0.040	0.024	0.083	80	40	47
3/16" #26	26	0.190	0.500	0.145	0.375	0.034	0.018	0.069	63	24	64
3/16," #24	49	0.200	0.500	0.136	0.325	0.050	0.024	0.101	60	24	50
3/16" #22	72	0.210	0.500	0.131	0.308	0.060	0.031	0.122	57	24	43
1/4" #22 - .670 LWD	51	0.250	0.670	0.180	0.473	0.050	0.031	0.104	48	18	60

Note: Small diamond designs are available in other alloys such as aluminum, stainless steel, nickel, gold, platinum, zirconium and silver.

[B] A variation in weight per square fl. of ±10% is permissible, based on the weight of any sheet or bundle.

[C] A tolerance of ±10% is permitted in dimensions, center to center.

Table D

NOMINAL WEIGHTS AND DIMENSIONS*

Style	Nominal Weight in Lbs. per 100 Sq. Ft.[B]	Design Size (inches)[C] SWD	LWD	Opening Size (inches)[C] SWO	LWO	Strand Size (inches)[C] Width	Thickness	Overall Thickness (inches)[C]	No. of Diamonds per Ft. SWD	LWD	Open Area (%)
GRATING-CARBON STEEL											
2.0 lb.	2.00	1.33	5.33	1.000	3.60	0.235	0.135	0.460	9	2.25	77
3.0 lb.	3.00	1.33	5.33	0.940	3.44	0.264	0.183	0.540	9	2.25	60
3.14 lb.	3.14	2.00	6.00	1.625	4.88	0.312	0.250	0.656	6	2.00	69
4.0 lb.	4.00	1.33	5.33	0.940	3.44	0.300	0.215	0.618	9	2.25	55
4.27 lb.	4.27	1.41	4.00	1.000	2.88	0.300	0.250	0.625	8.5	3.00	58
5.0 lb.	5.00	1.33	5.33	0.813	3.38	0.331	0.250	0.655	9	2.25	50
6.25 lb.	6.25	1.41	5.33	0.813	3.38	0.350	0.312	0.715	8.5	2.25	50
7.0 lb.	7.00	1.41	5.33	0.813	3.38	0.391	0.318	0.740	8.5	2.25	45
GRATING-STAINLESS STEEL											
3.3 lb.	3.32	2.00	6.00	1.625	4.88	0.312	0.250	0.656	6	2.00	69
4.5 lb.	4.25	1.41	4.00	1.000	2.88	0.300	0.250	0.625	8.5	3.00	58
GRATING-ALUMINUM											
2.0 lb.	2.0	1.33	5.33	.940	3.44	.387	.250	.730	9	2.25	48

[A] 1 lb. = 0.454 kg; 1 in. = 25.4 mm.

[B] A variation in weight per square ft. of ±5% is permissible, based on the weight of any sheet or bundle. No combination of tolerances can be combined to yield weight per SF below -5 % tolerance range; the minimum weight per SF of - 5 % is absolute.

[C] A tolerance of ± 5 % is permitted in dimensions, center to center.

FOR METRIC CONVERSION OF VALUES IN TABLES A, B, C, and D

From Inch-Pound Units	To Metric Units	Multiply by
inch (in.)	mm	25.4
foot (ft)	mm	304.8
foot (ft)	meter (m)	0.3048
lb (Mass)	kg	0.4536
lbs (Mass) per sq ft	kg per sq meter (kg/m²)	4.882
lbs (Mass) per 100 sq ft	kg per sq meter (kg/m²)	0.4882
lb (Force)	Newton (N)	4.448
lbs (Force) per sq ft	Pascal (Pa)	47.88
No. of Diamonds per foot	No. of Diamonds per meter	3.28

"The design, selection and adaptability of Expanded Metal grating for specific uses must be determined by the buyer. The guidelines and specifications listed in this manual including Table E below, are not to be construed as a warranty by the Expanded Metal Manufacturers Association or its members of the fitness of any product for any given use or purpose."

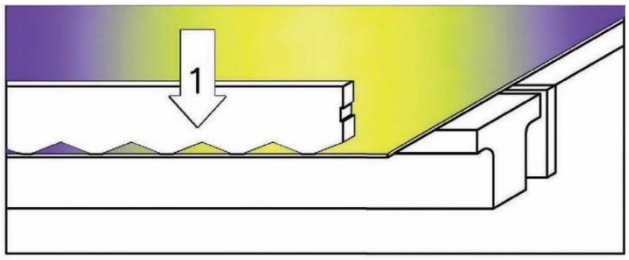
Table E - Concentrated Load Deflection Tables for a Fixed-Fixed Span (The Load Test Report can be viewed here.)

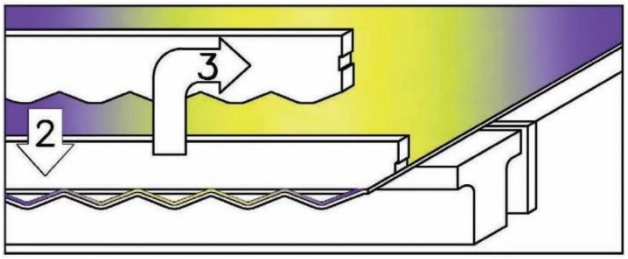
Standard (Raised) Expanded Metal - Non-Grating Product - (Ref. Table A)			
Style		**24-Inch Span**	**36-inch Span**
3/4#9	Concentrated Load Capacity (lb./sq. ft.)	128	44
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
1-1/2#9	Concentrated Load Capacity (lb./sq. ft.)	78	32
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
1-1/2#6	Concentrated Load Capacity (lb./sq. ft.)	164	84
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
Carbon Steel - Grating Product (Ref. Table D)			
Style (lbs. per sq. ft)		**24-Inch Span**	**36-inch Span**
2.0 lb.	Concentrated Load Capacity (lb./sq. ft.)	201	73
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
3.0 lb.	Concentrated Load Capacity (lb./sq. ft.)	274	126
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
3.14 lb.	Concentrated Load Capacity (lb./sq. ft.)	340	117
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
4.0 lb.	Concentrated Load Capacity (lb./sq. ft.)	468	201
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
4.27 lb.	Concentrated Load Capacity (lb./sq. ft.)	419	196
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
5.0 lb.	Concentrated Load Capacity (lb./sq. ft.)	526	250
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
6.25 lb.	Concentrated Load Capacity (lb./sq. ft.)	684	331
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
7.0 lb.	Concentrated Load Capacity (lb./sq. ft.)	758	338
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25
Aluminum - Grating Product (Ref. Table D)			
Style (lbs. per sq. ft)		**24-Inch Span**	**36-inch Span**
2.0 lb.	Concentrated Load Capacity (lb./sq. ft.)	320	136
	Deflection Under Allowed Concentrated Load (in.)	0.25	0.25

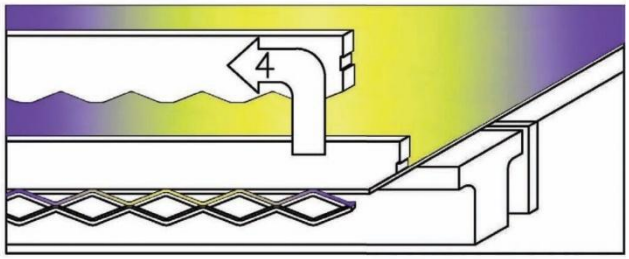
1. Concentrated load is applied at mid-span and is in units of pounds per foot of grating width.
2. Deflection is at the mid-span, and is measured in inches
3. The test specimens on which this table is measured were welded at alternate strands to an angle fixture. Testing shows that if the ends are not so welded, the capacity of the grating is drastically reduced.

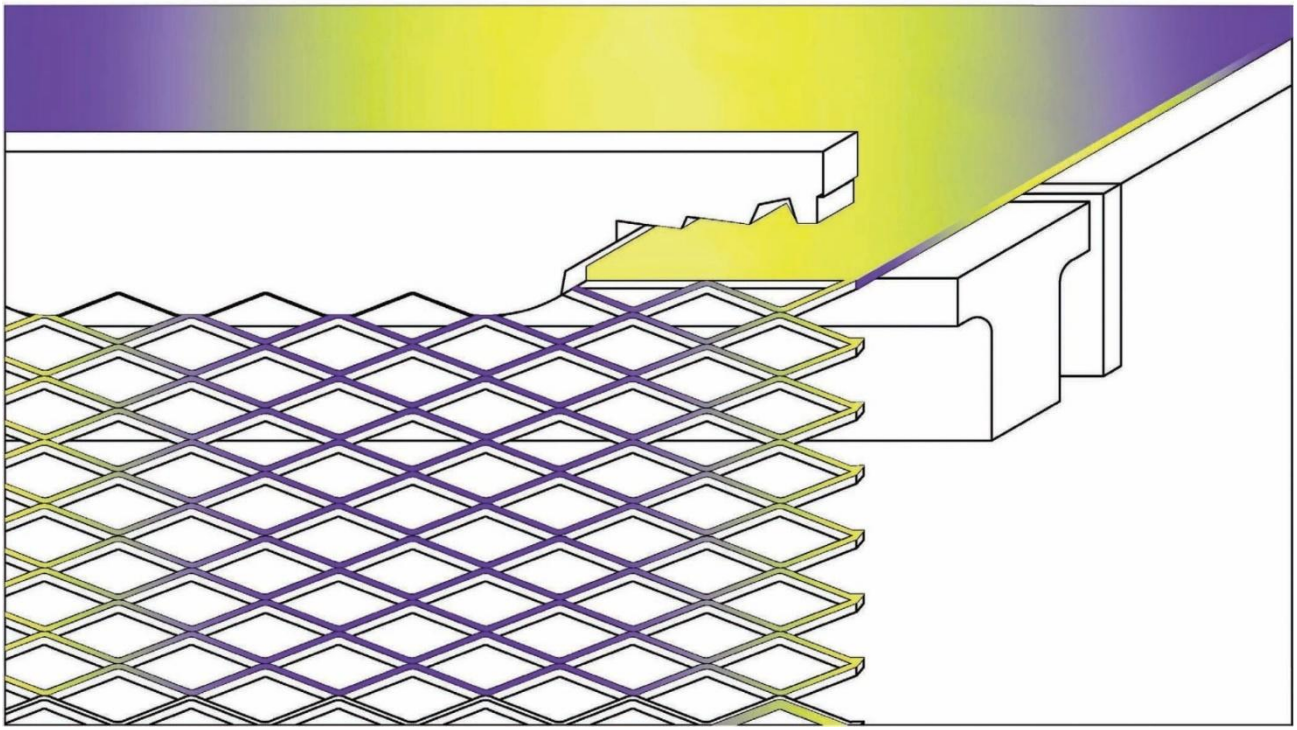
Manufacturing Process

Sheet or plate is mechanically advanced beyond the face of the flat bottom die an amount equal to the strand width of regular Expanded Metal before flattening. The top serrated cutting die then descends (1) and simultaneously slits and cold forms an entire row of half-diamonds (2). The top die then ascends and moves one half diamond right (3) as the base sheet or plate moves forward one strand width. The top die then descends, slits and cold forms another full row of half-diamonds completing a row of full diamonds in two strokes. The die then ascends, (4) returns to its initial position (1), and begins to form another, row of half-diamonds, repeating the process until a sheet of Expanded Metal is completed.









Types of Materials

Materials used in the manufacture of Expanded Metal include but not limited to:

Steel

A. Cold-rolled (ASTM A 1008/A1008M).

B. Hot-rolled, and Hot rolled-pickled and oiled (A1011/A1011M).

C. Pre-galvanized (ASTM A 653/A 653M), or Electro-galvanized (ASTM A 879) before expanding.

D. Hot Dip Galvanized (ASTM A123/A123M) after expanding.

E. Pre-finished (painted or plated).

Aluminum

A. Most common alloys-usually 3003-H14, 5005-H34 and 5052-H32 (ASTM B 209).

B. Pre-painted.

C. Anodized.

Stainless

A. Types 304 and 316 (including extra low-carbon

grades) (ASTM A 666).

B. Most 400 types (ASTM A 176).

Other Metals

A. Copper, nickel alloys, CP titanium (grades 1 and 2), precious metals.

Manufacturing Considerations

The variables in the expanded product include:

• Metal type

• Metal thickness

• Expanded pattern

• Strand width or unit weight

• Thickness of expanded product

• Piece or coil size

The expanding process yields a product whose overall thickness may be 1.5 to 5 times thicker than the base metal.

If the material is flattened, it may be reduced in thickness up to 20 percent of the original material thickness. Foil material may have the overall thickness increased up to two times the strand width. Strand width can be varied somewhat to change the percentage of open area, thus meeting strength or aesthetic requirements.

Custom manufactured sheet sizes or pieces, or material in coil form, are generally available on special order. Specific processes used to produce machine Expanded Metal products and additional considerations follow:

Expanding

An expanding press simultaneously slits and cold forms base material to form a diamond pattern. A sheet of Expanded Metal can be sheared to required size. It can also be manufactured to a specified

size in order to eliminate shearing and to reduce waste. A combination of expanding-to-size and shearing can be utilized to attain the final sheet size.

Flattening

The process used to produce flattened Expanded Metal. Most styles and designations may be flattened including some gratings.

Leveling

Expanded Metal is leveled after expansion by either an integral or separate leveling device.

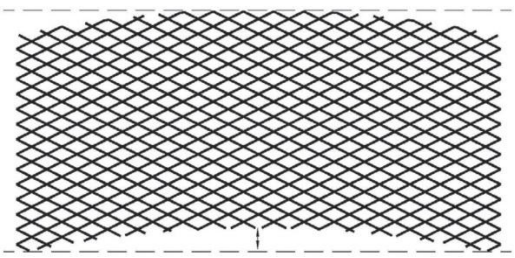
Shearing

Shearing is used to attain a special size and/or tolerance as required. The basic type shearing is random.

In random shearing, the shear line falls at random points on the mesh pattern. Edges are open and diamonds are not matched. (See page 18).

Camber

Bow in sheet. It is measured by placing a straight edge along the concave side of the sheet, parallel to the LWD, touching both ends of the sheet. The maximum distance between the edge of the Expanded Metal and the straight edge is the camber. A sheet may be within a width tolerance and still have camber.



Squareness

Expanded Metal sheets are manufactured to tolerances shown on page 18. Tighter tolerances must be specified and are obtained by shearing some or all sides. (See page 18).

Coatings

Because of its adaptability to metal finishing processes, Expanded Metal can be galvanized, anodized, coated, painted or plated for a variety of applications. Because of the light lubricant used during the expanding process, the product should be cleaned prior to finishing.

In hot-dip galvanizing, there can be some warpage of metal because of high temperatures. In addition, galvanizing does not always produce a smooth and even coating. Per ASTM A123, filming or excess zinc buildup in plain holes of less than 1/2" diameter may occur.

It is recommended that patterns of 1/2-in. (12.7mm), lighter than 0.084 in. (2.14mm), and large diamond patterns with a light weight per square foot not be galvanized.

Consideration should be given to producing these items from galvanized sheet.

Most manufacturers produce standard materials in special custom sheet sizes. Additional tolerances are provided for strand width thickness, percentage of open area, patterns per square foot. Adjustments may be made to meet the customer's particular requirements.

Consult individual manufacturers for details on special custom product.

Weights - Weight shall not vary in excess of ±10 percent of the nominal weight per square foot specified in Tables A through D of this manual.

Over and Under Shipments - Unless specified by the buyer all orders are subject to a shipping tolerance of ±10 percent of specified quantities.

Surface Condition - Some of the lubricant used in manufacture is usually present on Expanded Metal surfaces and aids in the prevention of corrosion. When requested to furnish dry, supplier shall not be responsible for conditions resulting from the absence of lubricants.

Standard

Dimensions:

SWD - Shall not vary greater than -0 +1/4 in. per foot of SWD dimension.

LWD - Shall not vary greater than -0 +1/4 in. per sheet.

Camber - The greatest deviation of a side - edge from a straight line shall not exceed 3/32 in. per foot of dimension.

Taper - Edges shall not deviate from parallel by more than 1/16 in. per foot of dimension, or 1/4 in. overall, whichever is greater.

Squareness - Ends shall not be more than 1/8 in. per foot out of square or 1/2 in. overall.

Flatness (Levelness) - Sheets shall be free from waves or buckles that are in excess of 1-1/2 in. from a plane surface.

Formability - Each piece should be able to withstand a 90 degree bend with a 1/4 in. inside radius in either direction, without fracture.

Flattened

Thickness after flattening shall not be less than 80% of the nominal thickness specified for the sheet from which the item was produced.

Dimensions:

SWD after flattening - Shall not vary from the nominal dimension more than -0 +1/4-in. per foot of dimension.

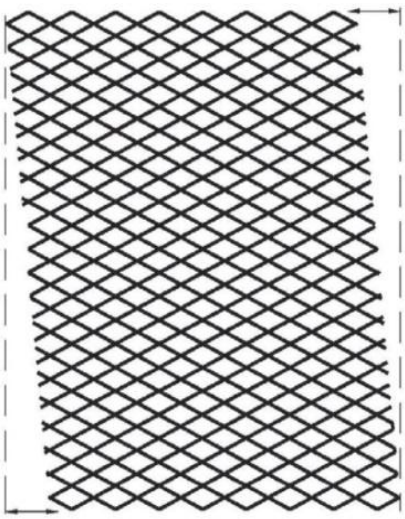
LWD after flattening - Shall not vary from the nominal dimension more than -0 +1/4-in. per foot of dimension.

Camber After Flattening - The greatest deviation of a side edge from a straight line after flattening shall not exceed 3/32-in. per foot of dimension.

Taper - Sheet edges shall not deviate from parallel greater than 1/8-in. per foot of dimension, to a maximum 3/8-in. overall.

Squareness - Ends shall not be more than 1/8 in. per foot out of square or 1/2 in. overall.

Flatness (Levelness) - Sheets shall be free from waves or buckles that are in excess of 1-1/2 in. from a plane surface.



Squareness

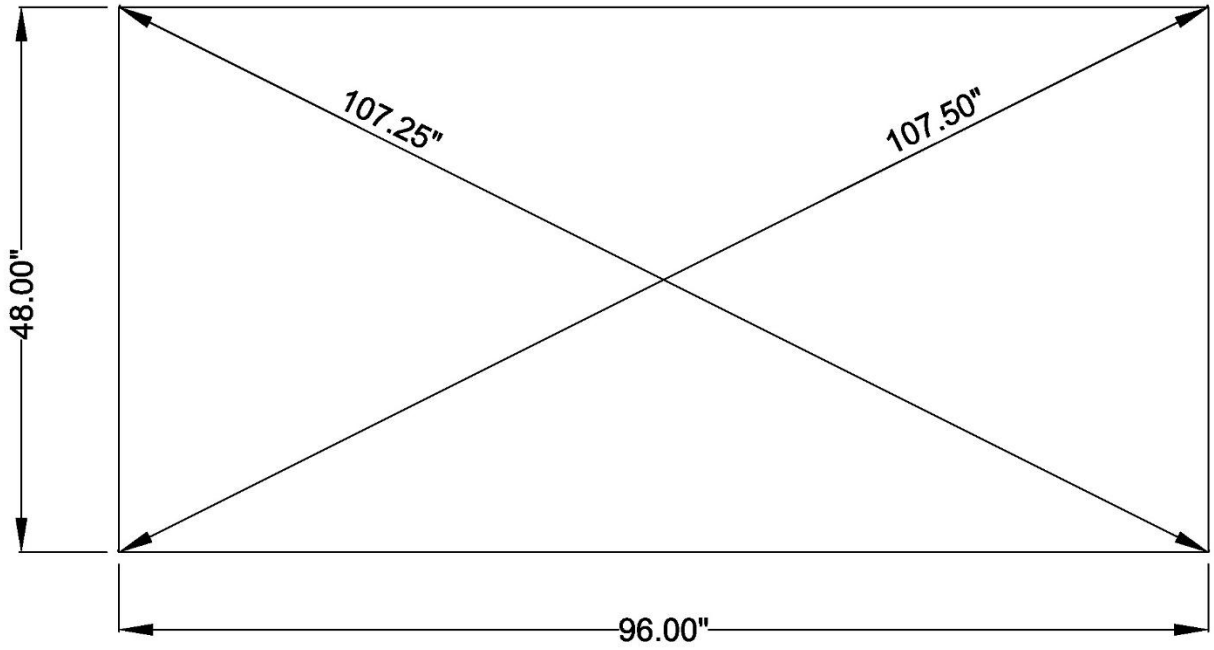
Grating

Dimensions:

SWD - Shall not vary from the nominal dimension more than -0 +1/4-in. per foot of width.

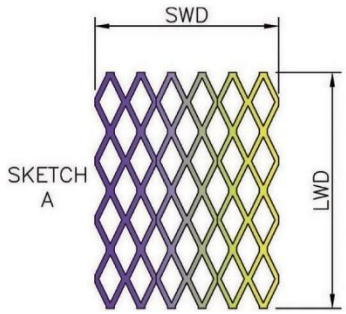
LWD - Shall not vary greater than -0 +1/2 diamond size.

Definition: “Out of square” is the greatest deviation of an end edge from a straight line at right angle to a side and touching one corner. It is also obtained by measuring the difference between diagonals of the sheet. The out of square deviation is one-half of that difference. See example below:



107.50"
-107.25"
0.25" / 2 = 0.125" Out of Square

Manufacturing Tolerance Standard

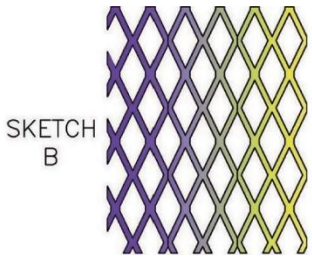


SWD (Short Way of Diamond)
Shall not vary greater than - 0" +1/4 in. per foot of width (Example: 48" could be 49")

LWD (Long Way of Diamond)
Shall not vary greater than - 0" +1/4 in. per sheet.

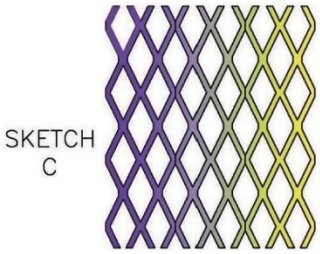
Note: Generally all stock or machine run sheets will have closed diamonds all four sides.

Random Sheared Tolerance Standard & Flattened Expanded Metal & Expanded Metal Grating



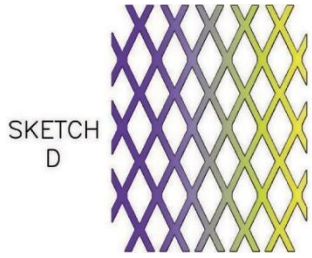
Sheared one side and one end
±1/4 in. causing open diamonds one side SWD one side LWD

Expanded Metal Grating
±1/2 in.



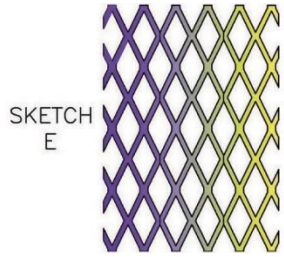
SWD – Same as stock and machine run tolerance.
LWD – Sheared both ends
±1/8 in. (open diamonds)

Expanded Metal Grating
±1/4 in.



Random sheared
SWD and LWD
±1/8 in. open diamonds 4 sides

Expanded Metal Grating
±1/4 in.



Random sheared
SWD
±1/8 in. open diamonds two sides – LWD closed diamonds

Both End Tolerances
±1/2 diamond size

Expanded Metal Grating
±1/4 in.

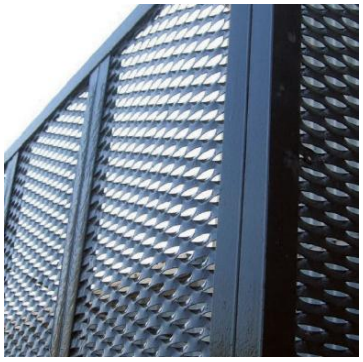
Applications

Expanded Metal patterns may be engineered for many specific applications. Such custom engineering take advantage of metal properties and die design to yield a product best suited for a particular application.

Special mesh designs are utilized for a variety of purposes, such as function optimization, open area usage, and appearance of the finished product.

Many special metals are suitable for the expanding process. For example, titanium, which is commonly used in the production of chlorine, is expanded and then fabricated into electrodes. Stainless steels are used in a variety of corrosive atmospheres. Certain metals, such as nickel, copper and silver, are suitable for small battery grids and expanded to precise tolerances. Other materials, such as molybdenum, platinum, gold or zirconium, can be expanded for many special electrochemical uses.

The versatility of Expanded Metal is the key to a virtually limitless variety of applications. Some of these applications include:

- Air and Fluid Filters
- EMI/RFI Shielding
- Battery Cells
- Ventilation Systems
- Strainers
- Satellite and Radar Antennas
- Partitions
- Outdoor Furniture
- Speaker Grills
- Security Walls, Ceilings, Floors, Doors
- Machine and Window Guards
- Fencing
- Shelving and Racks
- Concrete Reinforcements
- Walkways and Stair Treads
- Containers
- Greenhouse Benches
- Decorative Dividers

Some of the many product uses