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## Adiprene® L 42

A liquid urethane elastomer

**ADIPRENE L 42** is a liquid urethane elastomer which yields high quality vulcanizates of 80 durometer A hardness when cured with MBCA\*. ADIPRENE L 42 products have good tear strength, good abrasion resistance, and excellent flex life. They are very flexible at low temperatures having a torsional modulus of 10,000 psi (703 kg./sq. cm.) at -80°F (-62°C), and a brittleness temperature of -130°F (-90°C). ADIPRENE L 42 has been found suitable for the preparation of rolls, solid tires, diaphragms, boots, and for other applications where good flex life is needed. It should also be considered for making seals, bushings, and mountings for use at very low temperatures. ADIPRENE L 42 resembles ADIPRENE L-100 in its processing and handling characteristics, and can be processed in the same type of automatic mixing equipment used to process ADIPRENE L-100.

### Prepolymer Specifications:

|                                  |  |
|----------------------------------|--|
| % NCO Content                    | 2.65-2.95                                    |
| Brookfield Viscosity, poise@30°C | 120-220                                      |
| Color, Gardner                   | 0-3  |
| Appearance @ 25°C                | Clear viscous liquid free from contamination |

\*Methylene-bis-(o-chloroaniline) a curing agent for urethane elastomers.

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The polymer properties which characterize ADIPRENE L 42 are shown in *Table I*. It is similar to ADIPRENE L-100 in viscosity, solubility and storage stability, but is slightly lower in isocyanate content and specific gravity. ADIPRENE L 42 polymer is soluble in a variety of common fluids, with the exception of aliphatic solvents. Those solvents which contain active hydrogen, such as alcohols and amines, should definitely be avoided because the isocyanate groups in the polymer react readily with them.

**Table I**  
**PROPERTIES OF ADIPRENE L 42 POLYMER<sup>1</sup>**

|                                     |   |
|-------------------------------------|---|
| NCO Content .....                   | 2.65-2.95%  |
| Viscosity,                          |   |
| at 84°F (29°C) .....                | 17,000 cps  |
| at 122°F (50°C) .....               | 4,850 cps   |
| at 158°F (70°C) .....               | 1,900 cps   |
| at 212°F ( 100°C) .....             | 675 cps   |
| Specific Gravity at 25°/4°C .....   | 1.03  |
| Color .....                         | Pale amber  |
| Odor .....                          | Faint, characteristic   |
| Solubility .....                    | Soluble in most common solvents such as toluene, ethyl acetate, methyl ethyl ketone, and trichloroethylene. Solubility is limited in aliphatic solvents. Soluble in alcohols but alcohols react with the isocyanate groups. |
| Raw polymer storage stability ..... | Excellent at room temperature in the absence of moisture.   |

<sup>1</sup> These data are presented to describe ADIPRENE L42, and are not intended to serve as specifications.

## VULCANIZATE PROPERTIES (MBCA CURES)

Typical physical properties of an ADIPRENE L 42 product cured with MBCA are shown in *Table II*. This product has good tensile and tear strength, good abrasion resistance, high resilience, excellent flex life and good low temperature properties. Polymer properties are sensitive to processing. The Processing suggestions should be followed closely.

### Properties at High Temperature and High Humidity

When ADIPRENE L 42 is tested at 212°F (100°C), tensile strength and elongation are lower than the values measured at 75°F (24°C) but modulus remain unchanged. (See *Table II*). Tear strength is also reduced, but not drastically. When ADIPRENE L 42 is conditioned at 75°F (24°C), 100% R.H., there is a slight drop in modulus, tensile strength, and tear strength, which is not believed to be significant in terms of service. This is a reversible effect and the original properties are restored when the test samples are reconditioned at 60% R.H.

### Low Temperature Properties

The excellent low temperature properties of ADIPRENE L 42 vulcanizates are shown in *Table III*. Torsional modulus changes very little between room temperature and -40°F (-40°C), and does not reach 10,000 psi. (703 kg./sq. cm.) until the temperature is reduced to -80°F (-62°C). Brittleness temperature (ASTM D746-57T) is -130° F (-90°C). ADIPRENE L 42 has only a slight tendency to crystallize at low temperature even when under compression. Good resistance to compression set is maintained even after 2 weeks exposure at 0°F (- 18°C). In addition, ADIPRENE L 42 combines high strength with high elongation when cooled to -70°F (-57°C).

### Flex Life

ADIPRENE L 42/MBCA vulcanizates have excellent flex life, as shown in *Table IV*. In the notched Ross test, no cut growth occurred during 69 hours of flexing at a rate of 100 cycles/minute. The more vigorous DeMattia test, run at 300 cycles/minute, caused failure in 24 hours using notched specimens, but unnotched samples ran for 100 hours (1,800,000 flexes) with only slight cracking occurring.



**Table II**  
**TYPICAL PROPERTIES OF**  
**ADIPRENE L 42/MBCA VULCANIZATES**

ADIPRENE L 42 ..... 100  
 MBCA .....8.8

Mixed at 212°F (100°C)  
 Cured 3 hours at 212°F (100°C)  
 Postcured 1 week at 75°F (24°C), 60% R. H.

Pot life at 212°F (100°C), minutes ..... 6-12  
 Demolding time at 212°F (100°C), minutes<sup>1</sup> ..... 45-60

| Test Conditions   | 75°F (24°C) | 212°F (100°C) | 75°F (24°C) |
|---|-------------|---------------|-------------|
|   | 60% R.H.    |               | 100% R.H.   |
| Hardness, durometer A .....   | 80          | 80            | 75          |
| 100% Modulus, psi (kg./sq. cm).....                                   | 400 (28)    | 400 (28)      | 375 (26)    |
| 300% Modulus, psi (kg./sq. cm).....                                   | 625 (44)    | 625 (44)      | 550 (39)    |
| Tensile strength, psi (kg. / sq. cm)...                               | 3000 (211)  | 1700 (120)    | 2600(183)   |
| Elongation at break, % .....  | 800         | 650           | 780         |
| Tear strength (ASTM D-470),<br>lb./ in (kg./cm.) .....                | 70(12.5)    | 30(5.3)       | 65(11.6)    |
| Compression Set, Method B, after<br>22 hours at 158°F (70°C), % ..... | 45          | —             | —           |
| NBS Abrasion Index, % .....   | 110         | —             | —           |
| Resilience, Yertzley, % .....   | 70          | —             | —           |
| Specific Gravity .....  | 1.075       | —             | —           |
| Volume increase, after 1 week at 122° F (50° C), %                    |             |               |             |
| in Toluene .....  | 175         | —             | —           |
| in MEK .....  | 500         | —             | —           |
| in ASTM Oil No. 3 .....   | 25          | —             | —           |
| in ASTM Ref. Fuel B .....   | 60          | —             | —           |

<sup>1</sup> Demolding time shown is for rectangular slabs, 75 mils (1.9 mm) thick.





|                                     |                  |
|-------------------------------------|------------------|
| DeMattia flex test, unnotched ..... | 100 <sup>2</sup> |
| DeMattia flex test, notched .....   | 24 <sup>3</sup>  |

<sup>1</sup>No cut growth.      <sup>2</sup>Slight cracking.      <sup>3</sup> Failure.

### Aging Resistance of ADIPRENE L 42 MBCA Vulcanizates

ADIPRENE L 42 products hold up well under accelerated aging conditions. Accelerated aging for one week at 212°F (100°C) appears to tighten the state of cure slightly, since modulus, tensile strength and tear strength all increase (*Table V*). Aging at 250°F (121°C) for one week reduces tensile strength but has little effect on modulus and tear strength. Resistance to hydrolysis in warm water is very good; physical properties remain essentially unchanged after 12 weeks immersion in water at 122°F (50°C). However, some degradation takes place on immersion in water at 212°F (100°C), so frequent contact with boiling water is not recommended.

ADIPRENE L 42 vulcanizates also exhibit excellent ozone resistance. Samples under 40% strain exposed to a concentration of 100 ppm ozone cracked slightly after 30-50 hours but did not fail until after more than 100 hours exposure. Samples under 20% strain, exposed to the same concentration, showed only slight cracking after 250 hours. At a concentration of 3 ppm ozone, no cracking occurred in 500 hours under either 20 or 40% strain.

**Table V**  
**AGING RESISTANCE OF ADIPRENE L 42/MBCA VULCANIZATES**

|                     |     |
|---------------------|-----|
| ADIPRENE L 42 ..... | 100 |
| MBCA .....          | 8.8 |

Mixed at 212°F (100°C)  
Cured 3 hours at 212°F (100°C)  
Postcured 1week at 75°F (24°C), 60% R. H.

|                       | <u>Dry Heat Aging<sup>1</sup></u> |                               |                               | <u>Water Immersion</u>         |                              |
|-----------------------|-----------------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------------|
|                       | <u>Original</u>                   | <u>1 week @ 212°F (100°C)</u> | <u>1 week @ 250°F (121°C)</u> | <u>16 hours @212°F (100°C)</u> | <u>12weeks @122°F (50°C)</u> |
| Hardness, durometer A | 80                                | 80                            | 78                            | 75                             | 78                           |



|   |           |           |           |           |           |
|---|-----------|-----------|-----------|-----------|-----------|
| 100% Modulus,<br>psi (kg./sq. cm.)                              | 400 (28)  | 500 (35)  | 500 (35)  | 300 (21)  | 450 (32)  |
| 300% Modulus,<br>psi (kg./sq. cm.)                              | 625 (44)  | 700 (49)  | 650 (46)  | 425 (30)  | 600 (42)  |
| Tensile strength,<br>psi (kg./sq. cm.)                          | 3000(211) | 3400(239) | 1700(120) | 2000(141) | 3100(218) |
| Elongation at break, %  | 800       | 920       | 1250      | 1200      | 850       |
| Tear strength, (ASTM D-470),<br>lb./in. (kg. / cm.)             | 70 (12.4) | 85 (15.1) | 80 (14.2) | 80 (14.2) | 67 (11.9) |
| Compression set, Method B, after 22 hours at<br>158°F (70°C), % | 45        | 40        | 35        | 70        | —         |

'All aging followed by reconditioning for one week are 75°F (24°C), 60% R.H.

### Effect of MBCA Concentration on Vulcanizate Properties

The best balance of vulcanizate properties is obtained with the theoretical quantity of MBCA, 8.8 parts. The data shown in *Table VI* indicate that some variation in compounding is useful for the improvement of specific properties, although improvement in one property is usually at the expense of one or more other properties. For instance, decreasing the amount of MBCA to 80-90% of the theoretical quantity affects an increase in modulus, resistance to compression set, and solvent resistance. However, tear strength, abrasion resistance, and flex life decrease. An increase in the amount of MBCA to 110% of theoretical increases abrasion resistance, tear strength and flex life, but causes a significant decrease in tensile strength, solvent resistance and resistance to compression set.

Some improvement in heat resistance results from an increase in MBCA concentration to 110% of theoretical. Heat resistance decreases slightly as MBCA concentration is reduced below 100% of theoretical. Tensile properties at 212°F (100°C) are also dependent to a slight extent on the amount of MBCA, with the best properties occurring at 8.8 phr of MBCA (100% of theoretical). Hot tear strength improves rapidly with increasing MBCA concentration and is best at 110% of theoretical. Resistance to hot water is nearly independent of the amount of MBCA used. Heat buildup under dynamic testing conditions decreases with decreasing MBCA concentration. Best overall performance in the Goodrich Flexometer is obtained with 7.9 phr of MBCA (90% of theoretical).



### Effect of Cure Conditions on Properties

The cure cycle generally recommended for ADIPRENE L 42/MBCA compounds is three hours at 212°F (100°C). However, other cure cycles may be preferred in special circumstances.

The effect of variations in cure temperature on product properties is shown in Table VII. Approximately the same vulcanizate properties are obtained at cure temperatures of 158°F (70°C) and 212°F (100°C), but as the cure temperature is increased to 285°F (141°C), the vulcanizate becomes softer. The properties resulting from the high cure temperature are characteristic of the molecular structure obtained at that temperature; longer cure times at 285°F (141°C) will not cause increases in hardness and modulus beyond the values shown. Because of this temperature sensitivity, the use of high-temperature curing as a means of reducing hardness should be approached with caution. It is often difficult to control the temperature throughout the body of a large casting, so variations in hardness may result. Hardness reduction is more easily accomplished by changes in the curing system, as discussed in the section entitled "Miscellaneous Compounds." The data shown throughout this bulletin were determined after the indicated heat cure followed by a one week after cure at 75°F (24°C), 60% R.H. Where it is necessary to place parts in service immediately, an overnight postcure at 160-212°F (71-100°C) is suggested.

**Table VI**  
**EFFECT OF MBCA CONCENTRATION ON VULCANIZATE PROPERTIES**

|   |            |            |            |            |
|---|------------|------------|------------|------------|
| ADIPRENE L 42 .....   | 100        | 100        | 100        | 100        |
| MBCA.....   | 7.0        | 7.9        | 8.8        | 9.7        |
| % of theoretical MBCA concentration   | 80         | 90         | 100        | 110        |
| Mixed at 212°F (100°C)<br>Cured 3 hours at 212°F (100°C)<br>Postcured 1 week at 75°F (24°C), 60% R.H. |            |            |            |            |
| Hardness, durometer A .....   | 78         | 80         | 80         | 76         |
| 100% Modulus, psi. (kg./sq. cm.).....   | 550 (39)   | 475 (33)   | 400 (28)   | 350 (25)   |
| 300% Modulus, psi. (kg./sq. cm.).....   | 900 (63)   | 800 (56)   | 625 (44)   | 550 (39)   |
| Tensile strength, psi. (kg./sq. cm.).....   | 3000 (211) | 3100 (218) | 3000 (211) | 1900 (134) |
| Elongation at break, % .....  | 500        | 625        | 800        | 1150       |
| Tear strength (ASTM D-470),<br>lb./in. (kg. cm.)  |            |            |            |            |
| at 75°F (24°C).....   | 20 (3.6)   | 25 (4.4)   | 70 (12)    | 80 (14.4)  |
| at 212°F (100°C).....   | 7 (1.2)    | 9 (1.6)    | 30 (5.3)   | 70 (12)    |
| NBS Abrasion Index, %.....  | 35         | 70         | 110        | 120        |
| Compression set, Method B, after<br>22 hours at 158°F (70°C), %.....                                  | 20         | 25         | 45         | 55         |
| Volume increase, %, after 1 week at 122°F (50°C)<br>in Toluene.....                                   | 150        | 155        | 175        | 220        |





|  |            |            |            |                     |         |
|--|------------|------------|------------|---------------------|---------|
| in MEK .....                             | 300        | 350        | 500        | 2000+               |         |
| in ASTM Oil No. 3.....                   | 24         | 24         | 25         | 27                  |         |
| in ASTM Reference Fuel B .....           | 60         | 60         | 60         | 70                  |         |
| Torsional modulus, psi (kg./sq. cm.),    |            |            |            |                     |         |
| at -40°F (-40°C) .....                   | 1500 (106) | 1600 (113) | 1750 (123) | 2100 (148)          |         |
| at -70°F (-57°C) .....                   | 6500 (457) | 7000 (492) | 7500 (527) | 9500 (664)          |         |
| Flex Life                                |            |            |            |                     |         |
| Ross Flex, notched', hours to failure .  | —          | 69+        | 69+        | 69+                 |         |
| cut growth, inches (cm) .....            | —          | 0          | 0          | 0                   |         |
| DeMattia Flex, notched', hrs to failure  |            | —          | 50 flexes  | 24 85+ <sup>2</sup> |         |
| unnotched .....                          | —          | —          | 100+       | 100+                |         |
| Heat buildup, Goodrich Flexometer        |            |            |            |                     |         |
| Initial deflection, mils (mm) .....      | 145 (3.7)  | 175 (4.4)  | 150 (3.8)  | 138 (3.5)           |         |
| Minimum deflection, mils (mm).....       | 38 (.96)   | 41 (1.04)  | 75 (1.9)   | 77 (1.95)           |         |
| Time, minutes .....                      | 9          | 11         | 3          | 2                   |         |
| Final deflection, mils (mm).....         | 94 (2.4)   | 46 (1.17)  | 310 (7.9)  | 450 (11.4)          |         |
| Time, minutes .....                      | 20         | 20         | 14         | 9                   |         |
| Change in compression, mils (mm) ...     | 56 (1.4)   | 5 (.13)    | 265 (6.7)  | 373 (9.5)           |         |
| Final surface temperature rise, °F (°C)  |            | 63 (35)    | 51 (281)   | 70 (39)             | 72 (40) |
| Final internal temperature, °F (°C)..... | 259 (126)  | 236 (113)  | -3         | -3                  |         |

<sup>1</sup> Original cut 0.1 in. (2.54 mm).  
<sup>2</sup> Cut width 0.25 in. (6.25 mm); test stopped before failure.  
<sup>3</sup> Test terminated-stock collapsing.

**Table VII**

**EFFECT OF CURE TEMPERATURE ON  
 PROPERTIES OF ADIPRENE L 42 VULCANIZATES**

|                     |          |
|---------------------|----------|
| ADIPRENE L 42 ..... | 100      |
| MBCA .....          | 8.8      |
| Adipic Acid .....   | As Shown |

Mixed at 212°F (100°C)

Cured as shown.

Postcured 1 week at 75°F (24°C), 60% R.H.

| Cure Time' at Cure Temperature | <u>No Catalyst</u>                    |  | <u>0.15 phr Adipic Acid</u>          |                                      |
|--------------------------------|---------------------------------------|--|--------------------------------------|--------------------------------------|
|                                | <u>6 hours</u><br><u>158°F (70°C)</u> | <u>3 hours</u><br><u>212°F (100°C)</u> | <u>60 min</u><br><u>158°F (70°C)</u> | <u>15 min.</u><br><u>212°F 100°C</u> |
| Pot life, minutes              | 25                                    | 10                                     | 6                                    | 3                                    |
| Demolding time                 |                                       |  |                                      |                                      |



|  |            |            |            |            |
|--|------------|------------|------------|------------|
| @cure temperature, minutes <sup>2</sup>                          | 60         | 45         | 9          | 5          |
| Hardness, durometer A  | 82         | 80         | 82         | 80         |
| 100% Modulus, psi (kg./sq. cm.)                                  | 425 (30)   | 400 (28)   | 500 (35)   | 450 (32)   |
| 300% Modulus, psi (kg./sq. cm.)                                  | 625 (44)   | 625 (44)   | 700 (49)   | 650 (46)   |
| Tensile strength, psi (kg./sq. cm.)                              | 2800 (197) | 3000 (211) | 3000 (211) | 3400 (239) |
| Elongation at break, %   | 900        | 800        | 970        | 900        |
| Tear strength (ASTM D-470),<br>lb. / in. (kg. / cm.)             | 78 (13.9)  | 70 (12.5)  | 90 (16)    | 79 (14)    |
| Compression set (Method B),<br>after 22 hours at 158°F (70°C), % | 48         | 45         | 42         | 56         |

<sup>1</sup> Cure times shown are the minimum required to achieve the indicated properties. Negligible improvement results from longer cures.

<sup>2</sup> Demolding times shown are for rectangular slabs, 75 mils (1.9 mm) thick.

**Table VIII**  
**ADIPIC ACID CATALYSIS OF THE**  
**ADIPRENE L 42/MBCA REACTION**

|                     |          |
|---------------------|----------|
| ADIPRENE L 42 ..... | 100      |
| MBCA .....          | 8.8      |
| Adipic Acid .....   | As Shown |

Mixed at 212°F (100°C)  
Cured 3 hours at 212°F (100°C)  
Postcured 1 week at 75°F (24°C), 60% R. H.

| <b>Adipic acid added, phr</b>                        | <b>0</b> | <b>0.02</b> | <b>0.05</b> | <b>0.15</b> |
|--|----------|-------------|-------------|-------------|
| Pot life at 212°F (100°C), minutes                   | 12       | 8           | 7           | 3           |
| Demolding time<br>@ 212°F (100°C), min. <sup>1</sup> | 45       | 25          | 17          | 5           |
| Hardness, durometer A                                | 80       | 81          | 81          | 81          |
| 100% Modulus, psi (kg./sq. cm.)                      | 400 (28) | 475 (33)    | 475 (33)    | 500 (35)    |
| 300% Modulus, psi (kg./sq. cm.)                      | 625 (44) | 750 (53)    | 775 (55)    | 750 (53)    |



|  |            |            |            |            |
|--|------------|------------|------------|------------|
| Tensile strength, psi (kg./sq. cm.)                              | 3000 (211) | 3100 (218) | 3150 (222) | 3000 (211) |
| Elongation at break, %   | 800        | 800        | 760        | 750        |
| Tear strength (ASTM D-470),<br>lb./in. (kg. / cm.)               | 70 (12.5)  | 75 (13.4)  | 85 (15.1)  | 75 (13.4)  |
| Compression set (Method B),<br>after 22 hours at 158°F (70°C), % | 45         | 40         | 37         | 45         |

<sup>1</sup>Demolding times shown are for rectangular slabs, 75 mils (1.9 mm) thick.

### Catalysis of the ADIPRENE L 42 MBCA Reaction

In certain applications it may be desirable to reduce the demolding time and increase the cure rate of ADIPRENE L 42 compounds. This can be accomplished by catalyzing the curing reaction with small amounts of adipic acid. As shown in *Table VII*, addition of 0.15 phr adipic acid to the compound reduces demolding time at 212°F (100°C) to about 5 minutes and produces a high state of cure in thin slabs with a cure time of only 15 minutes at 212°F (100°C). A corresponding reduction in demolding time and cure time is also possible at 158°F (70°C) and 285°F (141°C). Properties of the resulting vulcanizate are comparable to those of an uncatalyzed compound which has been given a much longer heat cure.

The effect of adipic acid concentration on processing characteristics and vulcanizate properties of compounds mixed and cured at 212°F (100°C) is shown in *Table VIII*. Note that pot life of the mixed compounds is also reduced by the addition of adipic acid.

NOTE: If adipic acid is used, it should be added to the molten MBCA before the MBCA is mixed with ADIPRENE L 42. The adipic acid/MBCA mixture is stable for 2 to 3 days at 250°F (121°C), but the catalytic activity decreases slowly after that time. However, vulcanizate properties were unaffected by the use of an adipic acid/MBCA mixture which had been stored for one week at 250°F (121°C).

### Miscellaneous Compounds

Three variations of the basic ADIPRENE L 42/MBCA compound – two softer and one harder than 80 durometer A – are shown in *Table IX*.

*Compound W* is a 50-50 blend of ADIPRENE L 42 and ADIPRENE L-100. The resulting compound has a hardness of 85 durometer A and good overall properties.

*Compound Y* illustrates the hardness reduction which can be obtained by the addition of small quantities of plasticizers such as dioctyl phthalate. Some loss of tear strength results, with only slight changes in the other properties tested. At a concentration of 40 phr, dioctyl phthalate reduces the hardness of this compound to 68 durometer A; there is a slight additional decrease in modulus, but no significant drop in the other properties tested.



### MBCA/Quadrol Cures for Softer ADIPRENE Vulcanizates

Certain end-product applications require ADIPRENE L 42 vulcanizates softer than 80 durometer A. The MBCA/Quadrol curing system is a convenient means of achieving the desired hardness reduction. In order to obtain consistent hardness and physical properties with a mixed curative system such as this, it is necessary to maintain close control on all process variables, especially temperatures. Some loss of abrasion resistance, tear strength and flex life occurs, but these physical properties can then be significantly improved (more than 100%) by heat treating the finished part for 70 hours at 250°F (121°C) with little effect on hardness and modulus. (*Table X*).

**Table IX**  
**MISCELLANEOUS COMPOUNDS OF ADIPRENE L 42**

|  | <u>Standard</u> | <u>W</u>   | <u>Y</u>   |
|--|-----------------|------------|------------|
| ADIPRENE L 42 .....  | 100             | 50         | 100        |
| ADIPRENE L-100 .....   | —               | 50         | —          |
| MBCA .....   | 8.8             | 10.7       | 8.8        |
| Diocetyl phthalate .....   | —               | —          | 15         |
| Mixed at 212°F (100°C)<br>Cured 3 hours at 212°F (100°C)<br>Postcured 1 week at 75°F (24°C), 60% R. H. |                 |            |            |
| Hardness, durometer A .....  | 80              | 85         | 73         |
| 100% Modulus, psi (kg./sq. cm.) .....  | 400 (28)        | 725 (51)   | 350 (25)   |
| 300% Modulus, psi (kg./sq. cm.) .....  | 625 (44)        | 1250 (88)  | 500 (35)   |
| Tensile strength, psi (kg./sq. cm.) .....  | 3000 (211)      | 3650 (257) | 2500 (176) |
| Elongation at break, % .....   | 800             | 550        | 1000       |
| Tear strength, (ASTM D-470),<br>lb./in. (kg./cm.) .....  | 70 (12.5)       | 75 (13.4)  | 55 (9.8)   |
| NBS Abrasion Index, % .....  | 110             | 125        | 120        |
| Compression set (Method B),<br>after 22 hours at 158° F (70°C), % ....                                 | 45              | 30         | 45         |



|                              |     |     |     |
|------------------------------|-----|-----|-----|
| Resilience, Yerzley, % ..... | 70  | 65  | 68  |
| Flex life, Ross, hours ..... | 69+ | 0.5 | 69+ |

**Table X**  
**LOW DUROMETER ADIPRENE COMPOUNDS**

|                            |      |      |
|----------------------------|------|------|
| ADIPRENE L 42 .....        | 100  | 100  |
| MBCA .....                 | 7.45 | 7.00 |
| Quadrol <sup>1</sup> ..... | 0.75 | 1.00 |

All compounds mixed at 212°F (100°C)  
 Cured 3 hours at 212°F (100°C)  
 Postcured 16 hours at 158°F (70°C)  
 Specimens were tested 7 days after completion of postcure.

**Original Physical Properties**

|   |            |            |
|---|------------|------------|
| 100% Modulus, psi (kg./sq. cm.) .....                                   | 350 (25)   | 300 (21)   |
| 300% Modulus, psi (kg./sq. cm.) .....                                   | 600 (42)   | 525 (37)   |
| Tensile strength, psi (kg./sq. cm.).....                                | 2125 (149) | 1600 (113) |
| Elongation at break, % .....  | 575        | 540        |
| Hardness, durometer A.....  | 70         | 62         |
| Compression set, (Method B),<br>after 22 hours at 158°F (70°C), % ..... | 33         | 32         |
| NBS Abrasion Index, % .....   | 31         | 27         |
| Tear strength (ASTM D-470),<br>lb./in. (kg./cm.) .....                  | 26 (4.6)   | 20 (3.6)   |

**After Oven Aging 70 hours at 250° F (121° C)**

|   |         |        |
|---|---------|--------|
| 100% Modulus, psi (kg./sq. cm.).....                                    | 375     | 325    |
| 300% Modulus, psi (kg./ sq. cm.).....                                   | 550     | 500    |
| Tensile strength, psi (kg./sq. cm.).....                                | 3000    | 2650   |
| Elongation at break, % .....  | 825     | 785    |
| Hardness, durometer A.....  | 68      | 63     |
| Compression set, (Method B),<br>after 22 hours at 158°F (70°C), % ..... | 32      | 31     |
| NBS Abrasion Index, % .....   | 97      | 80     |
| Tear strength (ASTM D-470),<br>lb./in. (kg./cm.) .....                  | 57 (10) | 50 (9) |

<sup>1</sup>Wyandotte Chemicals Corp.

## PROCESSING

### Handling Characteristics

ADIPRENE L 42 contains reactive isocyanate groups and will therefore react with atmospheric moisture. Storage containers should be flushed with dry gas, preferably nitrogen, after each opening, unless the contents are used completely within a day or so. Five gallon and 55 gallon drums should be protected with desiccant to dry the air which replaces the ADIPRENE L 42. Anhydrous calcium sulfate is a satisfactory desiccant.

ADIPRENE L 42 tends to freeze slowly when stored at 75°F (24°C) or below. It is unharmed by freezing, and may be thawed by storing overnight at 125°F (52°C). After thawing, the liquid should be thoroughly mixed before it used.

### Laboratory Processing

For laboratory processing, ADIPRENE L 42 is heated to 212°F (100°C) in a non-porous, non-hygroscopic container such as a glass beaker, glass flask, or tin can. After being degassed under vacuum, it is mixed well with melted MBCA, care being taken to avoid the inclusion of air. The mixed compound is poured into preheated molds and oven cured for three hours at 212°F (100°C).

The time of gelatin of ADIPRENE L 42/MBCA mixtures varies according to the degree of agitation used. If left undisturbed after the MBCA is mixed in, the compound gels in 6 to 7 minutes at 212°F (100°C). If the mixture is agitated continuously following addition of MBCA, the liquid stage can be extended to 12 to 13 minutes, although the mixture becomes increasingly viscous during this time.

### Machine Processing

ADIPRENE L 42 has been processed satisfactorily in a commercially available automatic mixing machine of the type used to process ADIPRENE L-100. Two precautions should be noted:

1. ADIPRENE L 42 appears to be slightly more sensitive to MBCA variations than ADIPRENE L-100, so that very accurate metering is required to ensure the production of quality parts.
2. Initial studies of prepolymer stability during machine operation show that the product is stable for one shift (8 hours) at 212°F (100°C), but longer storage times should be avoided to ensure best results.

## CALCULATION OF AMOUNT OF CURING AGENT

The amount of amine or polyol to be used in curing ADIPRENE L 42 (or any liquid urethane prepolymer) can be calculated from the general formula:

Parts curing agent per 100 parts polymer =

$$\% \text{ NCO of polymer} \times \frac{\text{equivalent weight of curing agent}}{\text{equivalent weight of NCO}} \times \frac{\text{desired \% of theory}}{100}$$

For MBCA, this formula reduces to:  
parts MBCA per 100 parts polymer

$$= \% \text{ NCO} \times \frac{133.5}{42.02} \times \frac{\% \text{ theory}}{100}$$

$$= \frac{\% \text{ NCO} \times 3.18 \times \% \text{ theory}}{100}$$

For 1,4-butanediol, the formula reduces to:  
parts 1,4-butanediol per 100 parts polymer

$$= \% \text{ NCO} \times \frac{45}{42.02} \times \frac{\% \text{ theory}}{100}$$

$$= \frac{\% \text{ NCO} \times 1.07 \times \% \text{ theory}}{100}$$

For CAYTUR 21, the formula reduces to:

$$= \frac{\% \text{ NCO} \times 5.17 \times \% \text{ theory}}{100}$$

$$= \% \text{ NCO} \times \frac{217}{42.02} \times \frac{\% \text{ theory}}{100}$$

### EXAMPLES:

If % NCO of polymer = 2.80, and % theory  
= 95 parts MBCA per 100 parts polymer

$$= \frac{2.80 \times 3.18 \times 95}{100} = 8.46$$

parts CAYTUR 21 per 100 parts polymer

$$= \frac{2.80 \times 5.17 \times 95}{100} = 13.7$$

parts 1,4-butanediol per 100 parts polymer

$$= \frac{2.80 \times 1.07 \times 95}{100} = 2.85$$



### USA SOURCES OF MBCA

MVR Corporation  
152 Madison Avenue  
New York, NY 10016  
Phone: (212) 689-4330

American Cyanamid Corp.  
Bound Brook, NJ 08805  
Phone: (201) 560-2000

Polyester Corporation  
P.O. Drawer BBBB  
Southampton, NY 11968  
Phone: (516) 283-4400

Anderson Development Co.  
1415 East Michigan Street  
Adrian, MI 49221  
Phone: (517) 263-2121

\*(Test temperature is 75°F (24°C) except where specified otherwise)

**Test:**

**Method:**

|                                   |  |
|-----------------------------------|--|
| Abrasion Resistance, NBS          | ASTM D1630, National Bureau of Standards Abrader         |
| Brittleness Temperature, Solenoid | ASTM D746  |
| Compression Set                   | ASTM D395, Method B (Type I pellets, 25% deflection)     |
| Compression Modulus               | ASTM D695  |
| Electrical Properties             |  |
| Dielectric Constant               | ASTM D150  |
| Dielectric Strength               | ASTM D149  |
| Power Factor                      | ASTM D150  |
| Volume Resistivity                | ASTM D257  |
| Flex Life                         | ASTM D1052   |
| Hardness, Durometer A or D        | ASTM D2240   |
| Ozone Resistance:                 |  |
| Bent Loop                         | ASTM D 1149  |
| Static Exposure, 20% strain       | ASTM D 1149  |
| Peel Adhesion                     | ASTM D429, Method B,<br>pulled at 0.85 mm/ s (2 in/ min) |
| Resilience, Rebound               | ASTM D2632   |





Stress-Strain Properties

100% and 300% Modulus  
Tensile Strength  
Elongation at Break

} ASTM D412, pulled at 8.5 mm/ s (20 in/ min)

|                                  |  |
|----------------------------------|--|
| Shrinkage, Linear                | Accurate measurement of a 254 mm x 12.7 mm x 12.7 mm (10 in x 0.5 in x 0.5 in) bar after heat cure |
| Specific Gravity                 | ASTM D792  |
| Tear Strength, Split             | ASTM D470  |
| Graves                           | ASTM D624, Die   |
| Torsional Modulus, Clash-Berg    | ASTM D1043   |
| Viscosity                        | Brookfield   |
| Volume Change In Fluids          | ASTM D471  |
| Water Absorption (Weight Change) | ASTM D471  |
| Young's Modulus                  | ASTM D797  |

Proprietary compounding ingredients, solvents and equipment used with Adiprene prepolymers are identified below. The materials cited were those used in our work to obtain the reported results. This list is not exhaustive, nor is it intended to infer an endorsement of these manufacturers over any other who supply comparable products. For further information, request our TelTech "suppliers of urethane components and equipment."



| PRODUCT NAME | COMPOSITION | SUPPLIER |
|--------------|-------------|----------|
|--------------|-------------|----------|




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|  |   |   |
|--|---|---|
| <p>ADIPRENE® urethane rubber, L types</p>                    | <p>Reaction products of an aromatic diisocyanate and polyalkylene ether glycol.</p>                                   | <p>UNIROYAL CHEMICAL<br/>Chemical Group<br/>World Headquarters<br/>Middlebury, CT 06749</p> |
| <p>CAYTUR® 21</p>  | <p>Approximately 50% (by weight) dispersion of methylene dianiline/ sodium chloride complex in dioctyl phthalate.</p> |   |
| <p>BENZOFLEX* 9-88 plasticizer</p>                           | <p>Dibenzoate ester of dipropylene glycol or polyethylene glycol.</p>   | <p>Velsicol Chemical Co.<br/>341 E. Ohio Street<br/>Chicago, IL 60611</p>                   |
| <p>Binks spray gun with Formulation "C" metering control</p> |   | <p>Binks Manufacturing Co.<br/>9205 W. Belmont Ave.<br/>Franklin Park, IL 60131</p>         |
| <p>CELLOSOLVE* Acetate solvent</p>                           | <p>Ethylene glycol monoethyl ether acetate</p>  | <p>Union Carbide Corp.<br/>270 Park Avenue<br/>New York, NY 10017</p>                       |
| <p>CHEMLOCK* 318 and 319</p>                                 |   |   |



\*Reg. U.S. Pat. & Tm. Off.