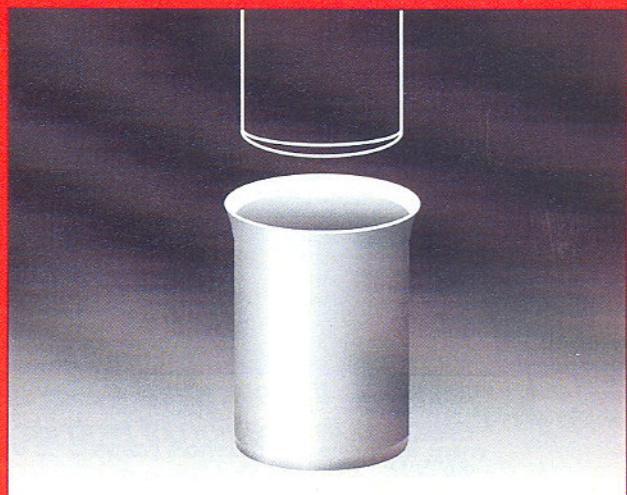
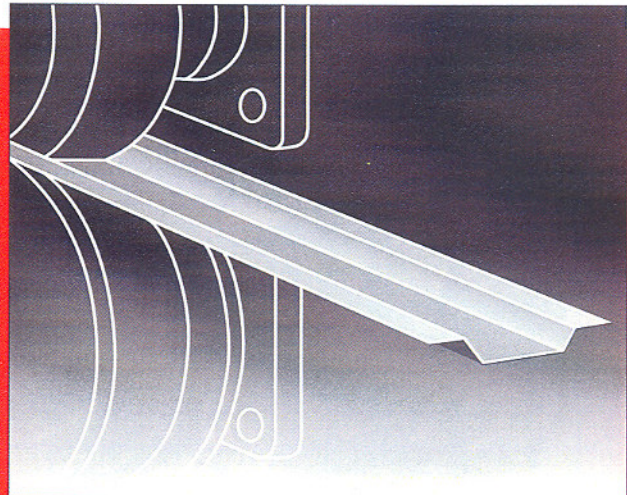
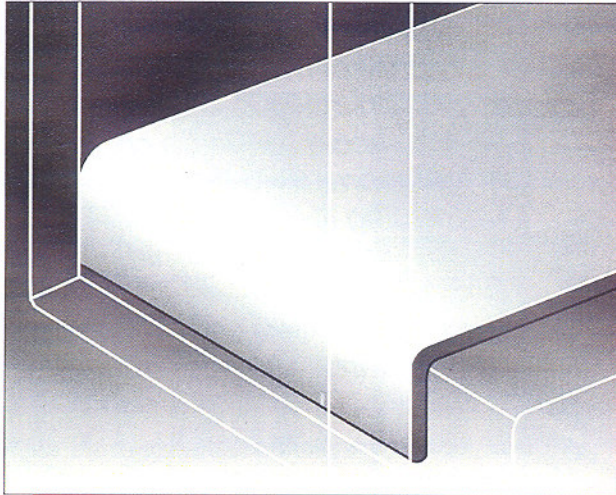


KAISER ALUMINUM HI-FORM™ SHEET



*FOR DIFFICULT FORMING APPLICATIONS
(2XXX, 6XXX, 7XXX ALLOYS)*

KAISER
ALUMINUM
TRENTWOOD WORKS

AEROSPACE PRODUCTS

Kaiser Aluminum supplies Hi-Form™ 2XXX, 6XXX, 7XXX sheet and coil products for applications that involve difficult forming operations. Hi-Form sheet not only has superior bending, stretching and drawing characteristics, but its inherent fine grain structure (Figure 1) also results in smoother surface finishes.

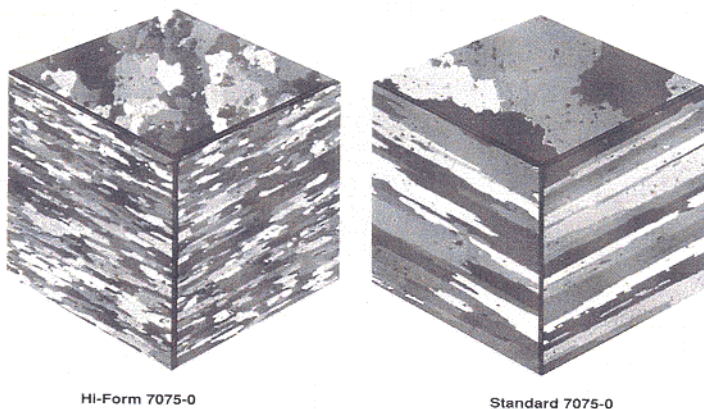


Figure 1. Hi-Form sheet's inherent fine grain structure results in smoother surface finishes.

Example components, formed in 2024-W sheet, are shown in the photograph below (Figure 2). Hi-Form sheet made an excellent test part, whereas the standard material cracked in a region of high localized strain.

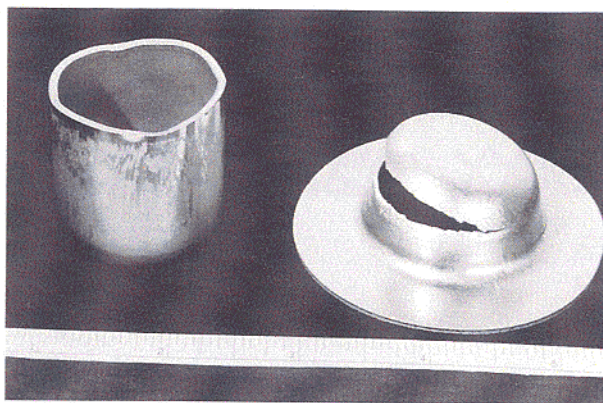


Figure 2. In a limiting draw ratio test, 2024-O Hi-Form sheet was capable of being drawn from a 73 mm diameter blank, whereas the standard O temper sheet failed under the same conditions.

A DECADE OF PROVEN APPLICATIONS

The attributes of Kaiser Aluminum's Hi-Form sheet have been proven over a 10-year production history of making parts like the one shown in Figure 2. However, we have also accumulated a considerable store of laboratory data based on simulative forming tests. The charts in Figure 3, for example, demonstrate that Hi-Form 2024-O and 7075-O sheets are more ductile and isotropic than the standard O temper materials.

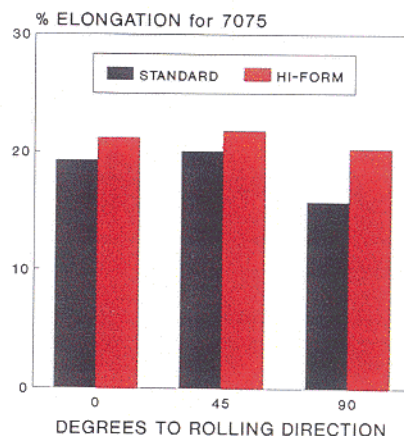
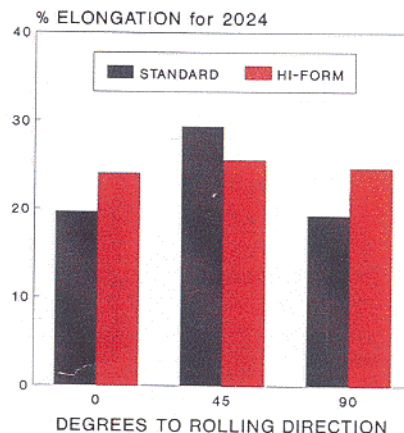


Figure 3. Tensile Elongation vs. Test Direction for Hi-Form and Standard 2024-O and 7075-O Sheet.

Hi-Form sheet also has better bending characteristics, as shown in the following photographs (Figure 4). These magnified views (2.48X) demonstrate much smoother surfaces and less surface tearing in the Hi-Form materials.

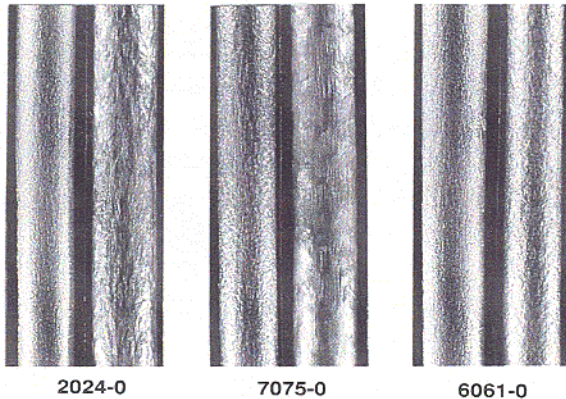


Figure 4. O_t Radius Bends in 0.063 in. O Temper Sheet. (Hi-Form on the left in each example; standard sheet on the right.)

THE FORMABILITY ADVANTAGE

In addition to forming in the stable O temper, many parts are fabricated from solution heat-treated and quenched (W temper) sheet. This processing sequence eliminates warping and distortion associated with heat treating a formed part. However, solution heat-treated and quenched sheet becomes harder and more difficult to form as it naturally ages. Standard practices, therefore, often call for refrigeration or minimizing the time delay after solution heat treating. Figure 5 shows that Hi-Form 2024-W and 7075-W not only have superior stretchability as measured by the Olsen cup test, but they are also less sensitive to natural aging effects.

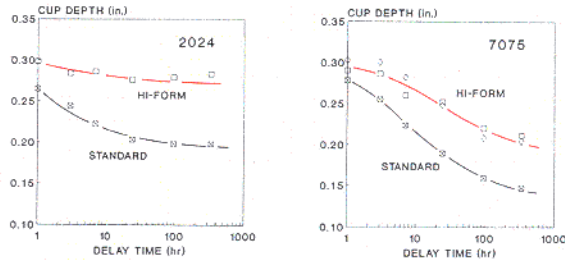


Figure 5. Olsen Cup Depth vs. Delay Time after Solution Heat Treatment for Hi-Form and Standard W Temper Sheet.

These benefits extend the allowable forming time and minimize the need for refrigeration prior to forming. As Figure 6 shows, parts made from Hi-Form sheet also have a much better surface appearance.

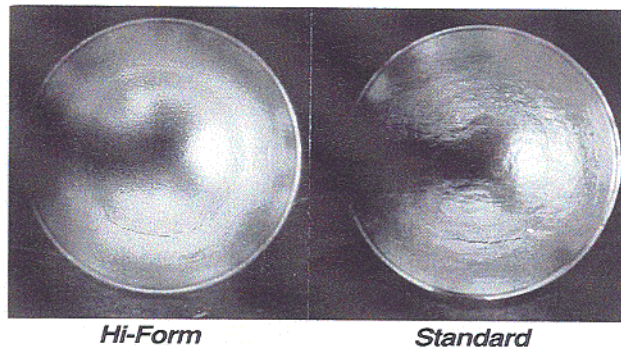


Figure 6. Stretch Formed Olsen Cups from Hi-Form and Standard 7075-W Sheet (1.38X).

SIMILAR MECHANICAL PROPERTIES

The mechanical properties of Hi-Form O and W temper sheet after heat treating to the T temper are generally the same as those of standard sheet processed in the same manner. Figure 7 on next page, for example, shows equal fatigue crack growth rates for 7075-T6 in which the starting materials were Hi-Form and standard O temper sheet.

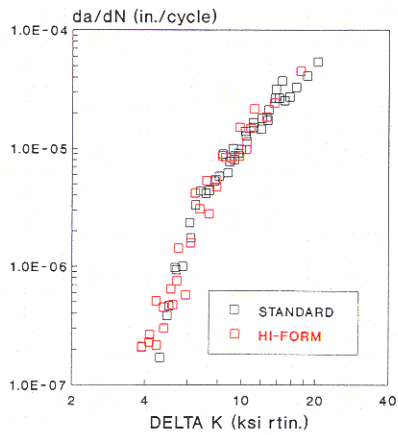


Figure 7. *da/dN vs. Delta K Curves for Hi-Form (fine grain) and Standard (coarse grain) 7075-T6 Sheet.*

One note of caution should be recognized when O temper sheet is formed and subsequently heat treated. If the heating rate is fast, as in a salt bath or a preheated air furnace, the material can develop coarse recrystallized grains in regions of critical cold work. For 2024 alloy, the critical strain is about 10%; and as Figure 8 shows, the strength decreases at this point, but remains above the T42 specification minimum. Similarly, 6061 and 7075 recrystallize at about 5% and 20% cold work, respectively, but strengths remain

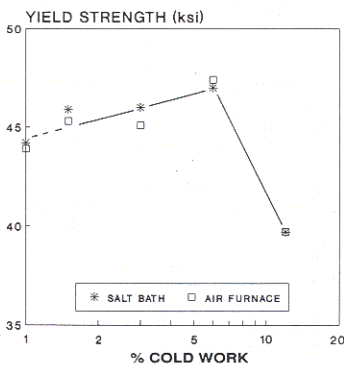
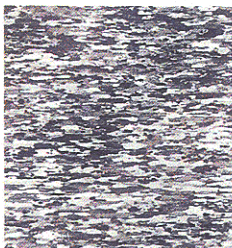
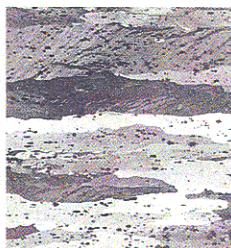


Figure 8. *Effect of Cold Work before Solution Heat Treating on the Strength and Grain Structure of 2024-T42 Hi-Form Sheet.*



0%



12%

above T62 minimums. This recrystallization effect can be minimized if the formed parts are annealed prior to solution heat treating.

TOP-QUALITY AEROSPACE PRODUCTS

Kaiser Aluminum's top-quality aerospace products are available worldwide directly from the mill and through a select network of distributors and agents. Specially trained representatives are available to serve your needs. Ask us about the advantages Kaiser's Hi-Form sheet may offer for your application.

For more information, fax 509-927-6309 or call 509-9276542 (800-326-2586 in the US).

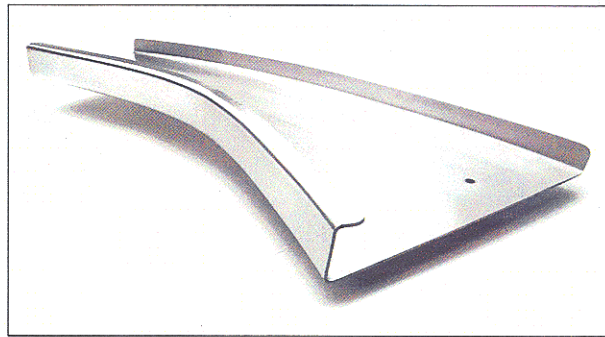


Figure 9. *A typical example of a production success through the use of Hi-Form sheet.*

**KAISER
ALUMINUM
TRENTWOOD WORKS**

AEROSPACE PRODUCTS

E. 15000 Euclid
P.O. Box 15108
Spokane, WA 99215

© Kaiser Aluminum 544-302 2.5M

"This publication is for general information only and is not intended to be used for design purposes. Kaiser Aluminum assumes no responsibility or liability for the use of information herein."