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**A comprehensive guide to...**

# Sealants and Caulking Compounds

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The post-war building boom throughout the world, coupled with new concepts in architectural design and components and a cost factor spiraling upward, has brought about a need for new types of materials for buildings which would enable these new designs to be built, while keeping costs, in particular remedial and maintenance, to a minimum. One area where these new materials have played an extremely important part is in the field of sealants, including caulking compounds and crack and seam sealers.

Raw material manufacturers and compounders have developed many new polymers and formulations to serve this field. They are: (1) One part (no mixing), one package catalyst and base packed together with a miscible barrier between; (2) two part (base and activator packed separately), and (3) tapes, curing and non-curing types.

### *Types of Materials*

These available materials are of the following generic types: Soya oil, alkyd, polybutene resin (non drying), polybutene resin (drying), polyisobutylene (curing and non-curing), butyl, nitrile, neoprene, Hypalon, neoprene/Hypalon, polyacrylic, polysulfide, silicone, urethane, epoxy.

In many cases they are modified further, such as: epoxy/polysulfide/amines, polysulfide/coal-tar, polyvinyl acetate/cork, polyurethane/coal-tar and neoprene/asphalt.

Extruded tapes of polybutene, polyisobutylene/butyl, especially the latter, are available in many states of cure, and in various combinations with other resins.

There are many specialized industrial-type sealants which include vinyl plastisol and foam-in-place. Most of these sealants may be used alone, or in conjunction with another. Some are limited to specific uses, while others suit a variety of uses. Experience points out that use of the most expensive sealant does not necessarily provide the best material for the use. In selection of the proper sealant for the job, its properties and the joint design are the most important considerations.

Primers for sealants play an important part in the performance of the sealant. The selection of primers is based on (1) substrate, (2) sealant, and (3) performance conditions. Those primers in most common use are chlorinated rubber, polyvinyl chloride solutions, aminosilicones, polyurethanes, and two part epoxy/amide and/or epoxy polysulfide and others based on vinyls.

Back-up materials recommended for use with sealants of these types include butyl rod stock, polyurethane foam, neoprene rod stock, polyethelene foam, and untreated oakum or jute. It is essential and must be insisted upon that the backing materials be asphalt and creosote free, in order that sealant performance provides expected service. Another caution is that sealants not be in contact with any compound containing asphalt, creosote, oil, or extractible plasticizers.

**Schedule I — Traffic Bearing Sealants**

| | 2 part Poly-Sulfide | 2 part Poly-urethane Prepoly-mer | 2 part Poly-Sulfide Coal Tar | 2 part Poly-urethane Coal Tar | 2 part Poly-Sulfide/ Epoxy | Neoprene Asphalt Hot Melt * |
|---|---|---|---|---|---|---|
| Compounded to Shore "A" Req't | 40-55 | 25-35 | 5-15 | 15-35 | 65-80 | 50-70 |
| Form | pour gun | pour gun | pour | pour | pour | hot melt |
| Tensile psi | 100-300 | 150-400 | 60-125 | 100-300 | 800-1200 | 50-100 |
| Modulus psi @ 100% | 75-100 | 75-100 | 50-75 | 50-100 | — | fails |
| Ultimate elongation | 150-250 | 200-350 | 75-150 | 100-150 | 50 | 15 |
| Recovery % | 35-50 | 90-99 | 40 | 85-95 | 25 | 5 |

*Recommended only where initial economy requires it.

## Schedule II — Non Traffic Bearing Sealants

| PROPERTIES | Flexible Epoxy Crack Filler | Drying, Oil-Base Caulk | Non-Dry Polybutene Caulk or Tape | Non-Cure Polyisobutylene Bed. Compound | Curing Polyisobutylene or Butyl Sealant | 1 Part Nitrile or Butyl Seam Sealant | 1 Part Neoprene Sealant | 1 Part Hypalon Sealant | 1 Part Polyacrylic Sealant | 1 Part Polysulfide | 1 Part Silicone | 1 Part Polyether Polyurethane Sealant Shore A Less Than 25 | 2 Part Polyurethane Shore A 20-35 | 2 Part Urethane Shore A 40-60 | 2 Part Polysulfide Shore A Less Than 25 | 2 Part Polysulfide Shore A Greater Than 25 | 2 Part Polysulfide Epoxy Sealant | 2 Part Polysulfide Coal Tar Sealant | 2 Part Polyurethane Coal Tar Sealant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tack free time @ 75° F. 250°/R.H. | 2 hours | 1-3 hrs | Not Rec | Not Rec | 2-4 hrs | 10-20 Min. | 15-30 Min. | 12-48 hrs. | 2-8 hrs. | 12-48 hours | 2-4 hours | 12-24 hours | 8-24 hours | 8-24 hours | 6-12 hours | 4-12 hours | 2-8 hours | 1-4 hours | 12-24 hours |
| Cure time (days) ¼" x ¼" Channel | 3 | 120 | Not Rec | Not Rec | 120 | 7 | 30 | 180 | 30 | 60 | 5 | 30 | 3-6 | 3-4 | 4-7 | 4-7 | 3-7 | 3-4 | 7-10 |
| Tensile strength psi | 1200-1500 | 2-4 | 0-1 | 4-10 | 10-20 | 250-400 | 100-200 | 20-40 | 40-60 | 100-200 | 60-150 | 250-500 | 150-400 | 250-600 | 75-200 | 100-300 | 800-1200 | 60-125 | 100-300 |
| Elongation % | 15 | 5 | Not Rec | 20 | 25 | 75-125 | 20-40 | 15-50 | 25-60 | 150-200 | 100-200 | 300-450 | 250-600 | 200-350 | 200-350 | 150-250 | 40-50 | 75-150 | 100-150 |
| Modulus @ 100% Elongation | Not Rec | Not Rec | Not Rec | Not Rec | Not Rec | 200-300 | Not Rec | Not Rec | Not Rec | 75-100 | 40-80 | 30-80 | 50-100 | 100-150 | 40-100 | 75-100 | Not Rec | 50-75 | 50-75 |
| Shore "A" Initial | 75 | Not Rec | Not Rec | Not Rec | 10-18 | 40-60 | 50-65 | 12-25 | 20-40 | 30-45 | 25-35 | 30-50 | 20-35 | 40-60 | 15-24 | 25-55 | 65-80 | 35-50 | 40-60 |
| Recovery after 100% Elongation | 10 | Not Rec | Not Rec | Not Rec | 15 | 35 | 22 | 20 | 20 | 45 | 83 | 90 | 60-75 | 75-82 | 33-65 | 40-65 | 25 | 50 | 70 |
| Continuous Service Range Deg. F. | −30 +300 | −10 +180 | −60 +150 | −45 +210 | −25 +210 | −40 +268 | −25 +210 | −25 +225 | −15 +210 | −45 +250 | −90 +400 | −60 +275 | −60 +275 | −45 +275 | −60 +250 | −45 +265 | −20 +225 | −25 +210 | −30 +210 |
| Water Immersion Properties | Excell. | Very Poor | Poor | Fair | Fair | Good | Fair | Fair | Fair | Good | Good to Fair | Fair to Good | Very Good | Very Good | Good | Very Good | Good | Fair | Excell. |
| Primer Recommended Underwater | None | Not Rec | Not Rec | *R or M | *R or M | None | *R or M | *R or M | **V | *M or **V | ***S | *M or ***S | ***M or ***S | **M or ***S | **M or ***S | **M or ***S | None | *R or **M | **M or *R |
| Dilute Acid Resistance | Excell. | Fair | Good | Good | V. Good | V. Good | Good | Fair | Fair | V. Good | Good | Good | V. Good | V. Good | V. Good | Excell. | V. Good | Good | Excell. |
| Dilute Alkali Resistance | Excell. | V. Poor | V. Poor | V. Poor | Fair | Good | Fair | Good | Fair | Good | Fair | V. Good | Excell. | Excell. | Excell. | Excell. | Excell. | V. Good | Excell. |
| Solvent Resistance | Excell. | V. Poor Not Rec | V. Poor Not Rec | Poor Not Rec | Poor Not Rec | V. Good | Good | Fair Not Rec | Good | Excell. | Excell. | Excell. | Excell. | Excell. | Excell. | Excell. | Excell. | V. Good | V. Good |
| Fire Resistance | Good | Poor Not Rec | Poor Not Rec | Poor Not Rec | Poor Not Rec | Fair Not Rec | Good | V. Good | Fair Not Rec | Good | Excell. | V. Good | V. Good | V. Good | V. Good | V. Good | Fair Not Rec | Fair Not Rec | Excell |
| Electrical Insulation Properties | V. Good | Poor NR | Good | Good | V. Good | Good | Fair NR | Poor NR | Good | Good | V. Good | Excell. | Excell. | Excell. | V. Good | Excell. | V. Good | Good | Good |
| Aging Properties | V. Good | V. Poor NR | V. Good | Excell. | Good | Good | Fair NR | Good | V. Good | V. Good | Excell. | Excell. | Excell. | Excell. | Excell. | Excell. | V. Good | Good | Good |

*Chlorinated Rubber
**Moisture cured polyurethane
***Aminosilicone

## Schedule III — Average Life Expectancy (years) of Non Traffic Bearing Sealants

| Joint Size & Performance Conditions | Surface | Flexible Epoxy Crack Filler | Drying, Oil-Base Caulk | Non-Dry Polybutene Caulk or Tape | 1 Part Non-Cure Polyisobutylene bed Compound | Sealant 1 Part Curing Polyisobutylene Butyl | 1 Part Nitrile or Butyl Seam Sealant | 1 Part Neoprene Sealants | 1 Part Hypalon Sealant | 1 Part Polyacrylic Sealant | 1 Part Polysulfide | 1 Part Silicone | 1 Part Polyether Polyurethane Sealant Shore A Less Than 25 | 2 Part Polyurethane Shore A 20-35 | 2 Part Polysulfide Shore A Less Than 25 | 2 Part Polysulfide Coal Tar Sealant | 2 Part Polyurethane Coal Tar Sealant | 2 Part Silicone Sealant | 1 Part Vinylacrylic Cork Filled Sealant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hairline Cracks—to 1/8" Wide Joint Above Grade** | concrete | 11 | 0 (NR) | (NR) | (NR) | (NR) | 7 | 4 | (NR) | (NR) | (NR) | (NR) | (NR) | 5-P | (NR) | (NR) | (NR) | (NR) | (NR) |
| | wood | 9 | 1 (NR) | (NR) | (NR) | (NR) | 6 | 5 | (NR) | (NR) | (NR) | (NR) | (NR) | 8-P | (NR) | (NR) | (NR) | (NR) | (NR) |
| | metal | 10 | 0 (NR) | (NR) | (NR) | (NR) | 8 | 5 | (NR) | (NR) | (NR) | (NR) | (NR) | 4-P | (NR) | (NR) | (NR) | (NR) | (NR) |
| | glass | 10 | 0 (NR) | (NR) | (NR) | (NR) | 5 | 3 | 5 | 5 | 7 | 10 | (NR) | 2-P-S | (NR) | (NR) | (NR) | (NR) | (NR) |
| **From 1/8" to 1/4" Wide Above Grade** | concrete | 12 | (NR) | (NR) | B | 5 | 5 | 6 | 6 | 5 | 8-R | 7-M | 9-M | 10-M | 8 | (NR) | (NR) | 8 | 5 |
| | wood | 10 | 2 (NR) | (NR) | B | 4 | 6 | 5 | 7 | 7 | 8-M | 8-M | 10-M | 10 | 9 | (NR) | (NR) | (NR) | 4 |
| | metal | 12 | (NR) | B | 8 | 5 | 8 | 5 | 7 | 7 | 11 | 10-S | 8-S | 8-S | 10 | (NR) | (NR) | (NR) | 4 |
| | glass | 10 | 2 (NR) | B | B | 6 | 8 | 5 | 6 | 7 | 9 | 10-S | 8-S | 10-S | 9 | (NR) | (NR) | 10-S | 5 |
| **From 1/8" to 1/4" Wide Under Water** | concrete | 12 | (NR) | (NR) | B-M | 3 | 1 (NR) | 5-R | 5 | 5-V | 6-M | 5-M | 6-M | 9-M | 7-V | (NR) | (NR) | (NR) | (NR) |
| | wood | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) |
| | metal | (10) | (NR) | (NR) | B-M | 2 (NR) | 3 | 3-V | 4 | 4-V | 6-S | 6-S | 5-V | 4-S | 5 | (NR) | (NR) | (NR) | (NR) |
| | glass | 8 | (NR) | (NR) | B | 2 (NR) | 2 (NR) | 2-S (NR) | 3 | 4-S | 4-S | 7-S | 5-S | 5-S | 3-S | (NR) | (NR) | 8-S | (NR) |
| | plastic | (NR) | (NR) | (NR) | B | 3 | 5 | 5 | 4 | 5 | 2 (NR) | 6-S | 5-S | 6-S | 4-S | (NR) | (NR) | (NR) | 3 |
| **From 1/4" to 3/4" Wide Above Grade** | concrete | (NR) | (NR) | B-M | B | 5 | (NR) | 5 | 6 | 5 | 8-M | 7-M | 9-M | 8-M | 8-R | 7 | 8-M | (NR) | 4 |
| | wood | (NR) | 2 (NR) | B-M | B | 3 | 2 (NR) | 5 | 5 | 4 | 6-M | 8-M | 10-M | 10-M | 9-R | 8-M | 9-M | (NR) | 3 |
| | metal | (NR) | (NR) | B | B | 4 | 2 (NR) | 5 | 5 | 4 | 10 | 9-S | 7-S | 10 | 11 | 5-V | 7-S | (NR) | 5 |
| | glass | (NR) | 2 (NR) | B | B | 5 | 3 | 6 | 4 | 4 | 11 | 10-S | 9-S | 12-S | 12 | 6-S | 8-S | 12-S | 5 |
| | plastic | (NR) | (NR) | (NR) | B | 3 | 5 | 5 | 4 | 5 | 2-(NR) | 6-S | 5-S | 6-S | 4-S | (NR) | (NR) | 9-S | 3 |
| **From 1/4" to 3/4" Wide Under Water** | concrete | (NR) | (NR) | not to be used under polysulfides polyurethane silicone sealants | B-M | 2 (NR) | (NR) | 5-M | (NR) | (NR) | 7-M | 5-M | 6-M | 9-M | 6-V | 2-M (NR) | 6-M | (NR) | (NR) |
| | wood | (NR) | (NR) | | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) |
| | metal | (NR) | (NR) | | B-V | 1 (NR) | (NR) | 3-V | (NR) | (NR) | 6-S | 5-S | 5-V | 5-S | 7-S | (NR) | 4-V | 8-S | (NR) |
| | glass | (NR) | | | B-S | 2 (NR) | (NR) | 1-S (NR) | (NR) | (NR) | 1-V (NR) | 5-S | 5-S | 3-S | 2-S (NR) | (NR) | (NR) | 5-S | (NR) |
| | plastic | (NR) | (NR) | | B-V | 3 | (NR) | 5-V | (NR) | (NR) | 1-V (NR) | 5-S | 5-S | 3-S | 2-S (NR) | (NR) | (NR) | 5-S | (NR) |
| **From 3/4" to 1 1/2" Wide Above Grade** | concrete | (NR) | NR except for temporary use, & then on non-porous surfaces | | B | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 9-R | 7-R | 6 | 8 | (NR) | (NR) |
| | wood | (NR) | | | B | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 11-M | 7-R | 7 | 9 | (NR) | (NR) |
| | metal | (NR) | | | B | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 8 | 8 | 4 | 7 | 8-S | (NR) |
| | plastic | (NR) | | | B | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 3-S | 2-S (NR) | (NR) | (NR) | 5-S | (NR) |
| | glass | (NR) | | | B | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 12-S | 12 | 4-S | 4 | 12 | (NR) |
| **From 3/4" to 1 1/2" Wide Under Water** | concrete | (NR) | | | B-M | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 7-M | 6-M | (NR) | 6-M | (NR) | (NR) |
| | wood | (NR) | | | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 5-M | (NR) | (NR) | (NR) | (NR) | (NR) |
| | metal | (NR) | | | B-S & V | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 5-S | 6-V | (NR) | 4-V | 4-S | (NR) |
| | glass | (NR) | | | B-S | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 4-S | 3-S | (NR) | (NR) | 5-S | (NR) |
| | plastic | (NR) | | | B-S | (NR)* | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | (NR) | 2-S (NR) | 1-S (NR) | (NR) | (NR) | 4-S | (NR) |

*The Butyl sealant must be of the type that will not harden beyond a Shore A of 40

**Explanation of Numbers and Letters for Schedule II and III**

B = Backing or bedding filler only
(NR) = Not recommended for this use
P = Pourable (self-leveling) grade
M = Polyurethane primer
R = Chlorinated rubber primer
S = Aminosilicone primer
V = Vinyl or butyral solution primer

A three year life expectancy is the minimum requirement for recommendation.

Numbers indicate expected service in years.

A letter following a number indicates a primer must be used prior to application of compound or sealant.

We have attempted in Schedule II and II to detail the properties and recommended uses of these materials on areas not subject to traffic. Traffic bearing areas present other problems and requires higher standards which are detailed below and in Schedule I.

***Traffic Bearing Sealant***

Joints and seams on grade, in decks, horizontal joints, expansion joints, and in those areas subject to heavy traffic, present conditions which require sealant performance far in excess of sealants used in non-traffic bearing areas. Experience has shown that only by following the procedures listed below, will sealant performance live up to expectations:

(1) Joint design and construction shall conform to this formula:

| *Joint Width* | *Joint Depth* |
|---|---|
| to 1/2" | not greater than width |
| to 1" | not greater than 1/2" |

Joints subject to traffic are recommended not to exceed 1 inch in width.

(2) Oil and asphalt free back-up must be used.

(3) Selection of the primer suitable for the substrate, e.g.,
Concrete — polyurethane or chlorinated rubber
Metal, glass and plastic — amino-silicone
Wood — polyurethane, neoprene

(4) Only those sealants having the following properties can perform properly:

(a) Shore "A" hardness from 40-60.

(b) Full cure in 7 days.

(c) Modulus for elongation of 100 per cent, not less than 75 psi minimum, 100 psi maximum.

(d) Minimum recovery 50 per cent.

(e) Minimum elongation 15 per cent.

Sealants exhibiting properties other than the foregoing will fail.

It appears that for the heavy traffic bearing surfaces described above, the 2 part polyurethane prepolymer sealant exhibits the best performance potential of those polymers known to today's technology. A further recommendation for sealants for traffic bearing surfaces is that in selecting colors, emphasis be placed on pigments having reinforcing properties such as black, charcoal or dark grey, rather than colors which tend to downgrade the sealant performance such as white or tan.

The authors have determined during the seven years in which this study has been made that the following properties are essential in obtaining optimum performance from the sealant.

(1) *Joint Design* — There must be room enough to place enough sealant in order to elongate and recover properly within the limits of the sealant selected. There should be not less than 1/4 inch width by 1/4 inch depth. In joints to 1/2 inch x 1/2 inch the depth of the sealant shall be the same as the width. In joints greater than 1/2 inch wide and to 1 inch, the depth of the sealant shall be not greater than 1/2 inch. In joints greater than 1 inch wide, the depth of sealant shall be not greater than 50 per cent of the width.

(2) Where back-up or bedding materials are used, care must be taken that these materials be compatible with the sealant used. In the case of polysulfides, polyurethanes, silicones, etc., these must be free of oil, asphalt and the ingredients used in compounding such a material must be of a non-migrating nature and exhibit no cold flow. There has been much interest shown of late in recently marketed and proven, "gun type", *non-curing* bedding compounds which act as a second line of defense against moisture, should there be a failure in the sealant. These must be certified free of asphalt, oil, creosote, and migrating ingredients not compatible with sealants of polysulfide, polyurethane, silicone, ets., bases.

(3) Consult the manufacturer as to the type of joint substrate, then specify and detail the drawings as well as the specific primer recommended, if any, and have your job superintendent see it is applied.

(4) Sealants serve an extremely important function in a building. Specify the proper sealant for the purpose and use more than the type polymer or resin in its description. State the properties required in detail and always, when using a known standard for 2 part materials and for one part materials, make certain the standards used require the highest performance.

(5) Require of the manufacturer certified performance tests showing compliance to these standards.

(6) Use the sealant that will do the job. This is not necessarily the most expensive sealant. Consider the type of structure, joint size and then, using charts I, II, and III, proper selection for the use can be made. For purposes of simplicity, the following "rule of thumb" may be used: (Sealants recommended here have minimum life expectancy of 5 years). In joints greater than 1/4 inch x 1/4 inch, it is recommended that the 2 part materials be used, because the 1 part materials presently available take too long to cure in the larger joints.

For a detailed outline, consult the accompanying charts.


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