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EFFECTS OF POROSITY ON WELD-JOINT TENSILE STRENGTH OF ALUMINUM ALLOYS

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MATERIALS AND PROCESSES LABORATORY

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16. ABSTRACT

Tensile properties in defect-free weldments of aluminum alloys 2014-T6 and 2219-T87 (sheet and plate) are shown to be related to the level or concentration of induced simulated porosity. The scatter diagram shows that the ultimate tensile strength of the weldments displays the most pronounced linear relationship with the level of porosity. The relationships between yield strength or elongation and porosity are either trivial or inconsequential in the lower and intermediate levels of porosity content. In highly concentrated levels of porosity, both yield strength and elongation values decrease markedly.

Correlation coefficients were obtained by simple straight line regression analysis between the variables of ultimate tensile strength and pore level. The coefficients were greater, indicating a better correlation, using a pore area accumulation concept or pore volume accumulation than the accumulation of the pore diameters. These relationships provide a useful tool for assessing the existing aerospace radiographic acceptance standards with respect to permissible porosity. In addition, these relationships, in combination with known design load requirements, will serve as an engineering guideline in determining when a weld repair is necessary based on accumulative pore level as detected by radiographic techniques.

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EFFECTS OF POROSITY ON WELD-JOINT TENSILE STRENGTH OF ALUMINUM ALLOYS

SUMMARY

Simulated porosity was introduced in weldments of aluminum alloys 2014-T6 and 2219-T87 (sheet and plate) by precision drilling. The simulated porosity was examined in terms of accumulative linear inch (cm) of pore diameters, accumulative volume, and accumulative area per unit length of weld, respectively. In addition, the summation of porosity area was expressed as percent pore area in a cross-sectional plane (cross-sectional area of tensile specimen). Each pore quantity was plotted against the corresponding ultimate tensile strength, yield strength, and elongation. The ultimate tensile strength of the weldments displayed the most significant correlation with the porosity concentration. The relationships between yield strength or elongation and porosity were either trivial or inconsequential in the lower and intermediate levels of porosity content. In highly concentrated levels of porosity, both yield strength and elongation values decreased markedly. Accumulative pore area and percent pore area in weldments of each base metal thickness displayed a very strong linear relationship with ultimate tensile strength. Simple straight line regression analysis showed correlation coefficients (r) which exceeded 0.900, and the square of the coefficients (r^2) were in excess of the numerical value 0.810. In essence, this means that more than 81 percent of the total ultimate tensile strength variation can be explained by the associated accumulative pore area. In some cases, the correlation coefficient actually surpassed the value of 0.980.

The ultimate tensile strength of each individual value (all thicknesses) was plotted as a function of corresponding percent pore area for weldments of each alloy. These combined data exhibited a correlation coefficient of 0.882 for weldments of aluminum alloy 2014-T6, and a correlation coefficient of 0.913 for weldments of alloy 2219-T87.

Tensile tests conducted at -320°F (-196°C) with 1/4-in. (0.635-cm) thick plate weldments also showed strong linear relationships between simulated porosity level and ultimate tensile strength. The order of decreasing correlation coefficients was (1) area, (2) volume, and (3) linear concepts. Simple

straight line regression analysis yielded correlation coefficients in the range of -0.93 to -0.99 for the variables ultimate tensile strength versus either accumulative pore area or percent pore area.

The overall results of this evaluation show the most valid predictor of weld ultimate tensile strength to be the pore area concept. Percent pore area is another way of expressing pore area per unit length of weld. Accumulative volume per unit length of weld is also shown to be a strong indicator of joint strength. The correlation coefficient value between accumulative linear units per unit length of weld and tensile strength was relatively poor when compared to the coefficients obtained by using either pore area or pore volume versus ultimate tensile strength.

INTRODUCTION

The acceptance of weldments in aluminum alloys is governed by both surface quality and internal quality. Undercutting, cracks, suck-back, burn-through, drop-through, lack of penetration, and misalignment are well known examples of objectionable surface defects. However, these problems can be recognized by visual or dye penetrant inspection. Undesirable internal defects are characterized by slag and dross inclusions, tungsten inclusions, lack of fusion, fissures, cracks, and porosity. Porosity is the major item observed in x-rays of welds. This investigation is concerned exclusively with spherical type macroporosity in an otherwise perfect weld in order that the effect of porosity alone upon joint weldment tensile properties can be examined. Porosity is generally caused by gaseous hydrogen bubbles [1]. The source of hydrogen is moisture and hydrocarbons which break down in the high temperature arc during welding [2].

Weldments generally show varying amounts of internal porosity, as detected by radiographic techniques. Weldments are sometimes rejected because porosity is considered as excessive in accordance to radiographic acceptance standards. In the past, the standards have been based for the most part on conservative engineering judgements. The general trend has been to establish arbitrary radiographic acceptance standards with porosity slightly larger in diameter and slightly greater in quantity than normally encountered in controlled production welds; thus, variations do exist in porosity acceptance standards from one specification document to another. To maintain production schedules, sometimes larger pores than permitted by a standard have been tolerated and waived. It is the consensus that in some cases a repair may result in a weld of lower quality than the original porosity-laden weld. though the appearance of the repaired weld might be superficially better on the radiographic film [3]. However, leaving an intact large pore or accepting an array of pores not conforming to a specified acceptance standard leaves some doubt as to the structural integrity of the joint. Perhaps, existing standards are excessively stringent, and if so, how much relaxation is possible? The primary objective of this investigation is to determine to what degree tensile properties relate to porosity content, as expressed in terms of accumulative linear, volume, and area measurements of porosity per unit length of weld.

Welding engineers and metallurgists have attempted to introduce porosity in welds by faulty welding procedures, such as contaminating either the abutting edges, the shielding gases, or a combination of both. However, correlating the level of porosity to ultimate tensile strength by these techniques remains rather questionable. First, the purity as well as the physical metallurgical characteristics of the weld metal is altered. Second, reproduction of pore geometries and pore sizes into additional weld panels falls short of expectations. Third and probably most important, the fracture path should pass through the porosity, and not through other extraneous defects, such as dross and oxides which are associated normally with impure weld metal [4].

This investigation used weldments of the highest quality, with precision drilled holes simulating porosity along the surface of the weld interface (line of fusion) of each tensile specimen. Pore diameters, depths, and geometries were carefully controlled and measured exactly. Defects on or near the weld surface are considered more harmful than defects within (internal) the weld deposit [5, 6]. The fracture path of 2219-T87 weldments passes through the fusion zone on a single line which best fits the weld fusion lines. The normal fracture path of 2014-T6 weldments passes through only one side of the weld, and this being at the line of fusion or approximately normal to the base metal surface. Therefore, the specimens utilized in this investigation represented the worst conditions possible because (1) simulated porosity appeared at the surface, and (2) the simulated porosity was positioned along the normal fracture path. Specimen data are tabulated in the Appendix.

EQUIPMENT AND TEST SPECIMEN PREPARATION

The base materials (sheet and plate), the filler wires, and the shielding gases were all procured to appropriate aerospace specifications. The chemical composition limits of each base metal and filler wire are shown in Table 1.

TABLE 1. CHEMICAL COMPOSITION LIMITS OF BASE METAL AND FILLER METAL (MAXIMUM UNLESS SHOWN AS A RANGE)

Element	2014	4043	2219	2319
Si	0.5-1.2	4.5-6.0	0.20	0.20
Fe	1.0	0.8	0.30	0.30
Cu	3.9-5.0	0.30	5.8-6.8	5.8-6.8
Mn	0.4-1.2	0.03	0.20-0.40	0.20-0.40
Mg	0.2-0.8	0.05	0.02	0.02
Zn	0.25	0.10	0.10	0.10
Ti	0.15	0.20	0.02-0.10	0.10-0.20
V	-	-	0.05-0.15	0.05-0.15
Zr	-	-	0.10-0.25	0.10-0.25
Be	-	-	-	0.0008
Cr	0.10	-	-	-
Others Ea.	-	0.05*	0.05	0.05
Others Totals	-	0.15	0.15	0.15
Al	Remainder	Remainder	Remainder	Remainder

*Beryllium 0.008 maximum in welding electrode and filler wire only.

Source of Data:

1. Mayer, L.W. Alcoa Aluminum Alloy 2219; Alcoa Green Letter, Revised January 1962
2. Aluminum 145, Al-17, Engineering Alloys Digest, Incorporated, June 1954
3. Welding Kaiser Aluminum, First Edition, 1967

Preweld sections (4 in. × 24 in. = 10.6 cm × 60.96 cm) used in this evaluation were fabricated from three thicknesses of 0.107-in. (0.272-cm) sheet, 0.250-in. (0.635-cm) plate, and 0.500-in. (1.27-cm) plate of 2014-T6, and also three thicknesses, 0.125 in. (0.318 cm), 0.250 in. (0.635 cm), and 0.500 in. (1.27 cm) of 2219-T87. The short direction (4 in. = 10.16 cm) of each panel was cut parallel to the principal rolling direction. All the panels were cleaned as follows:

1. Soaked with alcohol and rinsed in water.

2. Soaked in hot (approximately 200°F/93°C) non-etchant type alkaline cleaner for 10 to 15 minutes and rinsed in water.

3. Immersed 1 to 3 minutes in a solution of 0.5 percent hydrofluoric acid and 5.0 percent nitric acid, by volume.

4. De-smutted by immersing in a 50 percent, by volume, solution of nitric acid for 1 to 2 minutes, rinsed in water, and dried by wiping.

Final joint preparation consisted of draw filing the abutting edges, and scraping the two adjoining faces for a distance of approximately 3/4 in. (1.905 cm) away from the filed edge. These operations removed foreign matter embedded in the material surface, removed surface oxides, and removed gases absorbed in the material surface along the area to be welded. Figure 1 shows the metal surface removal locations and the configuration of a section.

The weldments were made by the TIG process on standard welding equipment, which consisted of an Airco Function Controlled welding power supply, Model FCWS-3049 and Model HMW-E voltage controlled welding head. Work pieces were held consistently by clamping fixtures, and travel speeds were provided by an automatic rack drive system. Square butt-joint weldments were made in the down hand (flat) position as shown by the welding setup in Figure 2. One weld pass was used to complete weldments in thicknesses up to 0.250 in. (0.635 cm). Two passes (one from each side) were required to weld 1/2-in. (1.27-cm) thick plate. Filler alloys were types 4043 and 2319 in combination with base alloys 2014 and 2219, respectively. Radiographic inspection followed procedures which usually grade weldments to Class I, per MSFC-SPEC-259A [7].

The weld bead reinforcements were machined flush and smooth (16 RMS) with the base metal surface. Tensile specimen configuration consisted of simple strips with parallel edges (Fig. 3) for ambient temperature testing, and a "dog bone" pin hole type specimen (Fig. 4) for testing at -320°F (-196°C).

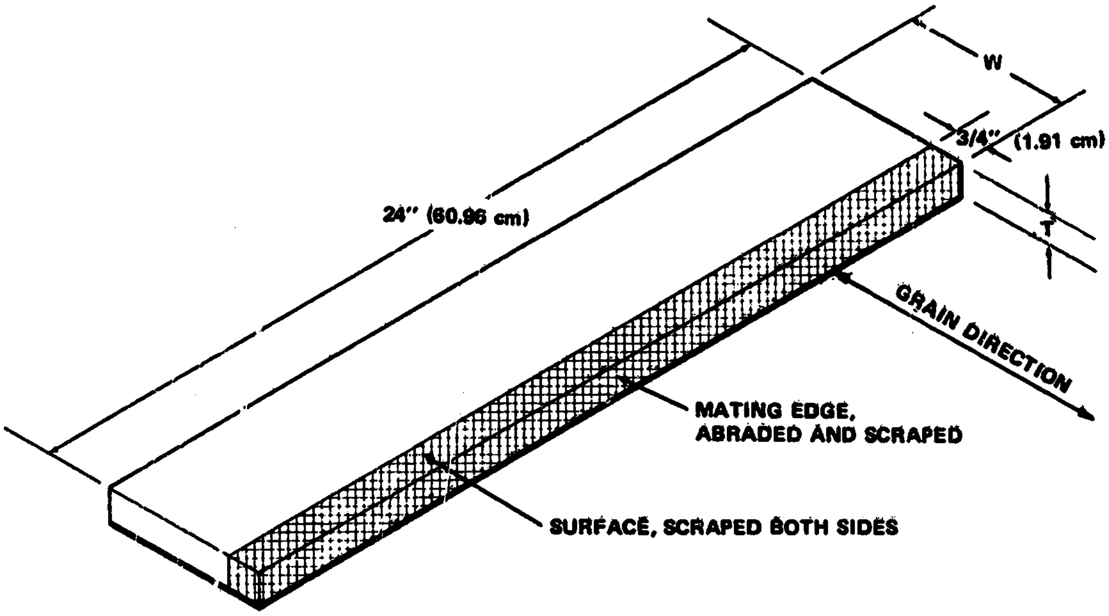

Figure 1. Panel geometry.

A precision drilling machine was used to drill simulated porosity in test specimens. The machine was equipped with a X-Y coordinate table for precise positioning of the specimen and exact spacing of holes, a vise for holding and leveling the specimen, and a dial indicator for controlling the depth of each hole. Standard high speed precision twist drills were used to make all holes.

Drilling, spacing, and measuring procedures were as follows:

1. Hole diameters and depths were varied in twenty steps from 0.009 in. (0.023 cm) to 0.203 in. (0.516 cm); however, in no case did the hole diameter or depth exceed three-quarters of the base metal thickness.

2. The depth of each hole was controlled to equal the diameter of the drill. This was done to approach, as near as possible, simulated spherical-type porosity.

3. Single hole specimens consisted of one hole drilled at the weld fusion line, but mostly within resolidified metal, at a position which bisected the width of the tensile specimen.

4. Multiple hole specimens consisted of identical holes drilled in a straight line at two diameter intervals, along the weld fusion line as stated in paragraph 3. Each array of holes, from two up to fifty individual pores, was centered with regard to specimen width. A graphic representation is shown in Figure 5.

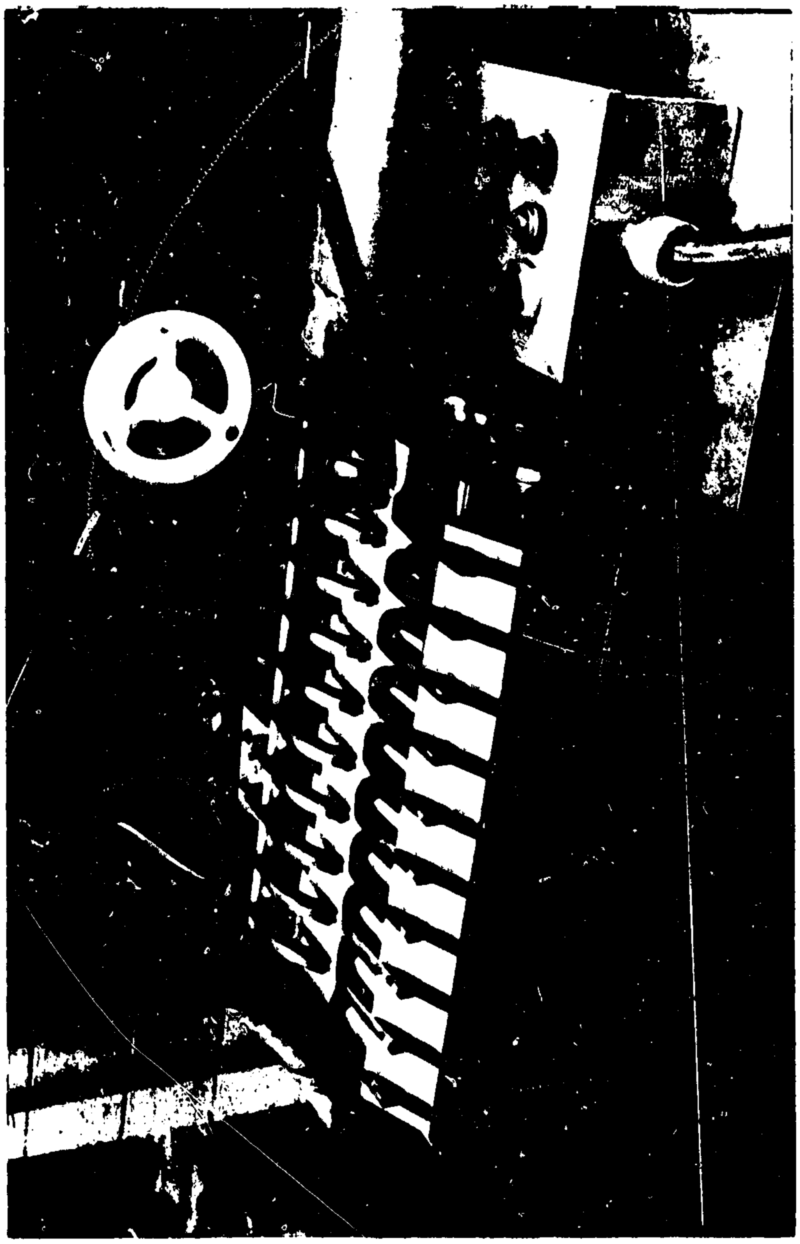

Figure 2. Flat weld position setup.

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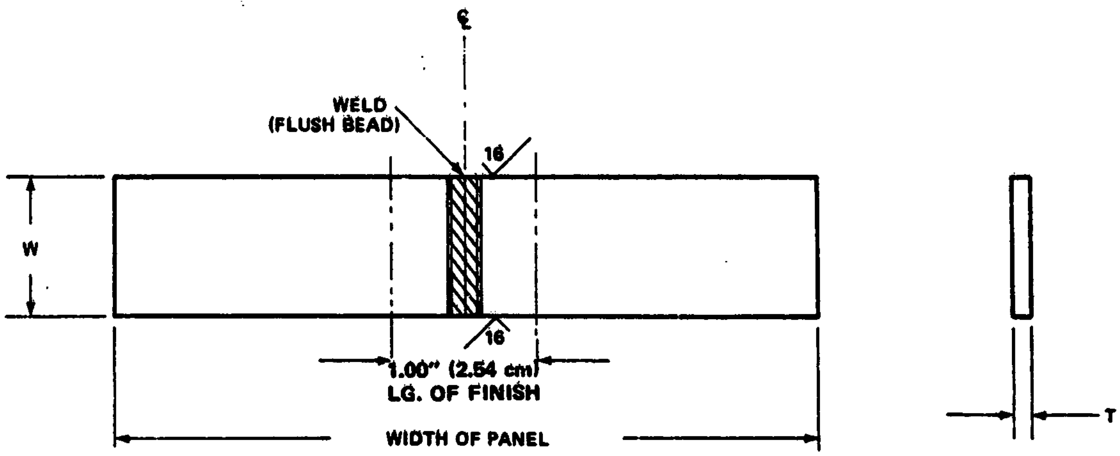


Figure 3. Transverse weld tensile specimen configuration for testing at ambient temperature.

5. The maximum number of holes drilled in any given specimen was dictated by hole diameter, base metal thickness, and the spacing procedure as stated in procedure 4.

6. Drills were changed at selected intervals during the drilling operation. This was done to maintain a sharp and clean drill, which assured a consistent hole diameter throughout the drilling operation.

7. A typical hole for each drill diameter was made in 1/4-in. (0.635-cm) wide by 1/4-in. (0.635-cm) thick plate weldment at selected intervals during the drilling operation. Each specimen was radiographed, and the resultant film was used to exactly measure hole dimensions with the aid of a Mikon Tool Microscope. These dimensions were converted into pore area, pore volume, or linear inch (cm) of porosity. Reproductions of typical radiographs are shown in Figure 6. The dimensions, as measured from the radiographs, are shown in Table 2.

DISCUSSION AND RESULTS

In this evaluation, a technique was employed which introduced porosity (simulated) and still maintained normal metal quality along the deposited weld seam, or stated more specifically, the weld metal was not altered with regard to either purity or normal physical metallurgical characteristics. Weldments

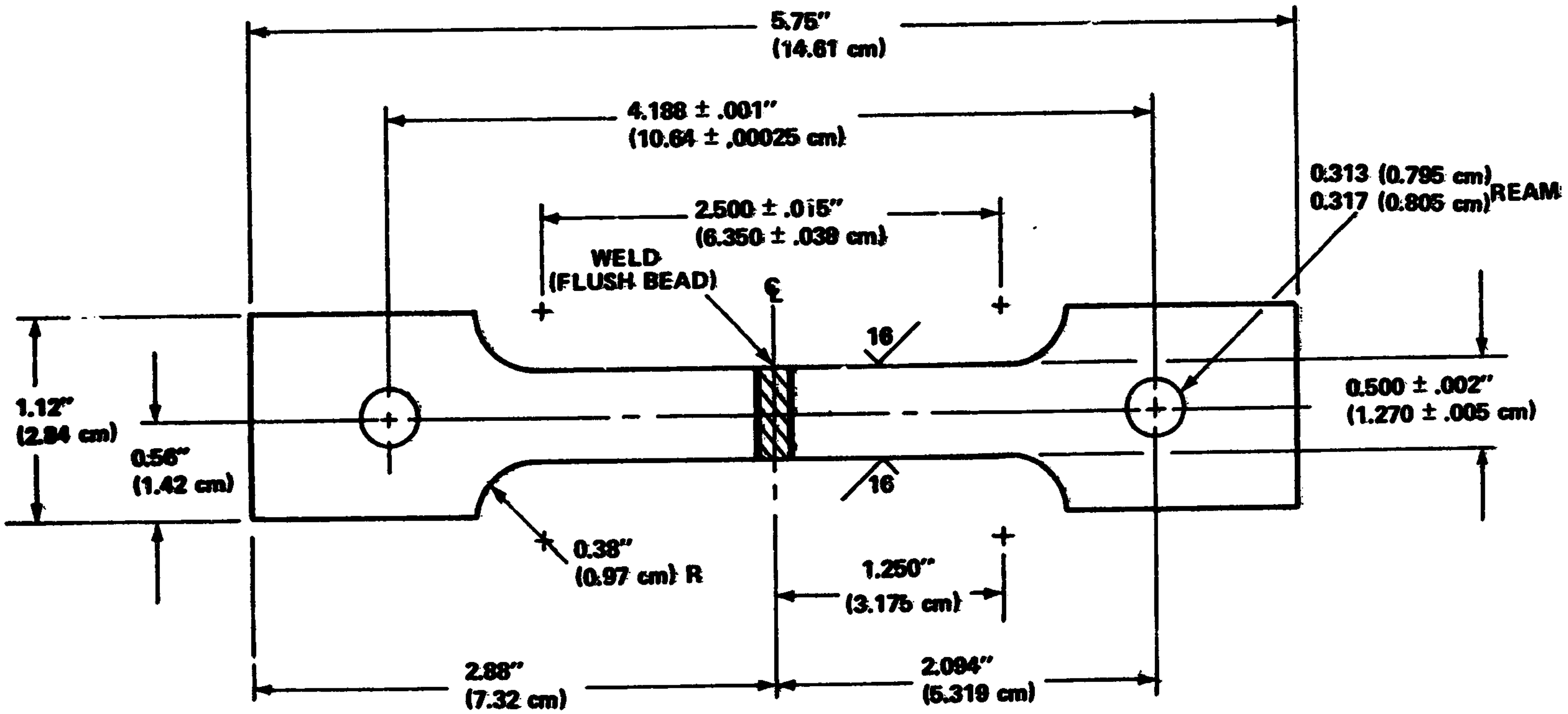


Figure 4. Transverse weld tensile specimen configuration for testing at -320° (-196°C).

were carefully selected with regard to initial quality and only weldments void of internal discontinuities, as disclosed by radiographic techniques, were used in this evaluation. The location of the simulated porosity was carefully positioned along the weld interface (line of fusion) which is included within the expected fracture plane.

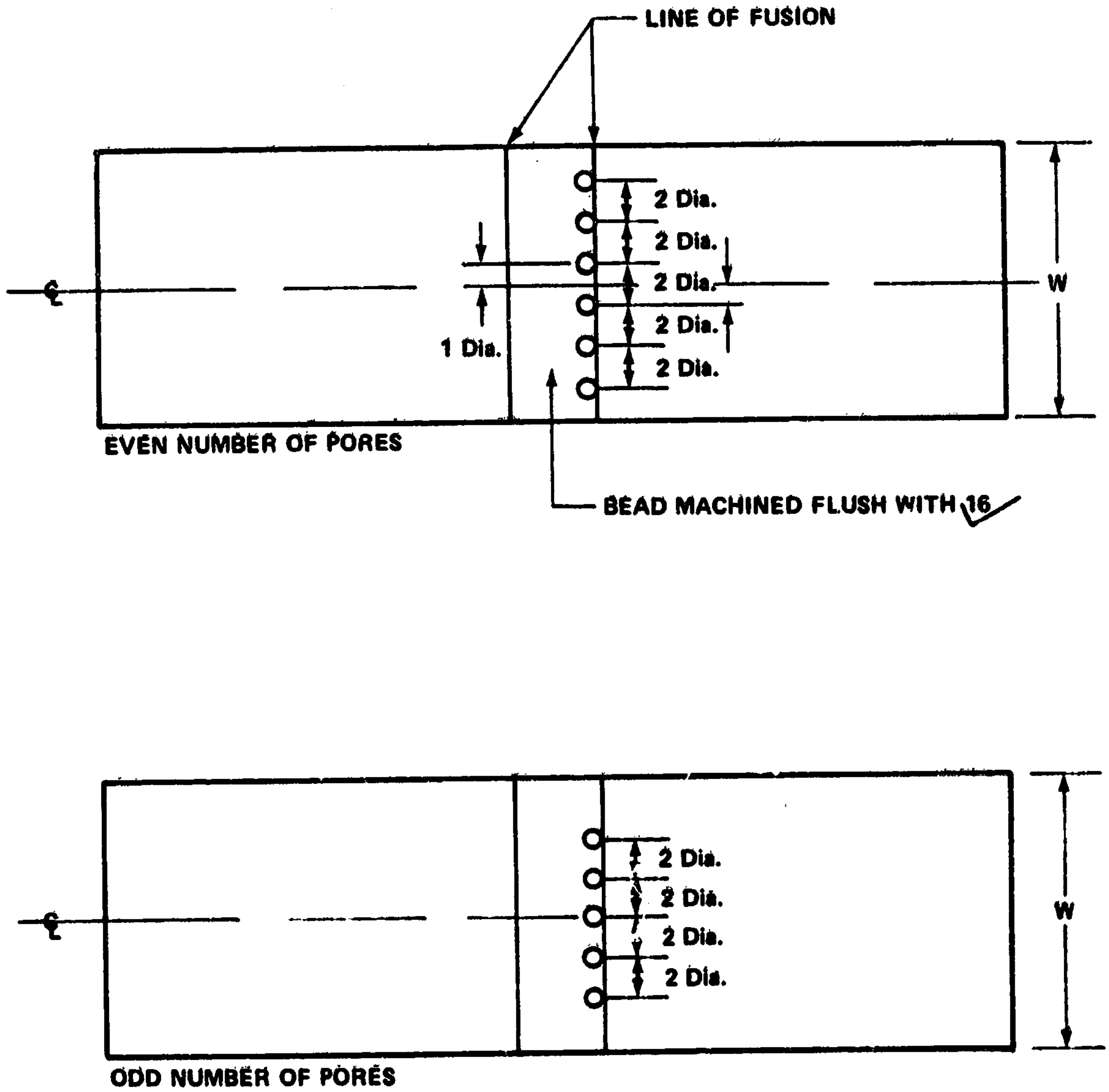


Figure 5. Graphic representation of spacing of simulated pores along the weld line of fusion.

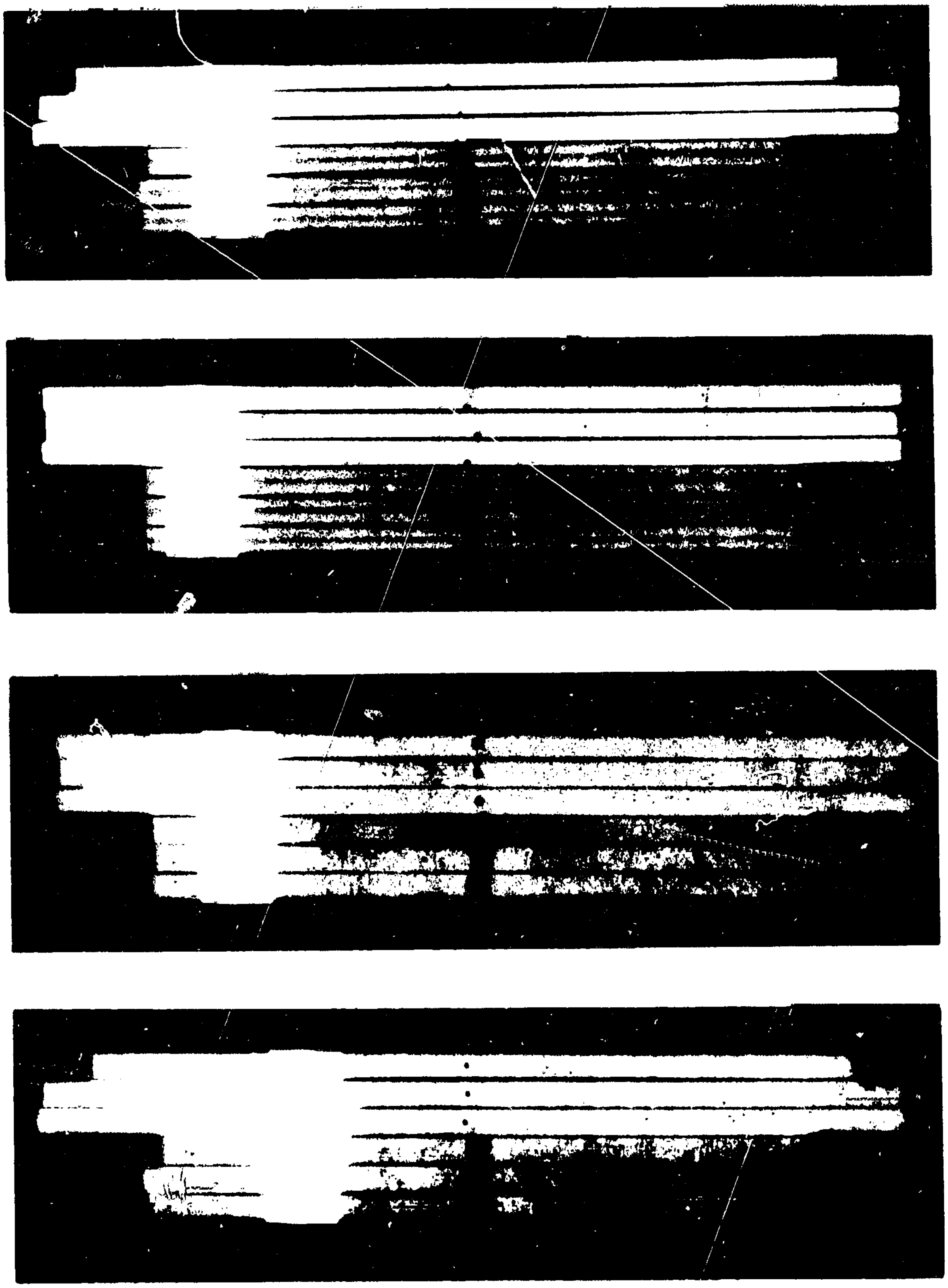
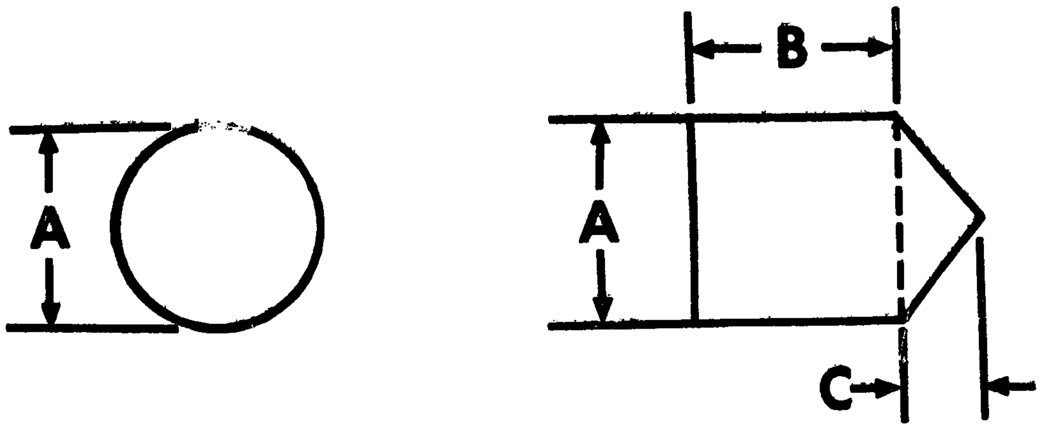


Figure 6. Reproduction of typical radiographs.

TABLE 2. POROSITY MEASUREMENTS FROM RADIOGRAPHS OF WELD SAMPLES



PORE MEASUREMENT, INCH (CM)

Drill Diameter Inch (cm)	A	B	C
0.0135 (0.0343)	0.012 (0.030)	0.010 (0.025)	0.003 (0.007)
0.0135 (0.0343)	0.012 (0.030)	0.005 (0.013)	0.001 (0.003)
0.0135 (0.0343)	0.012 (0.030)	0.005 (0.013)	0.001 (0.003)
0.020 (0.051)	0.018 (0.046)	0.015 (0.038)	0.005 (0.013)
0.020 (0.051)	0.016 (0.041)	0.013 (0.033)	0.004 (0.010)
0.020 (0.051)	0.017 (0.043)	0.017 (0.043)	0.005 (0.013)
0.031 (0.079)	0.029 (0.074)	0.021 (0.053)	0.008 (0.020)
0.040 (0.079)	0.039 (0.099)	0.029 (0.074)	0.0105 (0.027)
0.040 (0.079)	0.038 (0.097)	0.032 (0.081)	0.008 (0.020)
0.040 (0.079)	0.037 (0.094)	0.030 (0.076)	0.007 (0.018)
0.052 (0.132)	0.0505 (0.128)	0.037 (0.094)	0.012 (0.030)
0.0595 (0.151)	0.059 (0.150)	0.0435 (0.110)	0.016 (0.041)
0.0595 (0.151)	0.062 (0.157)	0.041 (0.104)	0.015 (0.038)
0.0595 (0.157)	0.061 (0.155)	0.041 (0.104)	0.015 (0.038)
0.070 (0.178)	0.071 (0.180)	0.054 (0.137)	0.015 (0.038)
0.081 (0.206)	0.082 (0.208)	0.060 (0.152)	0.019 (0.048)
0.081 (0.206)	0.077 (0.196)	0.054 (0.137)	0.022 (0.056)
0.081 (0.206)	0.077 (0.196)	0.056 (0.142)	0.026 (0.066)
0.089 (0.226)	0.0875 (0.222)	0.067 (0.170)	0.021 (0.053)
0.0995 (0.253)	0.099 (0.251)	0.076 (0.193)	0.023 (0.058)
0.0995 (0.253)	0.103 (0.262)	0.070 (0.178)	0.028 (0.071)
0.0995 (0.253)	0.100 (0.254)	0.075 (0.191)	0.026 (0.066)
0.110 (0.279)	0.111 (0.282)	0.081 (0.206)	0.026 (0.066)
0.120 (0.305)	0.121 (0.307)	0.088 (0.224)	0.032 (0.081)
0.120 (0.305)	0.120 (0.305)	0.083 (0.211)	0.037 (0.094)
0.120 (0.305)	0.120 (0.305)	0.081 (0.206)	0.035 (0.089)
0.1285 (0.326)	0.132 (0.335)	0.094 (0.239)	0.038 (0.097)
0.1405 (0.357)	0.145 (0.368)	0.100 (0.254)	0.038 (0.097)
0.1405 (0.357)	0.147 (0.373)	0.100 (0.254)	0.044 (0.112)
0.1405 (0.357)	0.146 (0.371)	0.099 (0.251)	0.041 (0.104)
0.1495 (0.380)	0.150 (0.381)	0.100 (0.254)	0.047 (0.119)
0.161 (0.409)	0.1625 (0.413)	0.116 (0.295)	0.0425 (0.108)
0.1695 (0.431)	0.174 (0.442)	0.127 (0.323)	0.041 (0.104)
0.180 (0.457)	0.185 (0.470)	0.142 (0.361)	0.042 (0.107)
0.191 (0.485)	0.193 (0.490)	0.1365 (0.347)	0.052 (0.132)
0.2031 (0.516)	0.208 (0.528)	0.143 (0.363)	0.054 (0.137)

NOTE: Each value shown is the average of three or more measurements.

The higher porosity (simulated) concentrations and larger diameters used in this effort greatly exceed those limitations imposed by existing aerospace specifications. Simulated porosity diameters ranged from 0.009 in. (0.023 cm) to 0.203 in. (0.516 cm). The accumulative porosity area, volume, and linear summation of pore diameters varied from 0 to 0.0717 $in.^2$ (0.463 cm^2), 0 to 0.0078 $in.^3$ (0.0503 cm^3), and 0 to 0.582 linear inch (1.478 cm), respectively, per linear inch (2.54 cm) of weld. The percent of pore area present in a unit length of weld varied from 0 to 36 percent. Pore diameter was measured by adding the long and short diameters and dividing by two. However, the two diameters (long and short) were approximately equal in most cases, and in only two cases did the two lengths vary by more than 0.006 in. (0.015 cm). The percent pore area was calculated by dividing the accumulative pore area by the cross-sectional area of the test specimen and multiplying by 100.

To determine quantitatively how much the pore concentration variable affects the mechanical properties of a weldment, a linear regression analysis statistical technique was applied. A simple, straight-line regression analysis was made when a linear trend was apparent after plotting accumulated data in scatter diagram. The ultimate tensile strength plots of the welds displayed the most significant correlation with simulated porosity level. Changes in yield strength and elongation values were either trivial or inconsequential in the lower and intermediate levels of porosity. In highly concentrated porosity-laden specimens, both yield strength and elongation values decreased markedly, as shown by the data obtained. The data used for this analysis are shown in the Appendix.

Simple, straight-line regression analysis fits a straight line to a series of points, as plotted by two variables. The correlation coefficient (r) is a measure of the linear relationship between two variables, and must be between +1.00 and -1.00. A correlation coefficient of +1.00 indicates a perfect direct linear relationship, while -1.00 would indicate a perfect inverse linear relationship. A correlation coefficient of zero indicates a complete absence of linear relationship. The square of the correlation coefficient (r^2) gives the percentage of total variation explained (fitted) or removed by the regression line [8].

If the linear relationship between two variables is assumed, the equation of the correlation coefficient is:

$$r = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{[N(\Sigma X^2) - (\Sigma X)^2][N(\Sigma Y^2) - (\Sigma Y)^2]}}$$

The equation of the least square line, or straight regression line of Y on X is:

$$Y' = a + bX$$

The slope b of the regression line is:

$$b = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{N(\Sigma X^2) - (\Sigma X)^2}$$

The Y-intercept (a) of the regression line [9] is:

$$a = \frac{\Sigma Y - b(\Sigma X)}{N}$$

Sample calculations of accumulative pore area versus ultimate tensile strength for each of three base weldment thicknesses are shown in Tables 3 and 4.

The porosity level was plotted against the corresponding tensile properties for each alloy, which included each thickness as a separate plot. Porosity level was expressed in terms of accumulative pore area, accumulative pore volume, and the accumulative linear pore diameter per unit length of weld, respectively, as well as percent pore area. Simple straight line regression analysis was performed because of the strong evidence of linear trends between ultimate tensile strength and the corresponding porosity level. The plots of the ultimate tensile strength versus percentage pore area for each thickness are presented in Figures 7 through 16.

All of the data plotted originated from measurements of 1,890 individual specimens tested at Marshall Space Flight Center (MSFC). The 2014-T6 specimens, welded with 4043, ranged in thickness from 0.107 in. (0.272 cm) to 0.500 in. (1.27 cm) and in width from 0.25 in. (0.635 cm) to 1.00 in. (2.54 cm). The number of individual pores drilled per specimen ranged from 0 to 50. The 2219-T87 specimens, welded with 2319, ranged in thickness from 0.125 in. (0 (0.318 cm) to 0.500 in (1.27 cm) and in width from 0.250 in. (0.635 cm) to 1.00 in. (2.54 cm). The number of individual pores drilled per specimen ranged from 0 to 40. Tests were made at room temperature in air and at -320°F (-196°C) in liquid nitrogen.

TABLE 3. SIMPLE STRAIGHT LINE REGRESSION ANALYSIS FOR ACCUMULATIVE PORE AREA VERSUS ULTIMATE TENSILE STRENGTH OF WELDMENTS IN ALLOY 2219-T87

Equation of the correlation coefficient (r):

$$r = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{[N(\Sigma X^2) - (\Sigma X)^2][N(\Sigma Y^2) - (\Sigma Y)^2]}}$$

Slope (b) of regression line:

$$b = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{N(\Sigma X^2) - (\Sigma X)^2}$$

The Y- intercept (a) of the regression line:

$$a = \frac{\Sigma Y - b(\Sigma X)}{N}$$

Equation of least square line (Y or X):

$$Y' = a + bX$$

Let Y = Transverse U.T.S. of weldment (flush bead)
X = Accumulative pore area

	Base Sheet Thickness of 0.125 Inch (0.318cm)	Base Plate Thickness of 0.250 Inch (0.635cm)	Base Plate Thickness of 0.50 Inch (1.27cm)
N	52	53	96
ΣX	0.53983	0.7731795	2.19799
ΣY	1,811,230	2,047,560	3,834,980
ΣX^2	0.0094259561	0.0231671242	0.0934600823
ΣY^2	63,547,332,500	79,549,312,000	153,526,256,600
ΣXY	17,522.1165	27,634.26384	84,411.6523
r	-0.966	-0.972	-0.903
b	-335,153.8	-188,104	-78,659.3
a	38,310.7	41,377	41,748.7
Y'	38,310.7-335,153.8X	41,377-188,104X	41,748.7-78,659.3X

NOTES:

1. These calculations were made from data obtained with 1-inch (2.54-cm) wide tensile specimens.
2. Individual Y and X values used in these calculations were the average value taken from 3 or more duplicate tests.

TABLE 4. SIMPLE STRAIGHT LINE REGRESSION ANALYSIS FOR ACCUMULATIVE PORE AREA VERSUS ULTIMATE TENSILE STRENGTH OF WELDMENTS IN ALLOY 2014-T6

Equation of the correlation coefficient (r):

$$r = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{[N(\Sigma X^2) - (\Sigma X)^2][N(\Sigma Y^2) - (\Sigma Y)^2]}}$$

Slope (b) of regression line:

$$b = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{N(\Sigma X^2) - (\Sigma X)^2}$$

The Y intercept (a) of the regression line:

$$a = \frac{\Sigma Y - b(\Sigma X)}{N}$$

Equation of least square line (Y on X):

$Y' = a + bX$

Let Y = Transverse U.T.S. of weldment (flush bead)
X = Accumulative pore area

SUMMATION

	2014-T6 Sheet Thickness of 0.107 inch (0.272 cm)	2014-T651 Plate Thickness of 0.250 inch (0.635 cm)	2014-T651 Plate Thickness of 0.50 inch (1.27 cm)
N	54	53	142
ΣX	0.54088	0.771717	5.19185
ΣY	2,111,090	2,339,860	6,268,460
ΣX^2	0.0094265914	0.02358159059	0.3730997403
ΣY^2	83,622,797,500	103,951,043,000	278,095,342,000
ΣXY	19,173.3787	31,378.1361	215,102.9397
r	-0.943	-0.950	-0.886
b	-491,877	-218,055	-76,860.61
a	44,021	47,323	46,954
Y'	44,021-491,877X	47,323-218,055X	46,954-76,860.61X

NOTES: 1. These calculations were made from data obtained with 1-inch (2.54-cm) wide tensile specimens.

2. Individual Y and X values used in these calculations were the average value taken from 3 or more duplicate tests.

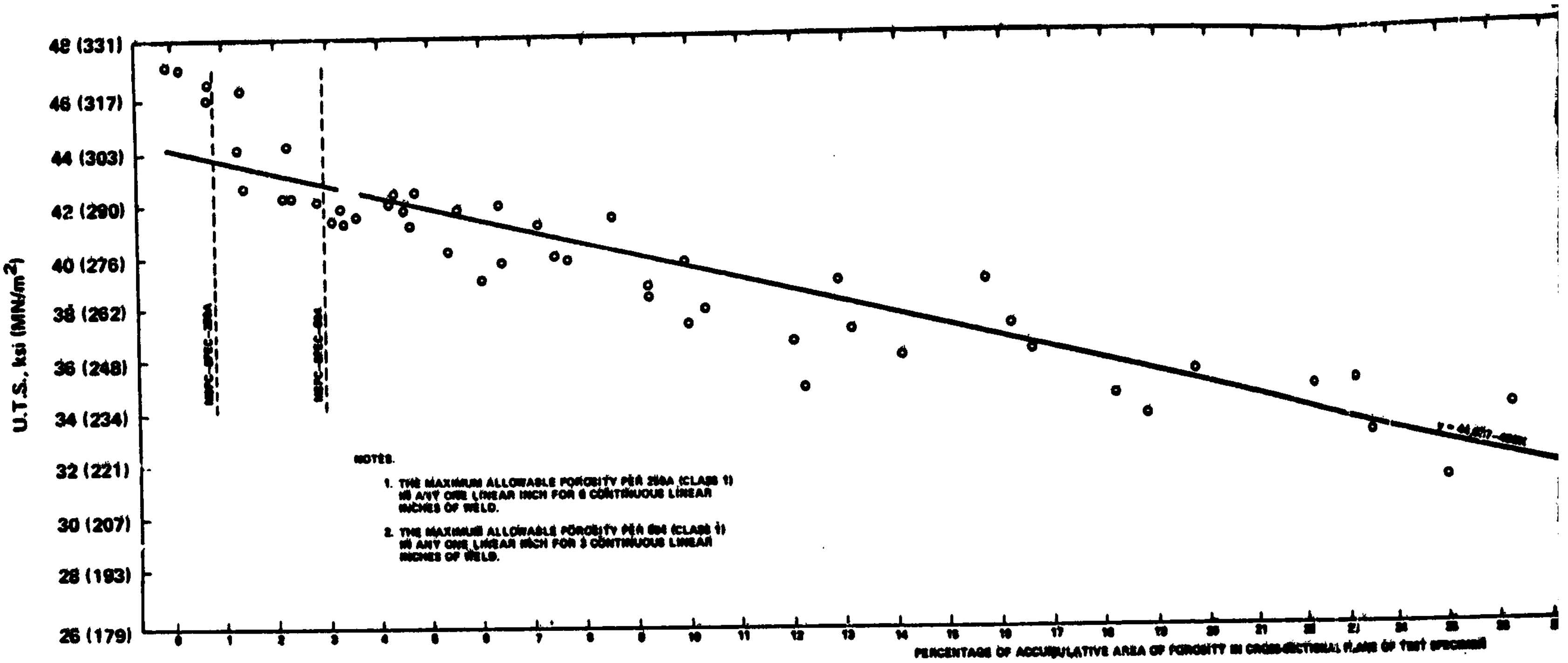


Figure 7. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T6 (0.107 in. = 0.272 cm she versus percentage of accumulative area of porosity in cross-sectional plane.

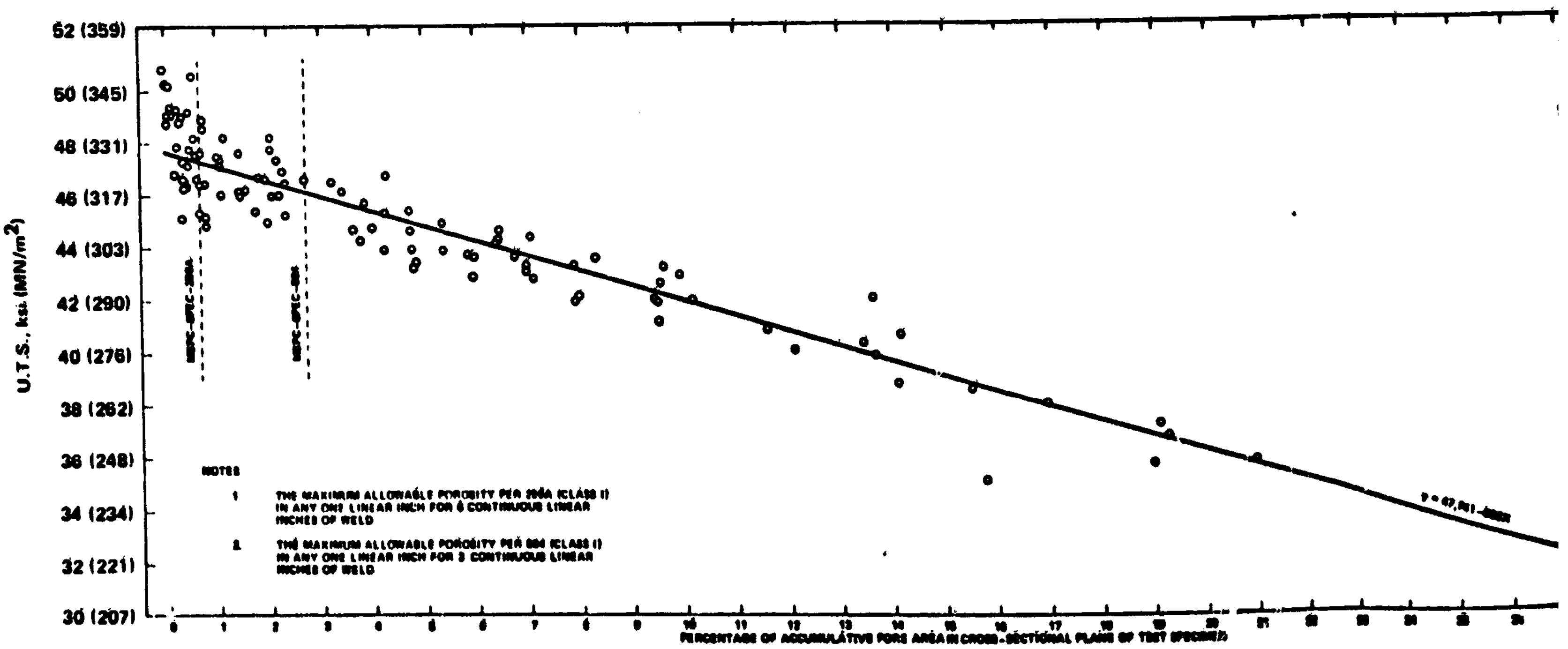


Figure 8. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.250 in. = 0.635 cm versus percentage of accumulative area of porosity in cross-sectional plane.

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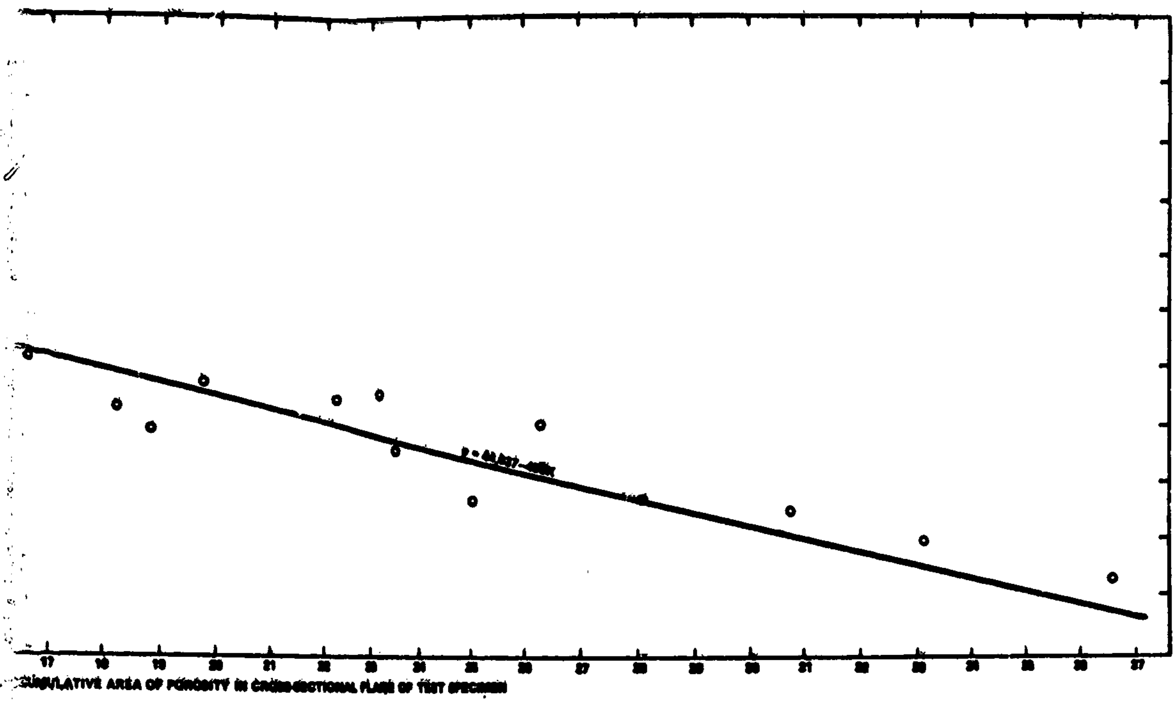
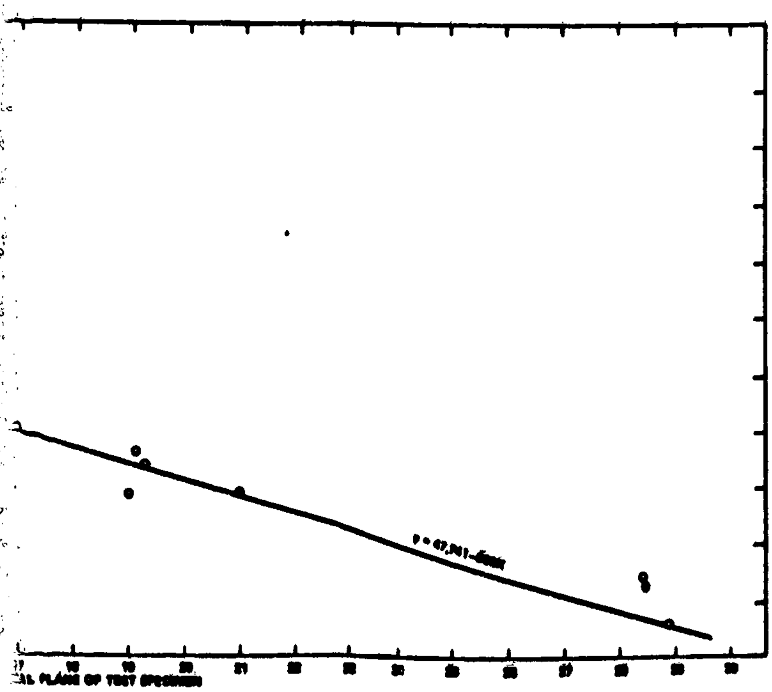


alloy 2014-T6 (0.107 in. = 0.272 cm sheet)
n cross-sectional plane.



lloy 2014-T651 (0.250 in. = 0.635 cm plate)
in cross-sectional plane.

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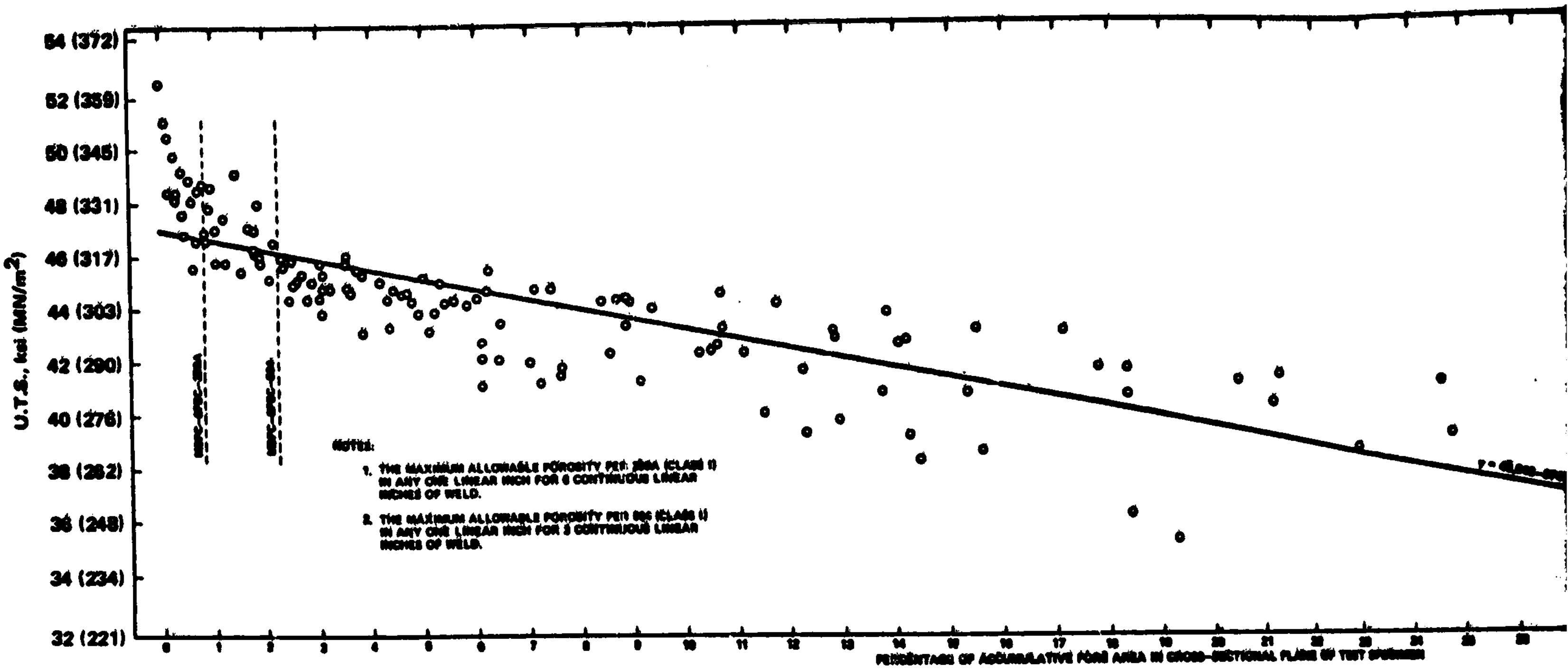

Figure 9. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.50 in. = 1.27 cm pla
versus percentage of accumulative area of porosity in cross-sectional plane.

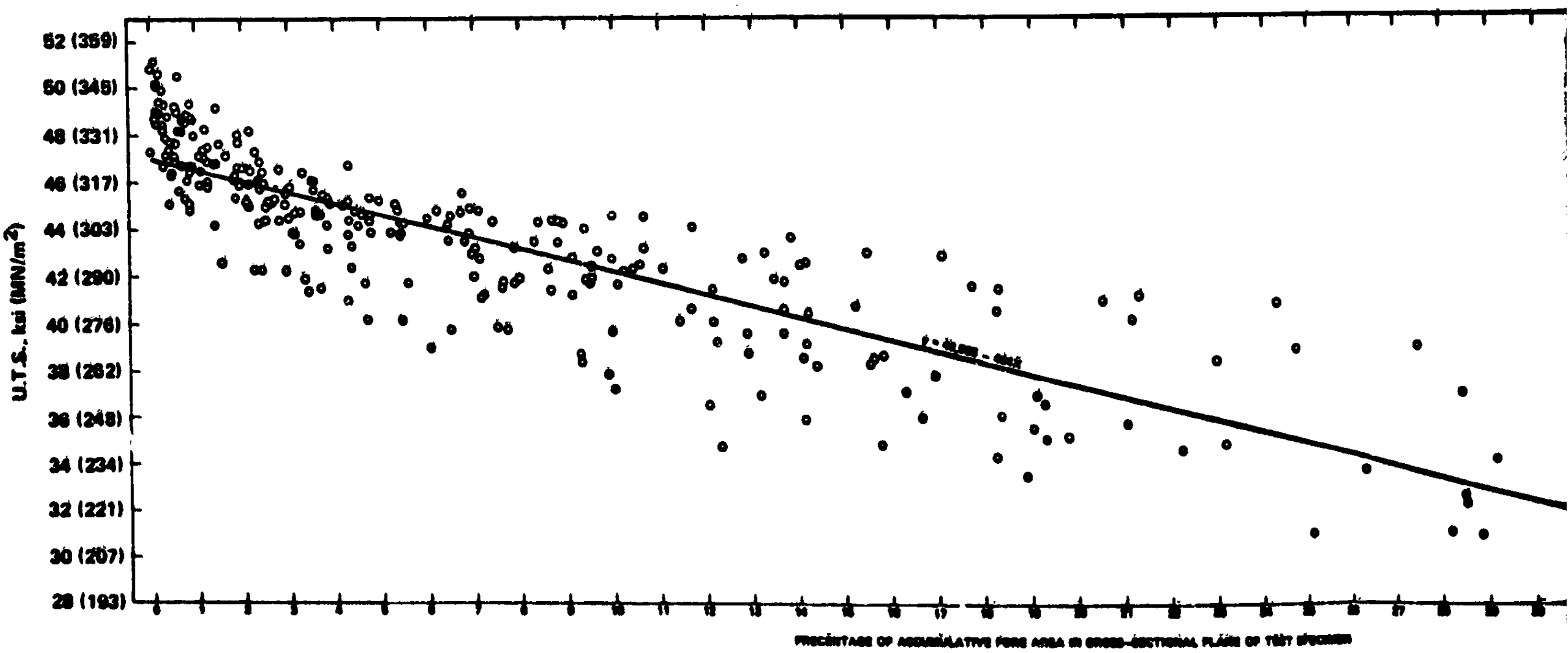

Figure 10. Ultimate tensile strength of flush bead TIG weldments in alloy 2014-T6 (all three thicknesses)
percentage of accumulative area of porosity in cross-sectional plane.

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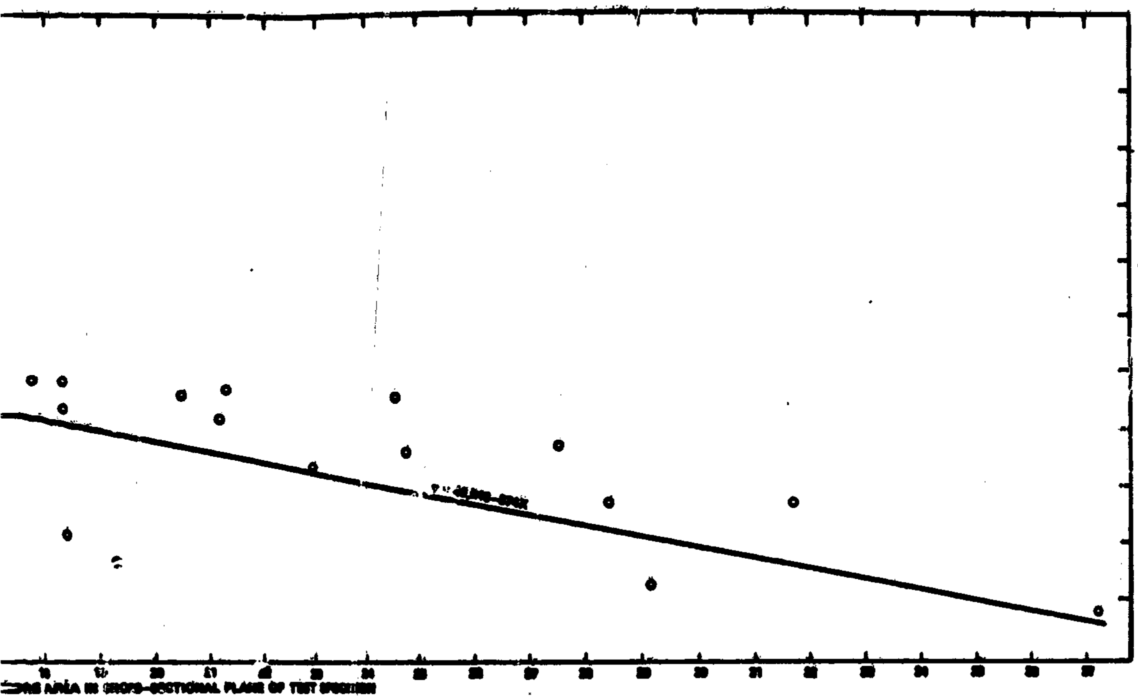
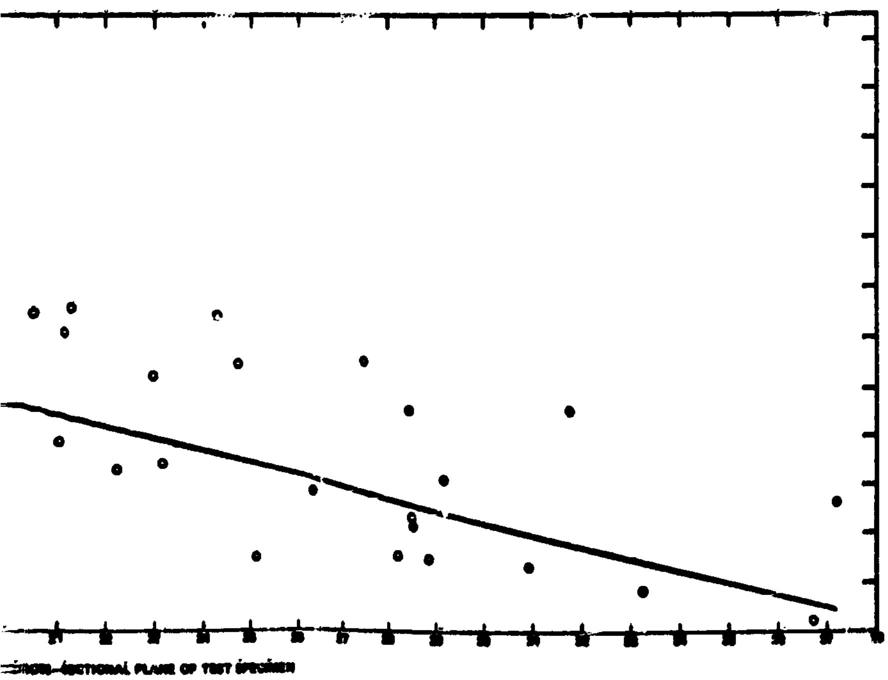


y 2014-T651 (0.50 in. = 1.27 cm plate)
cross-sectional plane.



oy 2014-T6 (all three thicknesses) versus
ross-sectional plane.

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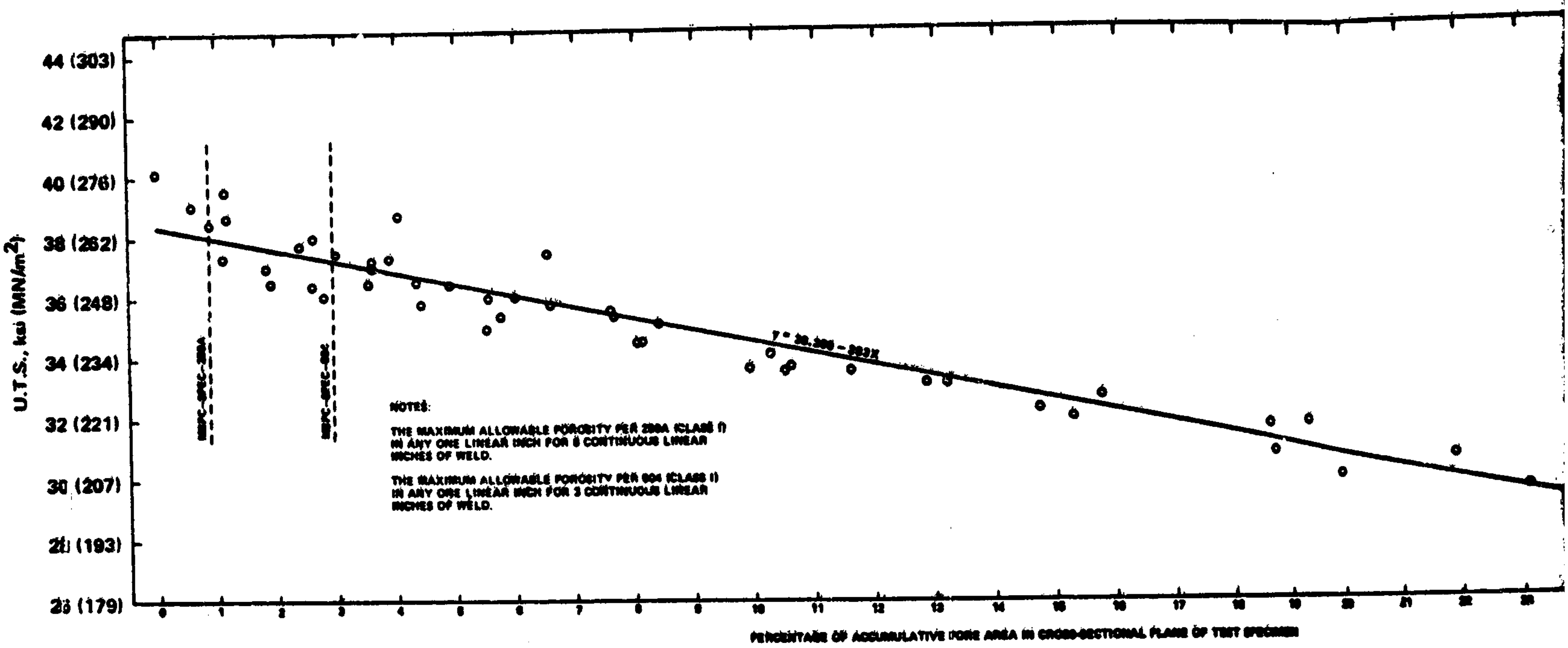


Figure 11. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.125 in. = 0.318 cm s versus percentage of accumulative area of porosity in cross-sectional plane.

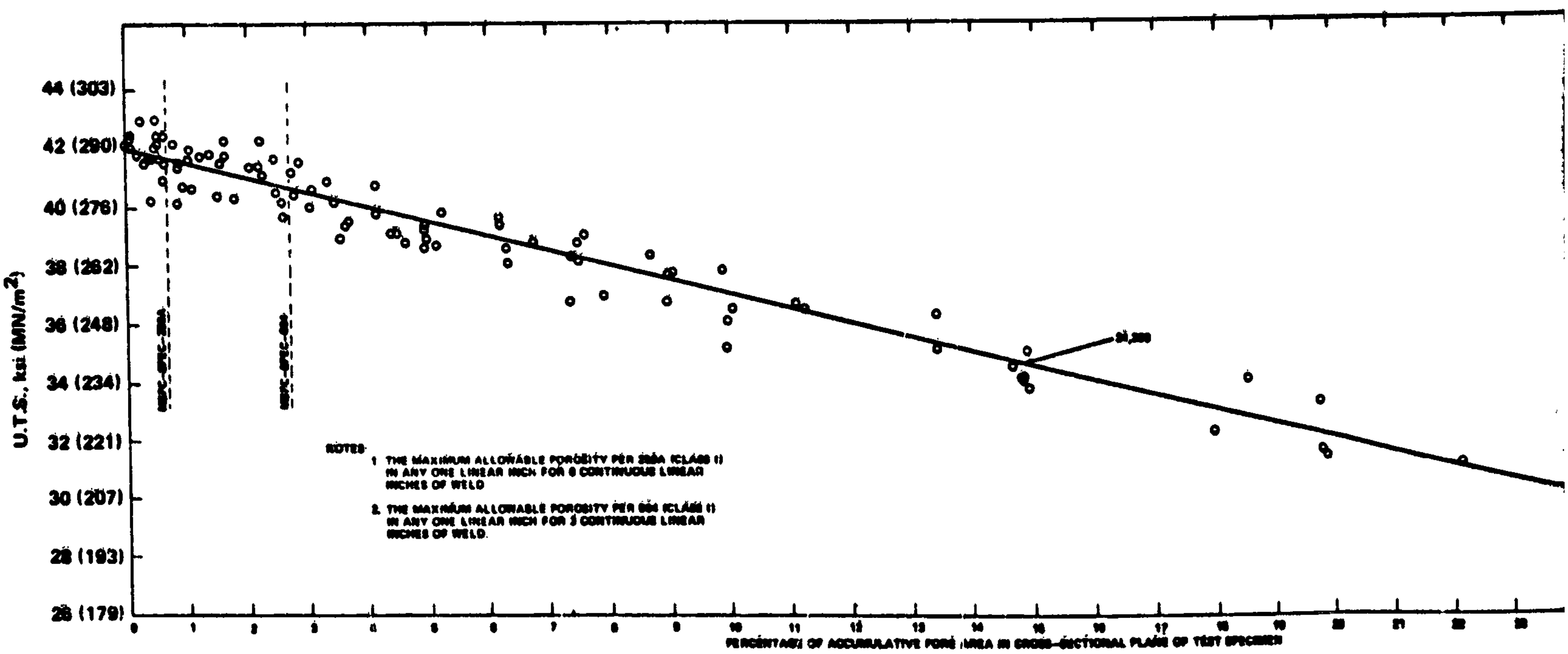
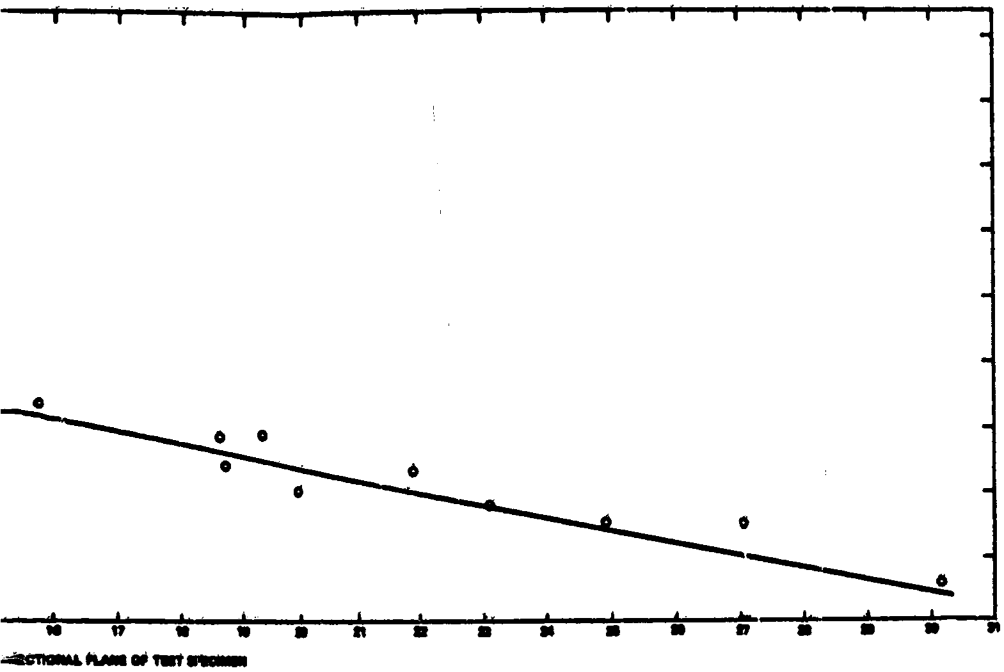
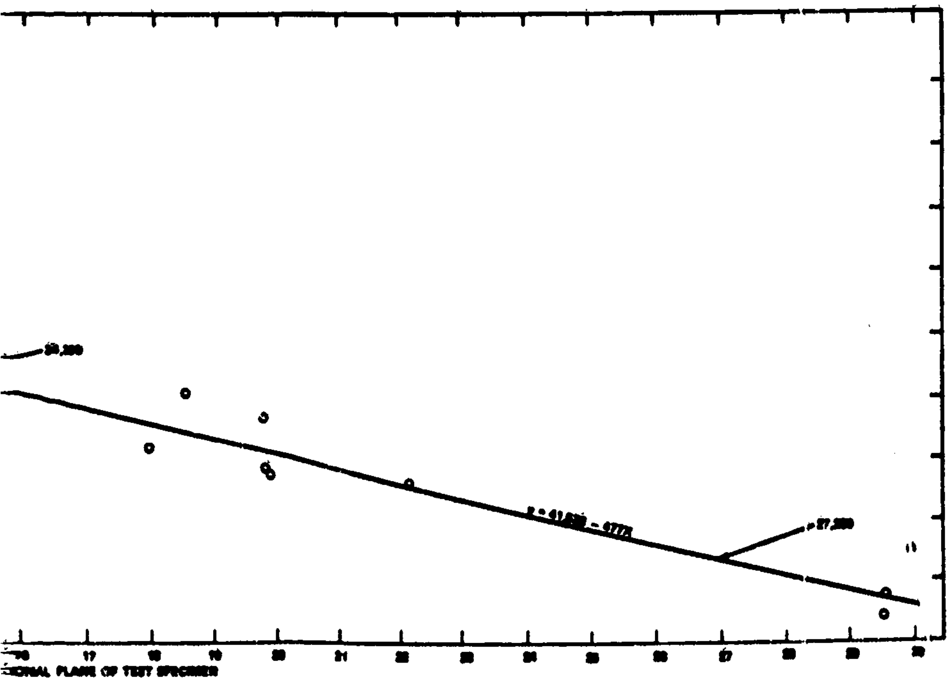


Figure 12. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.250 in. = 0.635 cm versus percentage of accumulative area of porosity in cross-sectional plane.



oy 2219-T87 (0.125 in. = 0.318 cm sheet)
in cross-sectional plane.



oy 2219-T87 (0.250 in. = 0.635 cm plate)
n cross-sectional plane.

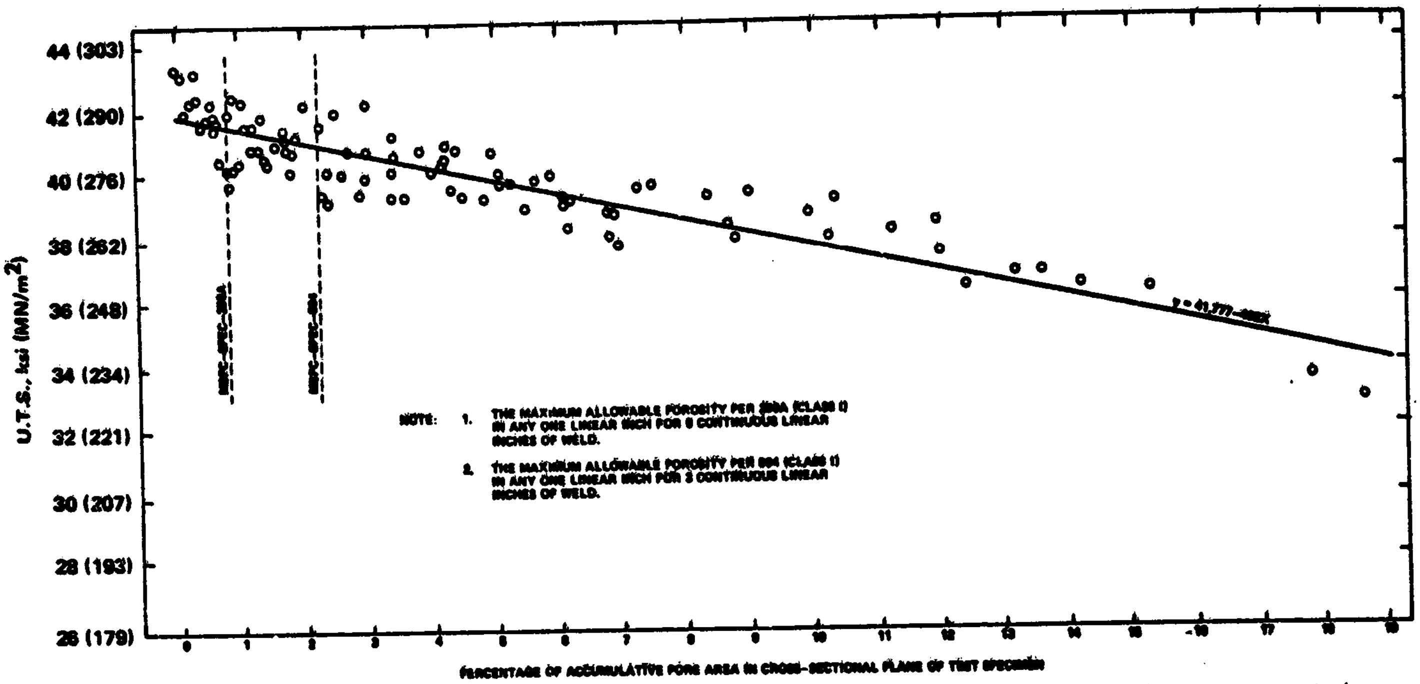


Figure 13. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.50 in. = 1.27 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane.

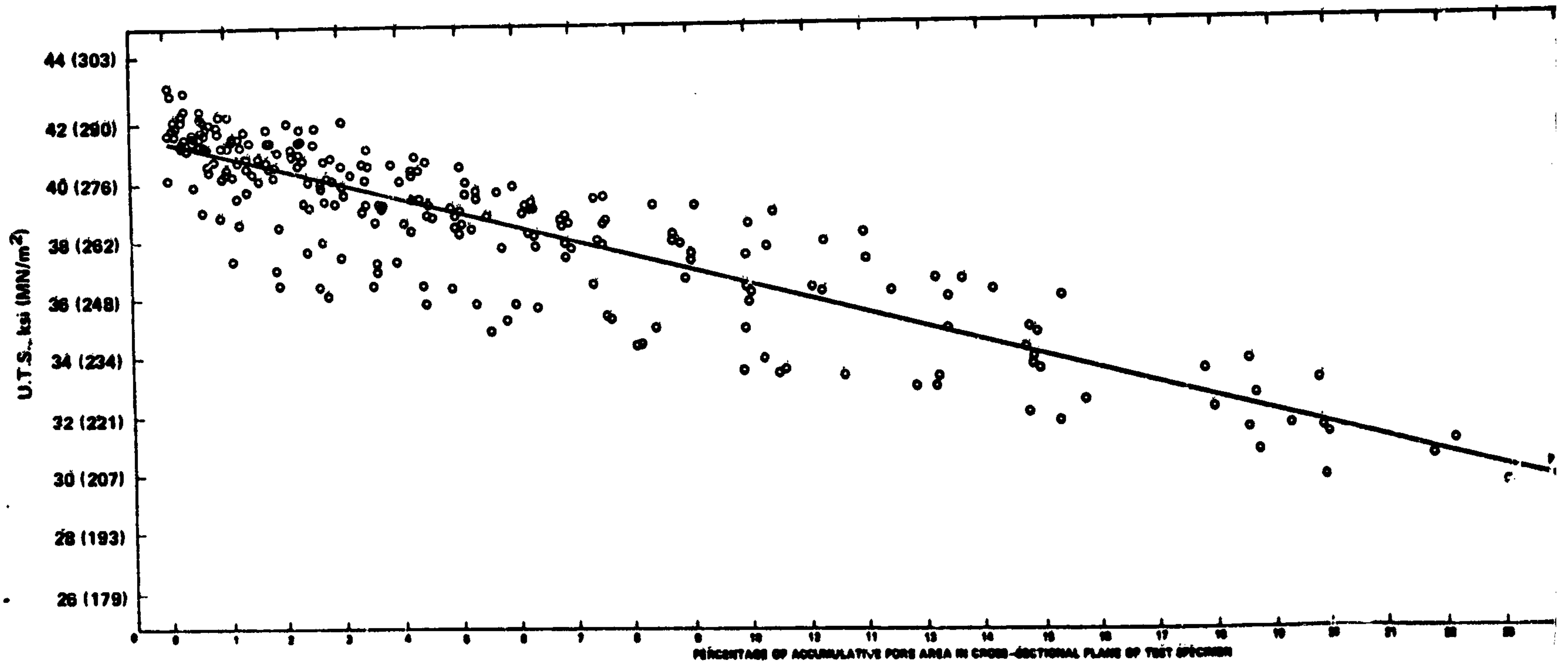


Figure 14. Ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (all three thicknesses) versus percentage of accumulative area of porosity in cross-sectional plane.

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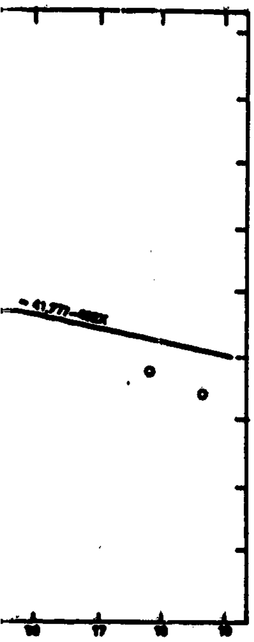
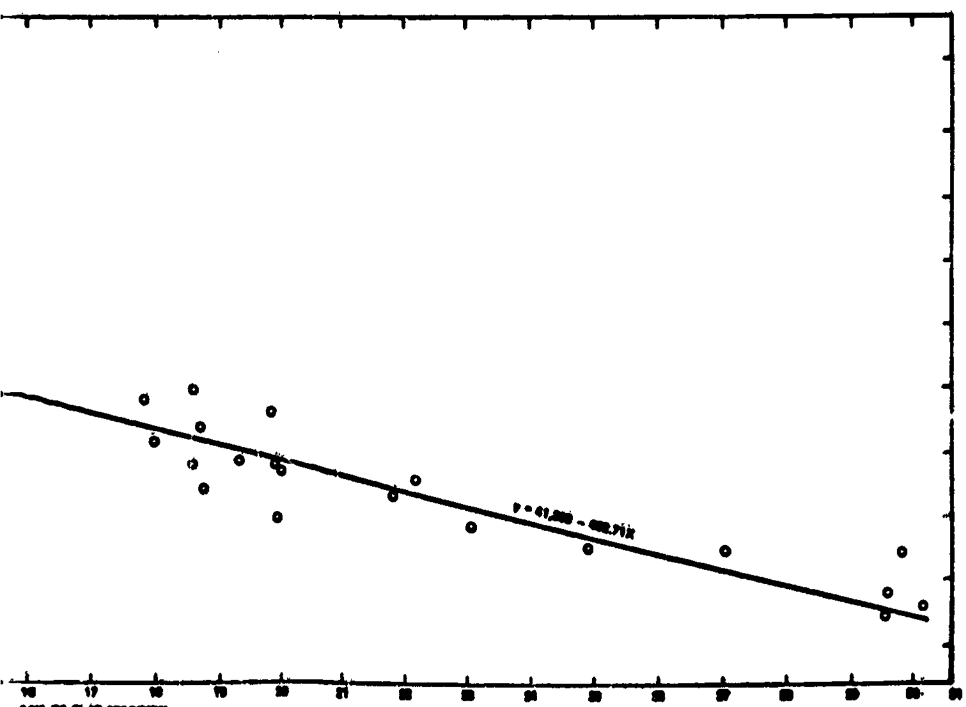


2219-T87 (0.50 in. = 1.27 cm plate)
cross-sectional plane.



2219-T87 (all three thicknesses)
-sectional plane.

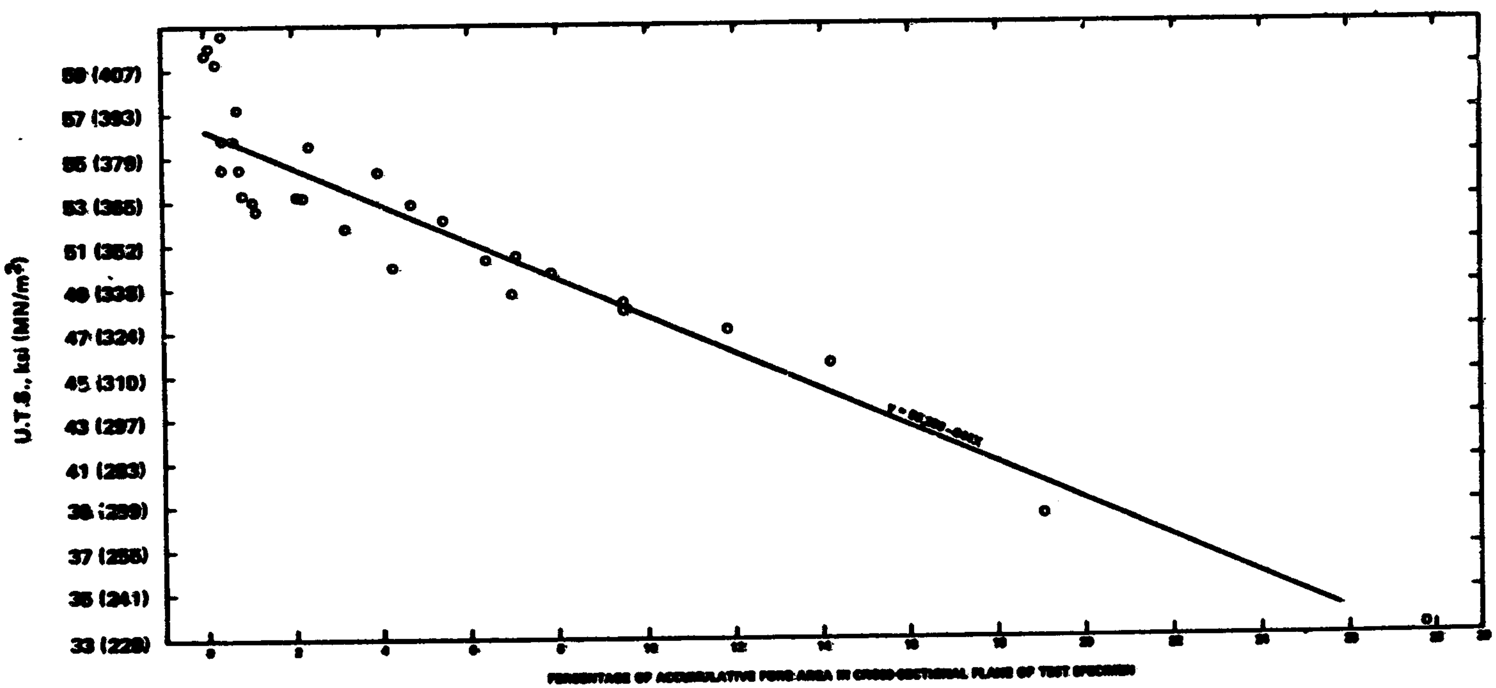


Figure 15. Cryogenic (-320° F = 196° C ultimate tensile strength of flush bead TIG weldments in alloy 2014-T651 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane.

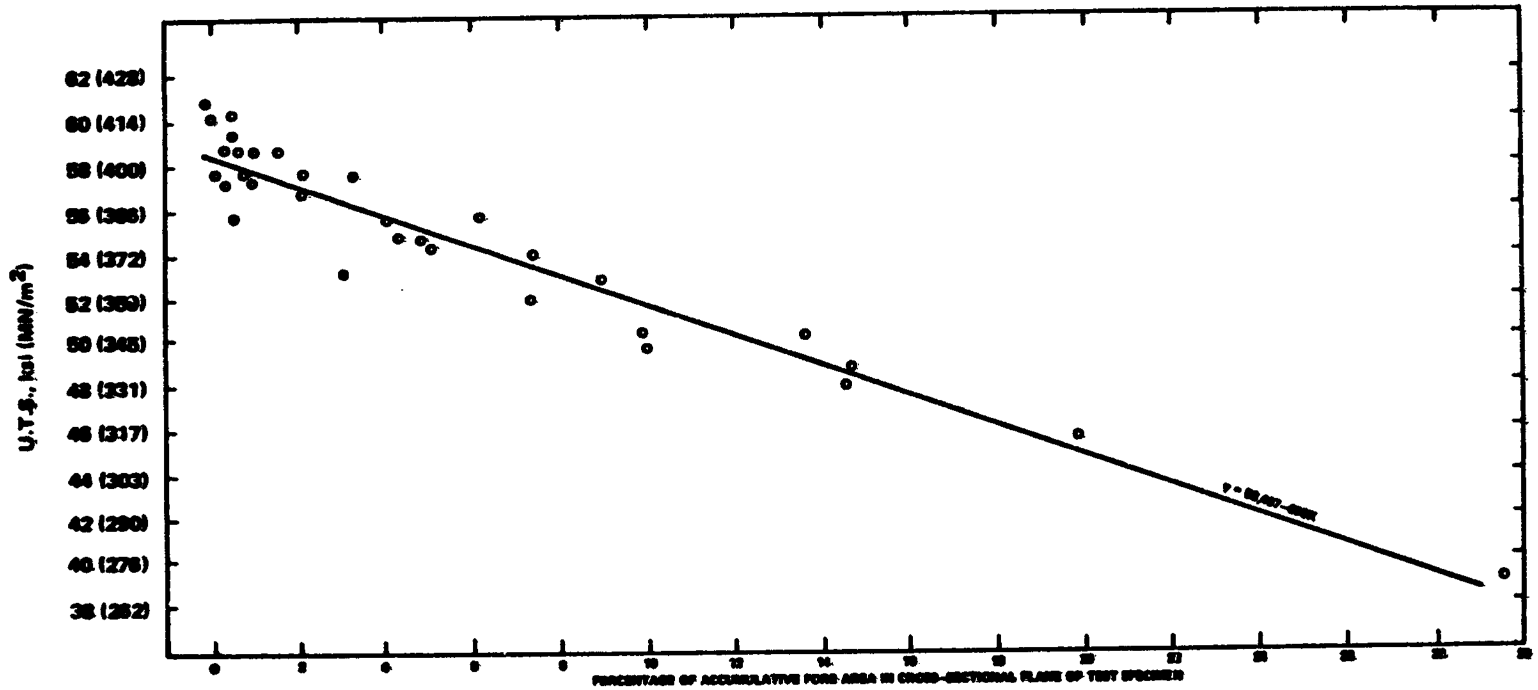


Figure 16. Cryogenic (-320° F = -196° C) ultimate tensile strength of flush bead TIG weldments in alloy 2219-T87 (0.250 in. = 0.635 cm plate) versus percentage of accumulative area of porosity in cross-sectional plane.

In general, accumulative pore area and percent pore area in weldments of each alloy displayed a very strong linear relationship with ultimate tensile strength. Simple straight line regression analysis yielded correlation coefficients (r) which exceeded -0.900, and the square of the coefficients (r^2) was in excess of the numerical value of 0.81. In essence, this means that more than 81 percent of the total ultimate tensile strength variation can be explained by the associated accumulative pore area or percent pore area. In some cases, the correlation coefficients actually surpassed the numerical value of -0.980. These two quantities are grouped together because percent pore area is only a slight mathematical refinement of accumulative pore area. Percent pore area by this method of calculation takes into account the small change in cross-sectional area from specimen-to-specimen. The maximum allowable percentage of porosity for the worst single linear inch of weld permitted by MSFC specifications 259A and 504 [7, 10] are shown for each thickness in the plots of Figures 7, 8, 9, 11, 12, and 13. These allowables represent the worst single inch in six continuous linear inches of weld in the case of 259A, and the worst one inch in three continuous linear inches of weld in the case of 504.

Accumulative pore volume per unit length of weld is also shown to be an excellent indicator of tensile strength. Overall, these correlation coefficient values were slightly lower than those values which were obtained by using the pore area concept.

The linear relationship between ultimate tensile strength and accumulative linear inch of porosity per unit length of weld was the weakest, as indicated by the resultant correlation coefficients. The coefficients varied from -0.591 to -0.872, with a majority of the values in the -0.750 range. Therefore, the accumulative linear inch concept is not considered as a good indicator to describe the effect of porosity upon weld joint strength degradation.

The ultimate tensile strength for each individual value (all thicknesses combined) was plotted as a function of corresponding percent pore area for each alloy (Figs. 10 and 14). These combined data exhibited a correlation coefficient of -0.882 for weldments of aluminum alloy 2014-T6, and a coefficient of -0.913 for weldments of alloy 2219-T87.

Tensile tests conducted at -320°F (-196°C) with 1/4-in. (0.635-cm) plate weldments also showed a strong linear relationship between ultimate tensile strength and accumulative simulated pore area or percent pore area (Figs. 15 and 16). Simple straight line regression analysis resulted in a correlation coefficient of approximately -0.94 for both alloys. Tensile strength as a function of accumulative pore volume showed a correlation coefficient greater than

-0.88 for both alloys; whereas, using the accumulative linear inch concept, the coefficients were -0.799 and -0.708 for alloy 2014-T6 and alloy 2219-T87, respectively. The resultant correlation coefficients are shown in Tables 5 and 6.

Remarkably, the linear relationship between ultimate tensile strength and accumulated pore area held from 0 to 30 percent pore area at room temperature and from 0 to 15 percent pore area at -320°F (-196°C). These were the highest values of pore area tested and did not necessarily represent a limiting pore area. Another fact which is obvious from reviewing Figures 7 through 16 is that the ultimate strength is reduced linearly to 63 percent of its initial value at 30 percent pore area (70 percent gross cross section of weld metal remaining). This indicates the toughness of these welds in the presence of spherical porosity.

CONCLUSIONS

Tensile properties in defect-free, weldments of aluminum alloy 2014-T6 or 2219-T87 (sheet and plate) are shown to be related to the level of induced simulated porosity. The scatter diagram (strength-porosity graph) showed that the ultimate tensile strength of the weldments displayed the most pronounced linear relationship with the level of porosity. (Yield strength and elongation decreased rapidly at high pore concentrations).

Accumulative pore area or percent pore area displayed the best linear relationship with ultimate tensile strength. Accumulative pore volume also displayed a strong relationship with ultimate tensile strength; whereas, accumulative linear pore diameters indicated a relatively weak relationship with weld strength.

Simple straight line regression analysis of tensile data (considering all thicknesses) showed that (a) 81 to 97 percent of the total ultimate tensile strength variation can be explained by the associated accumulative pore area concept, (b) 76 to 91 percent of the total ultimate tensile strength variation can be attributed to the associated accumulative pore volume, and (c) only 34 to 76 percent of the total ultimate tensile strength variation can be attributed to the associated linear accumulation of pore diameters. Tensile tests conducted at -320°F (-196°C) displayed similar linear trends between corresponding variables.

In summation, the selected relationship between weldment ultimate tensile strength and accumulative pore area may be treated as linear, provided only those pores which pass through the fracture path are considered for correlation purposes. However, the linear relationship holds to much greater pore concentrations than are curently allowed. Other internal defects, such as fissure, dross, sharp tails, lack of fusion, and impure weld metal, will undoubtedly affect the strength of the weld but were avoided to obtain the correlation of spherical-type porosity. Nevertheless, this relationship based on accumulative pore area, as detected by radiographic techniques, in combination with known design load requirements will serve as an engineering guideline in determining when a weld repair is necessary or when porosity is acceptable. In addition, this same relationship makes possible an assessment of existing radiographic acceptance standards, and it has been applied to determine the porosity levels in MSFC-SPEC-504.

TABLE 5. THE RELATIONSHIP BETWEEN TRANSVERSE WELDMENT ULTIMATE TENSILE STRENGTH AND PORE CONCENTRATION FOR ALLOY 2219-T87

Base Material Thickness Inch (cm)	Specimen Width Inch (cm)	Correlation Coefficient (r)			
		Accumulative Pore Volume vs. UTS	Accumulative Pore Area vs. UTS	Percent of Accumulative Pore Area vs. UTS	Accumulative Linear Pore Dia. vs. UTS
0.125 (0.318)	1.0 (2.54)	-0.933	-0.966	-0.966	-0.643
0.250 (0.635)	0.250 (0.635)	-0.937	-0.981	-0.981	-0.779
0.250 (0.635)	0.50 (1.27)	-0.953	-0.984	-0.984	-0.715
0.250 (0.635)	0.50 (1.27)	-0.948*	-0.990*	-0.992*	-0.708*
0.250 (0.635)	1.00 (2.54)	-0.930	-0.972	-0.981 (-0.980**)	-0.673
0.500 (1.27)	1.00 (2.54)	-0.875	-0.903	-0.917	-0.726
Using Ambient Temperature UTS Results from all Thicknesses and Widths				-0.913	

*---Tensile tests conducted at -320°F (-196°C).

**---This coefficient was obtained by using all the ambient temperature tensile results from 0.250-inch (0.635-cm) plate; this would include the results from 0.250-in. (0.635-cm), 0.50-in. (1.27-cm) and 1.00-in. (2.54-cm) wide tensile spec ns.

NOTES: 1. Tensile specimens were made from TIG weldments containing 2319 filler metal.

2. Weld beads were removed until flush with base metal surface.

3. Percent pore area was calculated by taking the accumulative pore area and dividing by the cross-sectional area of the tensile specimen X100.

4. Accumulative linear inch of pores was arrived by the summation of pore diameters.

5. The pore diameters ranged from 0.009 inch (0.023 cm) to 0.203 inch (0.514 cm).

6. The pore concentrations ranged as follows:

a. Accumulative pore volume was 0 to 0.135 cubic inches (0 to 0.221 cm^3).

b. Accumulative pore area was 0 to 0.094 square inch (0 to 0.607 cm^2).

c. Percent of accumulative pore area was 0 to 30.1.

d. Accumulative linear pores was 0 to 0.573 (0 to 1.455 cm).

TABLE 6. THE RELATIONSHIP BETWEEN TRANSVERSE WELDMENT ULTIMATE TENSILE STRENGTH AND PORE CONCENTRATION FOR ALLOY 2014-T6

Base Material Thickness Inch (cm)	Specimen Width Inch (cm)	Correlation Coefficient (r)			
		Accumulative Pore Volume vs. UTS	Accumulative Pore Area vs. UTS	Percent of Accumulative Pore Area vs. UTS	Accumulative Linear Pore Dia. vs. UTS
0.107 (0.272)	1.0 (2.54)	-0.909	-0.943	-0.945	-0.698
0.250 (0.635)	0.250 (0.635)	-0.891	-0.956	-0.956	-0.872
0.250 (0.635)	0.50 (1.27)	-0.901	-0.953	-0.952	-0.787
0.250 (0.635)	0.50 (1.27)	-0.885*	-0.939*	-0.939*	-0.799*
0.250 (0.635)	1.00 (2.54)	-0.890	-0.950	-0.952 (-0.953**)	-0.759
0.500 (1.27)	1.00 (2.54)	-0.890	-0.886	-0.885)	-0.591
Using Ambient Temperature UTS Results from all Thicknesses and Widths				-0.882	

*---Tensile tests conducted at -320°F (-196°C).

**---This coefficient was obtained by using all the ambient temperature tensile results from 0.250-inch (0.635-cm) plate; this would include the results from 0.250-in. (0.635-cm), 0.50-in. (1.27-cm) and 1.00-in. (2.54-cm) wide tensile specimens.

NOTES:
1. Tensile specimens were made from TIG weldments containing 4043 filler metal.
2. Weld beads were removed until flush with base metal surface.
3. Percent pore area was calculated by taking the accumulative pore area and dividing by the cross-sectional area of the tensile specimen X100.
4. Accumulative linear inch of pores was arrived by the summation of pore diameters.
5. The pore diameters ranged from 0.009 inch (0.023 cm) to 0.203 inch (0.514 cm).
6. The pore concentrations ranged as follows:
   a. Accumulative pore volume was 0 to 0.025 cubic inches (0 to 0.412 cm^3).
   b. Accumulative pore area was 0 to 0.181 square inch (0 to 1.168 cm^2).
   c. Percent of accumulative pore area was 0 to 36.1.
   d. Accumulative linear pores was 0 to 1.107 inch (0 to 2.182 cm).

APPENDIX

DATA FOR TENSILE STRENGTH MEASUREMENTS OF ALUMINUM ALLOY SPECIMENS

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TABLE A-1. FLUSH BEAD TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.107 INCH (0.272 CM) SHEET ALUMINUM ALLOY 2014-T6

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
47.36 (326.47)	36.09 (248.83)	2.0	0	0	0	0	0	0
46.06 (317.57)	35.01 (241.39)	2.0	0.0125 (0.0318)	5	0.0625 (0.1588)	0.00000622 (0.0001019)	0.00069 (0.00445)	0.78
42.66 (294.13)	35.73 (246.35)	1.3	0.0125 (0.0318)	10	0.125 (0.3175)	0.00001244 (0.0002039)	0.00138 (0.0089)	1.502
42.29 (291.58)	35.14 (242.28)	1.5	0.0125 (0.0318)	15	0.1875 (0.4763)	0.00001868 (0.0003058)	0.00207 (0.01335)	2.238
42.20 (290.96)	35.30 (243.39)	1.5	0.0125 (0.0318)	20	0.25 (0.635)	0.00002488 (0.0004077)	0.00276 (0.01781)	2.896
41.51 (296.20)	36.11 (248.97)	1.2	0.0125 (0.0318)	25	0.3125 (0.7983)	0.0000311 (0.0005096)	0.00345 (0.02226)	3.647
42.37 (292.13)	35.71 (246.21)	1.0	0.0125 (0.0318)	30	0.375 (0.9525)	0.00003732 (0.0006116)	0.00414 (0.02671)	4.358
42.45 (292.68)	36.60 (252.35)	1.0	0.0125 (0.0318)	33	0.4125 1.0478)	0.00004105 (0.0006727)	0.00455 (0.02935)	4.784
47.15 (325.09)	36.80 (253.73)	2.2	0.019 (0.0483)	1	0.019 (0.0483)	0.00000407 (0.0000667)	0.00032 (0.00203)	0.34
44.14 (304.34)	36.67 (252.83)	2.2	0.019 (0.0483)	4	0.076 (0.193)	0.00001629 (0.0002669)	0.00126 (0.00813)	1.362
42.25 (291.31)	37.24 (256.78)	1.5	0.019 (0.0483)	7	0.133 (0.3378)	0.0000285 (0.000467)	0.00221 (0.01426)	2.381
41.29 (284.69)	37.89 (261.24)	1.5	0.019 (0.0483)	10	0.19 (0.4826)	0.00004072 (0.0006673)	0.00315 (0.02032)	3.383
41.73 (287.72)	36.13 (249.11)	1.5	0.019 (0.0483)	13	0.247 (0.6274)	0.00005294 (0.0008675)	0.0041 (0.02645)	4.56
40.18 (277.03)	36.23 (249.80)	1.0	0.019 (0.0483)	16	0.304 (0.7722)	0.00006515 (0.0010676)	0.00504 (0.03252)	5.437
41.93 (289.10)	36.56 (252.07)	1.3	0.019 (0.0483)	19	0.361 (0.9169)	0.00007737 (0.0012679)	0.00599 (0.03865)	6.422
39.89 (275.03)	36.25 (249.94)	0.8	0.019 (0.0483)	22	0.418 (1.0617)	0.00008958 (0.001468)	0.00693 (0.04471)	7.484
41.45 (285.79)	35.29 (243.42)	1.0	0.019 (0.0483)	25	0.475 (1.2065)	0.0001018 (0.0016682)	0.00788 (0.05084)	8.616
46.72 (322.13)	36.78 (253.59)	1.8	0.029 (0.0737)	1	0.029 (0.0737)	0.00001565 (0.0002565)	0.00073 (0.00468)	0.836
41.38 (266.31)	35.30 (243.39)	1.5	0.029 (0.0737)	4	0.116 (0.2946)	0.0000626 (0.0010258)	0.0029 (0.01871)	3.194
41.75 (287.86)	35.00 (241.32)	1.2	0.029 (0.0737)	7	0.203 (0.5156)	0.0001096 (0.001796)	0.00508 (0.03277)	5.571
39.77 (274.21)	34.84 (240.21)	0.8	0.029 (0.0737)	10	0.29 (0.7366)	0.0001565 (0.0025646)	0.00725 (0.04677)	7.713
37.26 (256.90)	34.48 (237.73)	1.2	0.029 (0.0737)	13	0.377 (0.9576)	0.0002035 (0.0033348)	0.00943 (0.06084)	10.069
34.80 (239.94)	33.28 (229.46)	0.5	0.029 (0.0737)	16	0.464 (1.1786)	0.0002504 (0.0041033)	0.0116 (0.07484)	12.327
46.39 (319.85)	36.27 (250.07)	2.3	0.0393 (0.0998)	1	0.0393 (0.0998)	0.00003882 (0.0006361)	0.00134 (0.00865)	1.443
42.02 (289.72)	35.94 (247.80)	1.8	0.0393 (0.0998)	3	0.1178 (0.2992)	0.0001165 (0.0019091)	0.00401 (0.02587)	4.277
41.13 (283.58)	36.25 (249.94)	1.3	0.0393 (0.0998)	5	0.1963 (0.4986)	0.0001941 (0.0031807)	0.00668 (0.0431)	7.16
39.69 (273.65)	35.43 (244.28)	1.8	0.0393 (0.0998)	7	0.2748 (0.698)	0.0002717 (0.0044524)	0.00935 (0.06032)	9.991
38.86 (267.93)	34.97 (241.11)	1.5	0.0393 (0.0998)	9	0.3533 (0.8974)	0.0003494 (0.0057256)	0.01202 (0.07755)	12.943
38.86 (267.86)	34.68 (239.11)	0.8	0.0393 (0.0998)	11	0.4318 (1.0968)	0.000427 (0.0069973)	0.0147 (0.09484)	15.802
44.28 (305.30)	35.79 (246.76)	1.7	0.05 (0.127)	1	0.05 (0.127)	0.0000823 (0.0013459)	0.00217 (0.014)	2.321
38.74 (267.10)	35.35 (243.73)	1.3	0.05 (0.127)	4	0.2 (0.508)	0.0003285 (0.0053832)	0.00869 (0.05606)	9.302
37.16 (256.21)	33.54 (231.25)	1.8	0.05 (0.127)	7	0.35 (0.889)	0.0005749 (0.0094209)	0.0152 (0.09806)	16.278
34.99 (241.25)	32.37 (223.18)	1.5	0.05 (0.127)	10	0.5 (1.27)	0.0008213 (0.0135487)	0.02172 (0.14013)	23.18
41.86 (288.62)	35.37 (243.87)	1.5	0.059 (0.15)	1	0.059 (0.1499)	0.0001344 (0.0022024)	0.00304 (0.01961)	3.307
39.73 (273.93)	34.64 (238.84)	1.2	0.059 (0.15)	2	0.118 (0.2997)	0.0002668 (0.0043721)	0.00608 (0.03923)	6.48
37.88 (261.18)	34.07 (234.91)	1.2	0.059 (0.15)	3	0.177 (0.4496)	0.0004002 (0.0065581)	0.00912 (0.05884)	9.91
37.02 (255.25)	32.84 (226.43)	1.2	0.059 (0.15)	4	0.236 (0.5994)	0.0005336 (0.0087441)	0.01216 (0.07845)	13.199
36.14 (249.18)	32.51 (224.15)	1.2	0.059 (0.15)	5	0.295 (0.7493)	0.000667 (0.0109302)	0.0152 (0.09806)	16.643

TABLE A-1. (Concluded)

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
35.28 (243.25)	31.7[illegible] ([illegible])	1.[illegible]	0.059 (0.15)	6	0.354 (0.8992)	0.0008004 (0.0131162)	0.01823 (0.11761)	19.7[illegible]7
34.72 (239.39)	31.86 (219.67)	0.[illegible]	0.059 (0.15)	7	0.413 (1.049)	0.0009338 (0.0153022)	0.02127 (0.13[illegible]23)	22.229
33.92 (233.87)	30.86 (212.77)	0.4	0.059 (0.15)	8	0.472 (1.1989)	0.001067 (0.017485)	0.02431 (0.15384)	26.[illegible]12
41.13 (283.58)	35.33 (243.59)	1.5	0.07 (0.178)	1	0.07 (0.1778)	0.0002336 (0.003828)	0.00437 (0.02819)	4.[illegible]36
38.34 (264.35)	34.44 (237.46)	1.0	0.07 (0.178)	2	0.14 (0.3556)	0.0004672 (0.007656)	0.00873 (0.05632)	9.331
35.99 (248.14)	32.38 (223.25)	1.3	0.07 (0.178)	3	0.21 (0.5334)	0.0007008 (0.0114841)	0.0131 (0.08452)	14.177
33.59 (231.60)	31.76 (218.98)	1.3	0.07 (0.178)	4	0.28 (0.7112)	0.0009344 (0.0153121)	0.01747 (0.11271)	18.864
33.01 (227.60)	31.16 (214.84)	1.0	0.07 (0.178)	5	0.35 (0.889)	0.001168 (0.0191401)	0.02184 (0.1409)	23.529
31.30 (215.81)	28.38 (195.67)	1.2	0.07 (0.178)	6	0.42 (1.0668)	0.001402 (0.0229747)	0.0262 (0.16903)	23.144
29.90 (206.15)	28.18 (194.30)	0.7	0.07 (0.178)	7	0.49 (1.2446)	0.001635 (0.0267928)	0.03127 (0.20174)	33.194
39.02 (269.04)	30.02 (206.98)	1.5	0.0805 (0.204)	1	0.0805 (0.2045)	0.0003501 (0.0057371)	0.0057 (0.03677)	6.057
36.57 (252.14)	33.80 (233.04)	1.2	0.0805 (0.204)	2	0.161 (0.4089)	0.0007002 (0.0114742)	0.0114 (0.07355)	12.076
34.41 (237.25)	32.10 (221.32)	1.2	0.0805 (0.204)	3	0.242 (0.6147)	0.00105 (0.0172064)	0.0171 (0.11032)	18.25
31.17 (214.91)	29.93 (206.36)	1.2	0.0805 (0.204)	4	0.322 (0.8179)	0.0014 (0.0229419)	0.0228 (0.1471)	25.055
30.90 (213.05)	29.16 (201.05)	1.2	0.0805 (0.204)	5	0.403 (1.0236)	0.001751 (0.0286937)	0.0285 (0.18387)	30.778
28.52 (196.64)	27.39 (188.85)	0.8	0.0805 (0.204)	6	0.483 (1.2268)	0.00211 (0.0345767	0.0342 (0.22064)	36.62

NOTES: (1) ALL TENSILE SPECIMENS WERE ONE INCH WIDE.
(2) EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-2. FLUSH BEAD TENSILE RESULTS FOR 0.250 IN. (0.635 CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY

U. T. S., KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME $INCHES^3$ (cc)	ACCUMULATIVE PORE AREA $INCHES^2$ (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
50.87 (350.74)	36.81 (253.80)	3.1	0	0	0	0	0	0
50.21 (346.19)	37.04 (255.38)	2.3	0.009 (0.0229)	1	0.009 (0.0229)	0.000000603 (0.00000988)	0.000066 (0.000426)	0.1056
49.40 (340.60)	36.32 (250.42)	2.3	0.009 (0.0229)	2	0.018 (0.0457)	0.000001206 (0.00001976)	0.000132 (0.000852)	0.2074
47.87 (330.05)	36.66 (252.76)	2.3	0.009 (0.0229)	3	0.027 (0.0686)	0.000001809 (0.00002964)	0.000198 (0.001277)	0.3104
46.67 (321.78)	36.68 (252.90)	1.8	0.009 (0.0229)	4	0.036 (0.0914)	0.000002412 (0.00003953)	0.000264 (0.001703)	0.417
47.70 (328.88)	37.14 (256.07)	1.5	0.009 (0.0229)	5	0.045 (0.1143)	0.000003015 (0.00004941)	0.00033 (0.002129)	0.5211
48.16 (332.05)	36.43 (251.18)	2.0	0.009 (0.0229)	6	0.054 (0.1372)	0.000003618 (0.00005929)	0.000396 (0.002555)	0.614
45.28 (312.20)	36.47 (251.45)	1.7	0.009 (0.0229)	7	0.063 (0.16)	0.000004221 (0.00006917)	0.000462 (0.002981)	0.7257
45.10 (310.96)	36.42 (251.11)	2.0	0.009 (0.0229)	8	0.072 (0.1829)	0.000004824 (0.00007905)	0.000528 (0.003406)	0.8376
49.00 (337.85)	36.77 (253.52)	2.3	0.0165 (0.0419)	1	0.0165 (0.0419)	0.000002881 (0.00004721)	0.00024 (0.001548)	0.3812
48.56 (334.81)	36.20 (249.59)	2.5	0.0165 (0.0419)	2	0.033 (0.0838)	0.000005762 (0.00009442)	0.00048 (0.003097)	0.7591
47.34 (326.40)	36.12 (249.04)	1.8	0.0165 (0.0419)	3	0.0495 (0.1257)	0.000008643 (0.00014163)	0.00072 (0.004645)	1.1401
47.60 (328.19)	35.48 (244.63)	2.2	0.0165 (0.0419)	4	0.066 (0.1676)	0.000011413 (0.00018884)	0.00096 (0.006194)	1.5005
47.69 (328.81)	36.52 (251.80)	2.3	0.0165 (0.0419)	5	0.0825 (0.2096)	0.000014405 (0.00023606)	0.0012 (0.007742)	1.8779
45.95 (316.82)	35.99 (248.14)	1.8	0.0165 (0.0419)	6	0.099 (0.2515)	0.000017286 (0.00028327)	0.00144 (0.00929)	2.2652
48.17 (332.12)	36.62 (252.49)	2.3	0.039 (0.0991)	1	0.039 (0.0991)	0.000039 (0.0006391)	0.001368 (0.008826)	2.1462
46.72 (322.13)	36.63 (252.56)	2.2	0.039 (0.0991)	2	0.078 (0.1981)	0.000078 (0.0012782)	0.002736 (0.017652)	4.3066
44.62 (307.65)	36.10 (248.90)	2.0	0.039 (0.0991)	3	0.117 (0.2972)	0.000117 (0.0019173)	0.004104 (0.26477)	6.4896
45.32 (312.47)	35.73 (246.35)	2.3	0.059 (0.15)	1	0.059 (0.1499)	0.0001389 (0.0022762)	0.003007 (0.0194)	4.7496
41.82 (288.34)	35.16 (242.42)	1.8	0.059 (0.15)	2	0.118 (0.2997)	0.0002778 (0.0045523)	0.006014 (0.0388)	9.4724
41.79 (288.13)	33.36 (230.01)	2.3	0.0765 (0.1943)	1	0.0765 (0.1943)	0.0002856 (0.0046801)	0.005005 (0.03229)	7.8732
34.87 (240.42)	31.17 (214.91)	1.9	0.0765 (0.1943)	2	0.153 (0.3886)	0.0005712 (0.0093603)	0.01001 (0.06458)	15.7986
39.74 (274.00)	33.16 (228.63)	1.2	0.1005 (0.2553)	1	0.1005 (0.2553)	0.000661 (0.0108318)	0.008652 (0.055819)	13.7181
37.07 (255.59)	30.85 (212.70)	1.5	0.12 (0.3048)	1	0.12 (0.3048)	0.001078 (0.0176653)	0.01218 (0.07858)	[illegible]
31.19 (215.05)	26.75 (184.44)	1.0	0.1455 (0.3696)	1	0.1455 (0.3696)	0.001946 (0.0318892)	0.01793 (0.11568)	28.8402

NOTE: EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-3. FLUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2014-T651

U. T. S., KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME $INCHES^3$ (cc)	ACCUMULATIVE PORE AREA $INCHES^2$ (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
50.87 (350.74)	36.81 (253.80)	3.1	0	0	0	0	0	0
50.24 (346.39)	36.86 (254.14)	2.2	0.009 (0.0229)	2	0.018 (0.0457)	0.000001206 (0.00001976)	0.000132 (0.000852)	0.1045
49.07 (338.33)	36.42 (251.11)	2.0	0.009 (0.0229)	4	0.036 (0.0914)	0.000002412 (0.00003953)	0.000264 (0.001703)	0.2079
49.35 (340.26)	37.30 (257.18)	2.3	0.009 (0.0229)	6	0.054 (0.1372)	0.000003618 (0.00005929)	0.000396 (0.002555)	0.3091
46.26 (318.95)	36.98 (254.97)	2.0	0.009 (0.0229)	8	0.072 (0.1829)	0.000004824 (0.00007905)	0.000528 (0.003406)	0.4148
47.11 (324.81)	36.95 (254.76)	1.8	0.009 (0.0229)	10	0.090 (0.2286)	0.00000603 (0.00009881)	0.00066 (0.004258)	0.5136
50.57 (348.67)	36.46 (251.38)	2.2	0.009 (0.0229)	12	0.108 (0.2743)	0.000007236 (0.0001186)	0.000792 (0.0051)	0.6159
46.38 (319.78)	36.53 (251.87)	1.7	0.009 (0.0229)	14	0.126 (0.32)	0.000008442 (0.0001383)	0.000924 (0.005961)	0.7299
44.76 (308.61)	36.13 (249.11)	1.5	0.009 (0.0229)	16	0.144 (0.3658)	0.000009648 (0.0001581)	0.001056 (0.006813)	0.8205
48.83 (336.67)	36.84 (254.00)	2.5	0.0165 (0.0419)	2	0.033 (0.0838)	0.000005762 (0.00009442)	0.00048 (0.003097)	0.3756
47.53 (327.71)	36.65 (252.69)	2.2	0.0165 (0.0419)	4	0.066 (0.1676)	0.000011524 (0.00018884)	0.00096 (0.006194)	0.7589
47.08 (324.61)	36.94 (254.69)	2.0	0.0165 (0.0419)	6	0.099 (0.2515)	0.000017286 (0.00028327)	0.00144 (0.00929)	1.1259
[illegible]2 (316.61)	36.28 (250.14)	2.5	0.0165 (0.0419)	8	0.132 (0.3353)	0.000023048 (0.0003777)	0.00192 (0.01239)	1.4907
[illegible]5 (321.64)	36.54 (251.94)	2.2	0.0165 (0.0419)	10	0.165 (0.4191)	0.00002881 (0.0004721)	0.0024 (0.01548)	1.8663
47.34 (326.40)	36.47 (251.45)	2.0	0.0165 (0.0419)	12	0.198 (0.5029)	0.000034572 (0.0005665)	0.00288 (0.01858)	2.243
47.47 (327.30)	36.97 (254.90)	2.2	0.039 (0.0991)	1	0.039 (0.0991)	0.000039 (0.0006391)	0.001368 (0.008826)	1.0806
45.92 (316.61)	36.63 (252.56)	2.3	0.039 (0.0991)	2	0.078 (0.1981)	0.000078 (0.0012782)	0.002736 (0.017652)	2.1325
46.43 (320.13)	36.94 (254.69)	2.3	0.039 (0.0991)	3	0.117 (0.2972)	0.000117 (0.0019173)	0.004104 (0.026477)	3.2571
45.24 (311.92)	36.59 (252.28)	2.0	0.039 (0.0991)	4	0.156 (0.3962)	0.000156 (0.0025564)	0.005472 (0.035303)	4.2884
44.89 (309.51)	36.07 (248.70)	2.3	0.039 (0.0991)	5	0.195 (0.4953)	0.000195 (0.0031955)	0.00684 (0.044129)	5.3689
44.03 (303.58)	[illegible]	2.0	0.039 (0.0991)	6	0.234 (0.5944)	0.000234 (0.0038346)	0.008208 (0.052955)	6.4276
46.90 (323.37)	36.48 (251.52)	2.5	0.059 (0.15)	1	0.059 (0.1499)	0.0001389 (0.0022762)	0.003007 (0.0194)	2.3456
44.58 (307.37)	35.69 (246.08)	2.5	0.059 (0.15)	2	0.118 (0.2997)	0.0002778 (0.0045523)	0.006014 (0.0388)	4.7429
44.30 (305.44)	35.23 (242.90)	2.5	0.059 (0.15)	3	0.177 (0.4496)	0.0004167 (0.0068285)	0.009021 (0.0582)	7.0587
41.86 (288.62)	35.55 (245.11)	1.7	0.059 (0.15)	4	0.236 (0.5994)	0.0005556 (0.0091047)	0.012028 (0.0776)	9.4411
45.59 (314.33)	34.92 (240.77)	2.5	0.0765 (0.1943)	1	0.0765 (0.1943)	0.0002856 (0.0046801)	0.005005 (0.03229)	3.9132
43.23 (298.06)	34.16 (235.53)	2.5	0.0765 (0.1943)	2	0.153 (0.3886)	0.0005712 (0.0093603)	0.01001 (0.06458)	7.8571
40.72 (280.77)	34.21 (235.87)	2.2	0.0765 (0.1943)	3	0.2295 (0.5829)	0.0008568 (0.01404)	0.015015 (0.096871)	11.6848
43.52 (300.06)	35.02 (241.46)	1.2	0.1005 (0.2553)	1	0.1005 (0.2553)	0.000661 (0.0108318)	0.008652 (0.055819)	6.7752
40.21 (277.24)	32.96 (227.25)	1.8	0.1005 (0.2553)	2	0.201 (0.5105)	0.001322 (0.021664)	0.017304 (0.111638)	13.4766
42.45 (292.58)	34.19 (235.73)	2.0	0.12 (0.3048)	1	0.12 (0.3048)	0.001078 (0.0176653)	0.01218 (0.07858)	9.583
36.74 (253.31)	31.50 (217.19)	1.5	0.12 (0.3048)	2	0.24 (0.6096)	0.002156 (0.035331)	0.02436 (0.15716)	19.2569
38.66 (266.55)	32.75 (225.80)	1.3	0.1455 (0.3696)	1	0.1455 (0.3696)	0.001946 (0.0318892)	0.01793 (0.11568)	14.107
32.91 ([illegible]5.91)	28.92 (199.40)	1.0	0.1455 (0.3696)	2	0.291 (0.7391)	0.003892 (0.063778)	0.03586 (0.23135)	28.4603
NOTE:	EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.							

TABLE A-4. FLUSH BEAD TENSILE RESULTS FOR 1.00-IN. (2.54-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM) ALUMINUM ALLOY 2014-T651

U. T. S., KSI (MN/m^2)	Y. S. 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
50.87 (350.74)	36.81 (253.80)	3.1	0	0	0	0	0	0
49.04 (338.12)	37.01 (255.18)	2.8	0.009 (0.0229)	5	0.045 (0.1143)	0.000003015 (0.00004941)	0.00033 (0.002129)	0.1318
46.77 (322.47)	36.62 (252.49)	2.2	0.009 (0.0229)	10	0.09 (0.2286)	0.00000603 (0.00009881)	0.00066 (0.004258)	0.265
45.10 (310.96)	37.22 (256.62)	2.2	0.009 (0.0229)	15	0.135 (0.3429)	0.000009045 (0.00014822)	0.00099 (0.00638[illegible])	0.3933
46.35 (319.57)	36.56 (252.07)	2.3	0.009 (0.0229)	20	0.18 (0.4572)	0.00001206 (0.00019763)	0.00132 (0.00851[illegible])	0.5134
46.64 (321.57)	36.62 (252.49)	2.0	0.009 (0.0229)	25	0.225 (0.5715)	0.000015075 (0.00024703)	0.00165 (0.010645)	0.6643
48.93 (337.36)	36.50 (251.66)	2.7	0.009 (0.0229)	30	0.27 (0.6858)	0.00001809 (0.00029644)	0.00198 (0.012774)	0.782
46.44 (320.19)	36.40 (250.97)	2.3	0.009 (0.0229)	33	0.297 (0.7544)	0.000019899 (0.00032609)	0.002178 (0.014052)	0.8471
48.76 (336.19)	36.59 (252.28)	2.0	0.0165 (0.0419)	1	0.0165 (0.0419)	0.000002881(0.000047211)	0.00024 (0.0015484)	0.09415
47.38 (326.68)	38.66 (266.55)	2.2	0.0165 (0.0419)	4	0.066 (0.1676)	0.000011524 (0.00018884)	0.00096 (0.006194)	0.3811
47.45 (327.16)	37.78 (260.49)	2.3	0.0165 (0.0419)	7	0.1155 (0.2934)	0.000020167 (0.00033048)	0.00168 (0.010839)	0.6677
46.33 (319.44)	36.34 (250.56)	2.0	0.0165 (0.0419)	10	0.165 (0.4191)	0.00002881 (0.0004721)	0.0024 (0.01548)	0.9471
46.03 (317.37)	36.99 (255.04)	2.0	0.0165 (0.0419)	13	0.2145 (0.5448)	0.000037453 (0.0006137)	0.00312 (0.020129)	1.246
46.11 (317.92)	37.78 (260.49)	2.2	0.0165 (0.0419)	16	0.264 (0.6706)	0.000046096 (0.0007554)	0.00384 (0.024774)	1.5317
45.35 (312.68)	37.65 (259.59)	1.7	0.0165 (0.0419)	19	0.3135 (0.7963)	0.000054739 (0.000897)	0.00456 (0.029419)	1.8088
44.96 (309.99)	36.00 (248.21)	2.0	0.0165 (0.0419)	22	0.363 (0.922)	0.000063382 (0.0010386)	0.00528 (0.034064)	2.0837
46.45 (320.26)	37.06 (255.52)	2.3	0.0165 (0.0419)	25	0.4125 (1.0478)	0.000072[illegible]25 (0.0011803)	0.006 (0.03871)	2.3557
49.22 (339.36)	36.88 (254.28)	2.0	0.039 (0.0991)	1	0.039 (0.0991)	0.000039 (0.0006391)	0.001368 (0.008826)	0.5354
46.21 (318.61)	36.60 (252.35)	2.2	0.039 (0.0991)	3	0.117 (0.2972)	0.000117 (0.0019173)	0.004104 (0.026477)	1.6119
46.62 (321.44)	36.28 (250.14)	2.2	0.039 (0.0991)	5	0.195 (0.4953)	0.000195 (0.0031955)	0.00684 (0.044129)	2.7536
44.21 (304.82)	35.59 (245.39)	2.0	0.039 (0.0991)	7	0.273 (0.6934)	0.000273 (0.0044737)	0.009576 (0.061781)	3.7970
43.81 (302.06)	36.59 (252.28)	1.8	0.039 (0.0991)	8	0.312 (0.7925)	0.000312 (0.005[illegible]8)	0.010944 (0.070606)	4.265
43.34 (298.82)	36.26 (250.01)	2.0	0.039 (0.0991)	9	0.351 (0.8915)	0.000351 (0.00[illegible]519)	0.012312 (0.079432)	4.847
43.83 (302.20)	36.63 (252.56)	2.0	0.039 (0.0991)	10	0.39 (0.9906)	0.00039 (0.00[illegible]391)	0.01368 (0.088258)	5.3879
43.53 (300.13)	35.43 (244.28)	2.0	0.039 (0.0991)	11	0.429 (1.0897)	0.000429 (0.00703)	0.015048 (0.097084)	5.9833
44.18 (304.61)	35.52 (244.90)	2.5	0.039 (0.0991)	12	0.468 (1.1887)	0.000468 (0.007669)	0.016416 (0.105909)	6.463
48.23 (332.54)	37.37 (257.66)	2.7	0.059 (0.15)	1	0.059 (0.1499)	0.0001389 (0.0022762)	0.003007 (0.0194)	1.1947
45.13 (311.16)	37.05 (255.45)	2.5	0.059 (0.15)	2	0.118 (0.2997)	0.0002778 (0.0045523)	0.006014 (0.0388)	2.3686
44.63 (307.71)	37.30 (257.18)	2.7	0.059 (0.15)	3	0.177 (0.4496)	0.0004167 (0.0068285)	0.009021 (0.0582)	3.6775
43.90 (302.68)	36.80 (253.73)	2.5	0.059 (0.15)	4	0.236 (0.5994)	0.0005556 (0.0091047)	0.012028 (0.0776)	4.7882
42.75 (294.75)	35.38 (243.94)	2.0	0.059 (0.15)	5	0.295 (0.7493)	0.0006945 (0.011381)	0.015035 (0.0967)	5.971
42.72 (294.55)	35.16 (242.42)	2.7	0.059 (0.15)	6	0.354 (0.8992)	0.0008334 (0.013657)	0.018042 (0.1164)	7.1368
43.50 (299.92)	35.47 (244.56)	2.2	0.059 (0.15)	7	0.413 (1.049)	0.0009723 (0.015933)	0.021049 (0.1358)	8.3329
42.01 (289.65)	35.07 (241.80)	2.2	0.059 (0.15)	8	0.472 (1.1989)	0.0011112 (0.018209)	0.024056 (0.1552)	9.546
46.60 (321.30)	36.52 (251.80)	2.5	0.0765 (0.1943)	1	0.0765 (0.1943)	0.0002856 (0.0046801)	0.005005 (0.03229)	1.9885
44.72 (308.34)	37.42 (258.00)	2.0	0.0765 (0.1943)	2	0.153 (0.3886)	0.0005712 (0.0093603)	0.01001 (0.06458)	4.0217
43.64 (300.89)	37.08 (255.66)	2.2	0.0765 (0.1943)	3	0.2295 (0.5829)	0.0008565 (0.01404)	0.015015 (0.096871)	5.8859
41.98 (289.31)	35.34 (243.66)	2.2	0.0765 (0.1943)	4	0.306 (0.7772)	0.0011414 (0.01872)	0.02202 (0.129161)	7.9634

TABLE A-4. (Concluded)

U. T. S., KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
42.81 (295.17)	35.58 (245.32)	2.5	0.0765 (0.1943)	5	0.3825 (0.9716)	0.001428 (0.0234)	0.025025 (0.161451)	9.9821
40.16 (276.90)	35.20 (242.70)	2.2	0.0765 (0.1943)	6	0.459 (1.1659)	0.0017136 (0.02808)	0.03003 (0.193742)	12.1727
46.11 (317.92)	36.49 (251.59)	2.3	0.1005 (0.2553)	1	0.1005 (0.2553)	0.000661 (0.0108318)	0.008652 (0.055819)	3.4683
43.18 (297.72)	34.84 (240.21)	1.8	0.1005 (0.2553)	2	0.201 (0.5105)	0.001322 (0.021664)	0.017304 (0.111638)	7.0199
41.81 (288.27)	34.22 (235.94)	2.2	0.1005 (0.2553)	3	0.3015 (0.7658)	0.001983 (0.032436)	0.025956 (0.167458)	10.227
41.92 (289.03)	34.38 (237.04)	2.0	0.1005 (0.2553)	4	0.402 (1.0211)	0.002644 (0.043327)	0.034608 (0.223277)	13.7061
37.91 (261.38)	33.36 (230.01)	1.3	0.1005 (0.2553)	5	0.5025 (1.2764)	0.003305 (0.054159)	0.04326 (0.279096)	16.9514
43.16 (297.58)	36.49 (251.59)	2.0	0.12 (0.3048)	1	0.12 (0.3048)	0.001078 (0.0176653)	0.01218 (0.07858)	4.8333
43.08 (297.03)	35.88 (247.39)	1.8	0.12 (0.3048)	2	0.24 (0.6096)	0.002156 (0.035331)	0.02436 (0.15716)	9.6628
38.46 (265.17)	33.48 (230.84)	1.5	0.12 (0.3048)	3	0.36 (0.9144)	0.003234 (0.052996)	0.03654 (0.23574)	15.5622
35.68 (246.01)	30.86 (212.77)	1.8	0.12 (0.3048)	4	0.48 (1.2192)	0.004312 (0.070661)	0.04872 (0.31432)	19.0461
42.98 (296.34)	35.37 (243.87)	1.5	0.1455 (0.3696)	1	0.1455 (0.3696)	0.001946 (0.0318892)	0.01793 (0.11568)	6.9957
40.51 (279.31)	33.14 (228.49)	1.8	0.1455 (0.3696)	2	0.291 (0.7391)	0.003892 (0.063778)	0.03586 (0.23135)	14.2245
35.87 (247.32)	31.15 (214.77)	1.7	0.1455 (0.3696)	3	0.4365 (1.1087)	0.005838 (0.095668)	0.05379 (0.34703)	21.0528
32.52 (224.22)	29.17 (201.12)	1.3	0.1455 (0.3696)	4	0.582 (1.4783)	0.007784 (0.127557)	0.07172 (0.46271)	28.4829

NOTE: EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-5. TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF T16 WELDMENTS (4043 FILLER METAL) IN 0.50 IN. (1.27 CM) PLATE ALUMINUM ALLOY 2014-T651

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME $INCHES^3$ (cc)	ACCUMULATIVE PORE AREA $INCHES^2$ (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
52.70 (363.36)	34.57 (238.35)	4.8	0	0	0	0	0	0
48.50 (334.40)	34.37 (236.97)	2.5	0.0125 (0.0318)	5	0.0625 (0.159)	0.00000622 (0.0001019)	0.00069 (0.0045)	0.1[illegible]1
48.49 (334.33)	34.37 (236.97)	3.3	0.0125 (0.0318)	10	0.125 (0.318)	0.00001244 (0.0002039)	0.00138 (0.0089)	0.282
49.35 (340.26)	34.32 (236.63)	3.5	0.0125 (0.0318)	15	0.1875 (0.476)	0.00001866 (0.0003058)	0.00207 (0.0134)	0.421
48.98 (337.71)	34.06 (234.84)	3.7	0.0125 (0.0318)	20	0.250 (0.635)	0.00002488 (0.0004077)	0.00276 (0.0178)	0.564
48.63 (335.29)	34.61 (238.63)	3.0	0.0125 (0.0318)	25	0.3125 (0.794)	0.0000311 (0.0005096)	0.00345 (0.0223)	0.701
48.79 (336.40)	34.09 (235.04)	4.2	0.0125 (0.0318)	30	0.375 (0.953)	0.00003732 (0.0006116)	0.00416 (0.0267)	0.849
47.96 (330.67)	34.36 (236.91)	2.7	0.0125 (0.0318)	33	0.4125 (1.[illegible]48)	0.00004105 (0.0006727)	0.00455 (0.0294)	0.928
51.20 (353.01)	34.57 (238.35)	4.3	0.019 (0.0483)	1	0.019 (0.048)	0.00000407 (0.0000667)	0.00032 (0.0021)	0.064
48.27 (332.81)	34.51 (237.94)	3.5	0.019 (0.0483)	4	0.076 (0.193)	0.00001629 (0.0002669)	0.00126 (0.0081)	0.258
46.92 (323.50)	35.70 (246.14)	3.5	0.019 (0.0483)	7	0.133 (0.338)	0.0000285 (0.000467)	0.00221 (0.0143)	0.451
46.69 (321.92)	35.12 (242.15)	3.5	0.019 (0.0483)	10	0.19 (0.483)	0.00004072 (0.0006673)	0.00315 (0.0203)	0.651
46.69 (321.92)	35.16 (242.42)	3.3	0.019 (0.0483)	13	0.247 (0.627)	0.00005294 (0.0008675)	0.0041 (0.0265)	0.838
45.89 (316.40)	34.27 (236.28)	2.7	0.019 (0.0483)	16	0.304 (0.772)	0.00006515 (0.0010676)	0.00504 (0.0325)	1.043
45.87 (316.26)	34.31 (236.56)	3.0	0.019 (0.0483)	19	0.361 (0.917)	0.00007737 (0.0012679)	0.00599 (0.0386)	1.243
49.17 (339.01)	34.44 (237.46)	4.0	0.019 (0.0483)	22	0.418 (1.062)	0.00008958 (0.001468)	0.00693 (0.0447)	1.431
47.15 (325.09)	34.46 (237.59)	3.3	0.019 (0.0483)	25	0.475 (1.207)	0.0001018 (0.0016682)	0.00788 (0.0508)	1.623
45.26 (312.06)	33.98 (234.29)	3.0	0.019 (0.0483)	32	0.608 (1.544)	0.0001303 (0.0021352)	0.01008 (0.065)	2.066
44.41 (306.20)	34.98 (241.18)	2.0	0.019 (0.0483)	38	0.722 (1.834)	0.0001547 (0.0025351)	0.01197 (0.0772)	2.453
45.02 (310.40)	35.10 (242.01)	2.5	0.019 (0.0483)	44	0.836 (2.123)	0.0001792 (0.0029366)	0.01386 (0.0894)	2.857
44.81 (308.96)	33.41 (230.36)	2.3	0.019 (0.0483)	50	0.95 (2.413)	0.0002036 (0.003364)	0.01575 (0.1016)	3.2[illegible]4
50.66 (349.29)	34.11 (235.18)	3.5	0.029 (0.0737)	1	0.029 (0.074)	0.00001565 (0.0002565)	0.00073 (0.0047)	0.148
45.68 (314.95)	34.26 (236.22)	3.5	0.029 (0.0737)	4	0.116 (0.295)	0.0000626 (0.0010258)	0.0029 (0.0187)	0.595
47.09 (324.68)	34.38 (237.04)	3.0	0.029 (0.0737)	7	0.203 (0.516)	0.0001096 (0.001796)	0.00508 (0.0328)	1.039
45.53 (313.92)	33.55 (231.32)	3.0	0.029 (0.0737)	10	0.29 (0.737)	0.0001565 (0.0025646)	0.00725 (0.0468)	1.479
45.88 (316.33)	34.18 (235.66)	3.0	0.029 (0.0737)	13	0.377 (0.958)	0.0002035 (0.0033348)	0.00943 (0.0608)	1.924
45.71 (315.16)	34.34 (236.77)	3.0	0.029 (0.0737)	16	0.464 (1.179)	0.0002504 (0.[illegible]033)	0.011[illegible] (0.0748)	2.[illegible]63
44.53 (307.03)	35.66 (245.87)	2.5	0.029 (0.0737)	20	0.58 (1.473)	0.000313 (0.0051[illegible]2)	0.0[illegible] (0.0935)	2.96[illegible]
45.15 (311.30)	35.52 (244.90)	2.5	0.029 (0.0737)	26	0.754 (1.915)	0.000407 (0.006669[illegible])	0.1885 (0.1216)	3.871
44.36 (305.85)	35.55 (245.11)	2.7	0.029 (0.0737)	32	0.928 (2.357)	0.0005008 (0.008206[illegible])	0.0232 (0.1497)	4.749
49.95 (344.40)	36.01 (248.28)	3.8	0.0393 (0.0998)	1	0.0393 (0.10)	0.00003882 (0.000636[illegible])	0.00134 (0.0086)	0.272
47.03 (324.26)	34.17 (235.60)	3.3	0.0393 (0.0998)	3	0.1178 (0.299)	0.0001165 (0.0019091)	0.00401 (0.0259)	0.82
46.82 (322.81)	34.60 (238.56)	3.0	0.0393 (0.0998)	5	0.1963 (0.499)	0.0001941 (0.0031807)	0.00668 (0.0431)	1.362
46.04 (317.44)	34.05 (234.77)	3.0	0.0393 (0.0998)	7	0.2748 (0.698)	0.0002717 (0.0044524)	0.00936 (0.0603)	1.912
45.95 (316.82)	33.89 (233.66)	3.0	0.0393 (0.0998)	9	0.3533 (0.897)	0.0003494 (0.0057256)	0.01202 (0.0775)	2.464
45.86 (316.20)	34.94 (240.90)	2.3	0.0393 (0.0998)	11	0.4318 (1.097)	0.000427 (0.0069973)	0.0147 (0.0948)	3.008
45.40 (313.02)	34.01 (234.49)	3.0	0.0393 (0.0998)	14	0.5496 (1.396)	0.0005434 (0.0089047)	0.0187 (0.1206)	3.844
43.89 (302.61)	32.76 (225.87)	2.5	0.0393 (0.0998)	18	0.7066 (1.795)	0.0006988 (0.0114513)	0.02405 (0.1552)	4.906

TABLE A-5. (Continued)

U. T. S., KSI (MN/m²)	Y.S., 0.2% OFFSET KSI (MN/m²)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES³ (cc)	ACCUMULATIVE PORE AREA INCHES² (cm²)	CROSS-SECTIONAL PERCENT PORE AREA
44.48 (306.68)	33.84 (233.32)	2.5	0.0393 (0.0998)	22	0.8636 (2.194)	0.000854 (0.0139946)	0.02939 (0.1896)	6.009
47.76 (329.30)	32.98 (227.39)	3.7	0.05 (0.127)	1	0.05 (0.127)	0.00008213 (0.0013459	0.00217 (0.014)	0.443
46.33 (319.44)	34.09 (235.04)	3.5	0.05 (0.127)	4	0.2 (0.508)	0.0003285 (0.0053832)	0.00869 (0.0561)	1.779
45.38 (312.89)	33.44 (230.56)	3.0	0.05 (0.127)	7	0.35 (0.889)	0.0005749 (0.0094209)	0.0152 (0.0981)	3.114
44.77 (308.68)	33.74 (232.63)	2.5	0.05 (0.127)	10	0.5 (1.27)	0.0008213 (0.0134587)	0.02172 (0.1401)	4.427
44.77 (308.68)	33.03 (227.74)	2.5	0.05 (0.127)	14	0.7 (1.778)	0.00115 (0.0188451)	0.03041 (0.1962)	6.199
44.43 (306.34)	33.57 (231.46)	2.5	0.05 (0.127)	20	1.0 (2.54)	0.001626 (0.0266454)	0.04344 (0.2803)	8.847
48.18 (332.19)	34.11 (235.18)	3.3	0.05 (0.127)	1	0.059 (0.15)	0.0001334 (0.002186)	0.00304 (0.0196)	0.623
46.88 (323.23)	35.28 (243.25)	2.8	0.059 (0.15)	2	0.118 (0.30)	0.0002668 (0.0043721)	0.00608 (0.0392)	1.244
48.03 (331.16)	34.24 (236.08)	3.5	0.059 (0.15)	3	0.117 (0.45)	0.0004002 (0.0065581)	0.00912 (0.0588)	1.877
44.97 (310.06)	33.44 (230.56)	3.0	0.059 (0.15)	4	0.236 (0.599)	0.0005336 (0.0087441)	0.01216 (0.0785)	2.5
44.81 (308.96)	34.02 (234.56)	2.5	0.059 (0.15)	5	0.295 (0.749)	0.000667 (0.0109302)	0.0152 (0.0981)	3.124
45.55 (314.06)	35.88 (247.39)	2.8	0.059 (0.15)	6	0.354 (0.899)	0.0008004 (0.0131162)	0.01823 (0.1176)	3.724
43.39 (299.17)	34.91 (240.70)	2.8	0.059 (0.15)	7	0.413 (1.049)	0.0009338 (0.0153022)	0.02127 (0.1372)	4.349
45.27 (312.13)	35.84 (247.11)	3.0	0.059 (0.15)	8	0.472 (1.199)	0.001067 (0.017485)	0.02431 (0.1568)	4.962
45.54 (313.99)	36.61 (252.42)	2.8	0.059 (0.15)	10	0.59 (1.499)	0.001334 (0.0218603)	0.03039 (0.1961)	6.242
44.80 (308.89)	36.03 (248.42)	2.8	0.059 (0.15)	12	0.708 (1.798)	0.001601 (0.0262357)	0.03647 (0.2353)	7.432
44.39 (306.06)	35.93 (247.73)	2.8	0.059 (0.15)	14	0.826 (2.098)	0.001868 (0.030611)	0.04255 (0.2745)	8.667
45.62 (314.54)	35.78 (246.70)	2.8	0.059 (0.15)	16	0.944 (2.398)	0.002134 (0.0347)	0.04862 (0.3137)	9.982
48.66 (335.50)	33.87 (233.53)	3.2	0.07 (0.178)	1	0.07 (0.178)	0.0002336 (0.003828)	0.00437 (0.0282)	0.902
46.18 (318.40)	33.89 (233.66)	2.8	0.07 (0.178)	2	0.14 (0.356)	0.0004672 (0.007656)	0.00873 (0.0563)	1.794
45.34 (312.61)	34.05 (234.77)	3.2	0.07 (0.178)	3	0.21 (0.533)	0.0007008 (0.011484)	0.0131 (0.0845)	2.7
44.67 (307.99)	34.07 (234.91)	2.5	0.07 (0.178)	4	0.28 (0.711)	0.0009344 (0.015312)	0.01747 (0.1127)	3.599
44.18 (304.61)	32.93 (227.05)	2.5	0.07 (0.178)	5	0.35 (0.889)	0.001168 (0.0191401)	0.02184 (0.1409)	4.499
44.31 (305.51)	33.91 (233.80)	2.8	0.07 (0.178)	6	0.42 (1.067)	0.001402 (0.0229747)	0.0262 (0.169)	5.398
43.51 (299.99)	34.88 (240.49)	2.2	0.07 (0.178)	7	0.49 (1.245)	0.001635 (0.0267928)	0.03127 (0.2017)	6.446
44.32 (305.58)	35.47 (244.56)	2.3	0.07 (0.178)	10	0.7 (1.778)	0.002336 (0.0382802)	0.04367 (0.2817)	8.934
43.28 (298.41)	35.12 (242.15)	2.0	0.07 (0.178)	12	0.84 (2.134)	0.002804 (0.0459493)	0.0524 (0.3381)	10.712
43.15 (297.51)	34.11 (235.18)	2.3	0.07 (0.178)	14	0.98 (2.49)	0.00327 (0.0535857)	0.06254 (0.4035)	12.789
47.54 (327.78)	33.95 (234.08)	3.8	0.0805 (0.204)	1	0.0805 (0.204)	0.000350 (0.0057371)	0.0057 (0.0368)	1.173
46.00 (317.16)	34.18 (235.66)	2.8	0.0805 (0.204)	2	0.161 (0.409)	0.0007002 (0.0114742)	0.0114 (0.0735)	2.319
45.76 (315.51)	33.23 (229.11)	2.8	0.0805 (0.204)	3	0.242 (0.615)	0.00105 (0.0172064)	0.0171 (0.1103)	3.507
44.70 (308.20)	34.31 (236.56)	2.3	0.0805 (0.204)	4	0.322 (0.818)	0.0014 (0.0229419)	0.0228 (0.1471)	4.673
44.21 (304.82)	34.01 234.49)	2.3	0.0805 (0.204)	5	0.403 (1.024)	0.001751 (0.0286937)	0.0285 (0.1839)	5.825
44.36 (305.85)	33.95 (234.08)	2.2	0.0805 (0.204)	6	0.483 (1.227)	0.00211 (0.0345767)	0.0342 (0.2206)	7.004
44.06 (303.78)	34.50 (237.87)	2.3	0.0805 (0.204)	8	0.644 (1.636)	0.0028 (0.0458838)	0.0456 (0.2942)	9.36
44.16 (304.47)	34.01 (234.49)	2.0	0.0805 (0.204)	10	0.806 (2.047)	0.003501 (0.0573711)	0.057 (0.3677)	11.7
42.61 (293.79)	34.24 (236.08)	2.2	0.0805 (0.204)	12	0.966 (2.454)	0.00422 (0.0691534)	0.0684 (0.4413)	14.016

TABLE A-5. (Continued)

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
46.87 (323.16)	35.31 (243.46)	3.2	0.088 (0.224)	1	0.088 (0.224)	0.000445 (0.0072922)	0.00678 (0.0437)	1.391
44.42 (306.27)	32.79 (226.08)	2.8	0.088 (0.224)	2	0.176 (0.447)	0.00089 (0.0145845)	0.01356 (0.0875)	2.771
45.08 (310.82)	32.88 (226.70)	3.5	0.088 (0.224)	3	0.264 (0.671)	0.001335 (0.0218767)	0.02034 (0.1312)	4.168
44.35 (305.78)	33.23 (229.11)	2.5	0.088 (0.224)	4	0.352 (0.894)	0.00178 (0.029169)	0.02712 (0.175)	5.543
43.85 (302.34)	34.37 (236.97)	2.3	0.088 (0.224)	5	0.44 (1.118)	0.002225 (0.0364612)	0.03391 (0.2188)	6.938
44.34 (305.72)	34.40 (237.18)	2.3	0.088 (0.224)	6	0.528 (1.341)	0.00267 (0.0437535)	0.04061 (0.2620)	8.366
42.31 (291.72)	33.14 (228.49)	2.3	0.088 (0.224)	8	0.704 (1.788)	0.00356 (0.0583379)	0.05425 (0.3500)	11.073
43.84 (302.27)	33.03 (227.74)	3.2	0.088 (0.224)	10	0.88 (2.235)	0.00445 (0.0729224)	0.06781 (0.4375)	13.859
47.01 (324.12)	34.00 (234.42)	2.5	0.099 (0.251)	1	0.099 (0.251)	0.0006443 (0.0105582)	0.00866 (0.0559)	1.767
46.08 (317.71)	33.95 (234.08)	3.2	0.099 (0.251)	2	0.198 (0.503)	0.001289 (0.0211229)	0.01733 (0.1118)	3.53
45.04 (310.54)	34.37 (236.97)	3.2	0.099 (0.251)	3	0.297 (0.754)	0.001933 (0.0316762)	0.02599 (0.1677)	5.31
44.80 (308.89)	34.27 (236.28)	2.3	0.099 (0.251)	4	0.396 (1.006)	0.002578 (0.0422459)	0.03465 (0.2235)	7.111
43.44 (299.51)	33.46 (230.70)	2.5	0.099 (0.251)	5	0.495 (1.257)	0.003222 (0.0527991)	0.04332 (0.2795)	8.816
44.60 (307.51)	34.93 (240.84)	1.7	0.099 (0.251)	6	0.594 (1.509)	0.003868 (0.0633524)	0.05198 (0.3354)	10.66
42.72 (294.55)	32.90 (226.84)	2.3	0.099 (0.251)	8	0.792 (2.012)	0.005156 (0.0844917)	0.0693 (0.4471)	14.161
41.68 (287.38)	33.78 (232.91)	1.8	0.099 (0.251)	10	0.99 (2.51)	0.006443 (0.1055819)	0.08663 (0.5589)	17.734
46.54 (320.88)	32.84 (226.43)	2.5	0.109 (0.277)	1	0.109 (0.277)	0.000868 (0.014224)	0.01043 (0.0673)	2.155
44.42 (306.27)	32.08 (221.19)	2.5	0.109 (0.277)	2	0.218 (0.554)	0.001736 (0.0284479)	0.02087 (0.1346)	4.296
44.21 (304.82)	32.06 (221.05)	2.5	0.109 (0.277)	3	0.327 (0.831)	0.002604 (0.0426719)	0.0313 (0.2019)	6.446
42.35 (291.99)	31.46 (216.91)	2.2	0.109 (0.277)	4	0.436 (1.107)	0.003472 (0.0568959)	0.04174 (0.2695)	8.538
42.84 (295.37)	33.38 (230.15)	2.0	0.109 (0.277)	6	0.654 (1.661)	0.005208 (0.083438)	0.0626 (0.4039)	12.782
43.04 (296.75)	32.57 (224.56)	2.7	0.109 (0.277)	8	0.872 (2.215)	0.0069440 (0.1137918)	0.08347 (0.5385)	17.126
45.16 (311.37)	33.09 (228.15)	2.5	0.1205 (0.306)	1	0.1205 (0.306)	0.001135 (0.0185993)	0.01258 (0.0812)	2.557
43.25 (298.20)	33.12 (228.36)	2.0	0.1205 (0.306)	2	0.241 (0.612)	0.00227 (0.0372986)	0.02516 (0.1623)	5.096
41.78 (288.06)	32.53 (224.29)	1.8	0.1205 (0.306)	3	0.3615 (0.918)	0.003405 (0.055798)	0.03774 (0.2435)	7.638
42.34 (291.93)	32.86 (226.56)	2.2	0.1205 (0.306)	4	0.482 (1.224)	0.00454 (0.0743973)	0.05032 (0.3246)	10.248
43.13 (297.37)	33.19 (228.84)	3.0	0.1205 (0.306)	6	0.723 (1.836)	0.00681 (0.1115959)	0.07548 (0.4870)	15.47
41.16 (283.79)	32.68 (225.32)	2.5	0.1205 (0.306)	8	0.964 (2.449)	0.00908 (0.1487945)	0.10064 (0.6493)	20.518
43.88 (302.54)	34.27 (236.28)	2.7	0.132 (0.335)	1	0.132 (0.335)	0.00146 (0.0239251)	0.01492 (0.0963)	3.049
42.79 (295.03)	33.48 (230.84)	2.7	0.132 (0.335)	2	0.264 (0.671)	0.00292 (0.0478502)	0.02984 (0.1925)	6.1
41.29 (284.69)	33.12 (228.36)	2.3	0.132 (0.335)	3	0.396 (1.006)	0.00438 (0.0717753)	0.04476 (0.2888)	9.127
41.66 (287.24)	32.74 (225.74)	1.8	0.132 (0.335)	4	0.528 (1.341)	0.00584 (0.0957005)	0.05968 (0.385)	12.17
41.57 (286.62)	33.33 (229.80)	2.3	0.132 (0.335)	6	0.792 (2.012)	0.00876 (0.1435507)	0.08952 (0.5775)	18.314
41.09 (283.31)	32.50 (224.08)	2.0	0.132 (0.335)	8	1.056 (2.682)	0.01168 (0.19140)	0.11936 (0.7701)	24.524
44.80 (308.89)	33.98 (234.29)	2.8	0.1415 (0.359)	1	0.1415 (0.359)	0.00186 (0.0304562)	0.01726 (0.1114)	3.537
42.02 (289.72)	33.11 (228.29)	2.2	0.1415 (0.359)	2	0.283 (0.719)	0.003722 (0.0609927)	0.03452 (0.2227)	7.021
42.59 (293.65)	33.52 (231.11)	2.0	0.1415 (0.359)	3	0.4245 (1.078)	0.005583 (0.091489)	0.05178 (0.3341)	10.604
39.18 (270.14)	32.08 (221.19)	2.0	0.1415 (0.359)	4	0.566 (1.438)	0.007444 (0.1219853)	0.06904 (0.4457)	14.297

TABLE A-5. (Concluded)

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME $INCHES^3$ (cc)	ACCUMULATIVE PORE AREA $INCHES^2$ (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
41.34 (285.03)	33.03 (227.74)	2.5	0.1415 (0.359)	6	0.849 (2.156)	0.01117 (0.1830435)	0.10356 (0.6681)	21.3
37.25 (256.83)	32.21 (222.08)	1.8	0.1415 (0.359)	8	1.132 (2.875)	0.01489 (0.2440034)	0.13808 (0.8908)	28.394
43.18 (297.72)	33.24 (229.18)	3.8	0.1485 (0.377)	1	0.1485 (0.377)	0.002045 (0.0335115)	0.01853 (0.1195)	3.821
41.52 (286.27)	32.81 (226.22)	2.5	0.1485 (0.377)	2	0.297 (0.754)	0.00409 (0.0670231)	0.03706 (0.2391)	7.594
40.11 (276.55)	31.41 (216.57)	2.0	0.1485 (0.377)	3	0.4455 (1.132)	0.006135 (0.1005346)	0.05559 (0.3586)	11.45
40.86 (281.72)	33.45 (230.63)	2.2	0.1485 (0.377)	4	0.594 (1.509)	0.00818 (0.13404618)	0.07412 (0.4782)	15.257
38.57 (265.93)	32.51 (224.15)	2.2	0.1485 (0.377)	6	0.891 (2.263)	0.01227 (0.2010693)	0.11118 (0.7173)	22.943
44.61 (307.58)	33.65 (232.01)	2.2	0.1605 (0.408)	1	0.1605 (0.408)	0.0027 (0.0442451)	0.0223 (0.1439)	4.572
42.53 (293.24)	32.45 (223.74)	1.7	0.1605 (0.408)	2	0.3205 (0.814)	0.0054 (0.0884901)	0.0446 (0.2877)	9.132
40.82 (281.45)	31.55 (217.53)	2.2	0.1605 (0.408)	3	0.4815 (1.223)	0.0081 (0.1327352)	0.0669 (0.4316)	13.723
40.72 (280.76)	31.49 (217.12)	2.5	0.1605 (0.408)	4	0.642 (1.631)	0.0108 (0.1769803)	0.0892 (0.5755)	18.297
39.32 (271.10)	30.37 (209.40)	2.2	0.1605 (0.408)	6	0.963 (2.446)	0.0162 (0.2654704)	0.1338 (0.8632)	27.474
43.93 (302.89)	33.10 (228.22)	2.8	0.171 (0.434)	1	0.171 (0.434)	0.003346 (0.0548311)	0.02567 (0.1656)	5.223
42.38 (292.20)	32.13 (221.53)	2.8	0.171 (0.434)	2	0.342 (0.869)	0.006692 (0.1096622)	0.05134 (0.3312)	10.441
38.58 (266.00)	30.90 (213.05)	2.0	0.171 (0.434)	3	0.513 (1.303)	0.01004 (0.1645261)	0.07701 (0.4968)	15.595
40.30 (277.86)	30.58 (210.84)	2.0	0.171 (0.434)	4	0.684 (1.737)	0.01338 (0.2192589)	0.10268 (0.6625)	21.176
37.33 (257.38)	29.97 (206.64)	2.0	0.171 (0.434)	6	1.026 (2.606)	0.02008 (0.3290522)	0.15402 (0.9937)	31.659
42.19 (290.89)	33.08 (228.08)	2.7	0.1845 (0.469)	1	0.1845 (0.469)	0.004193 (0.068711)	0.03016 (0.1946)	6.155
39.30 (270.97)	32.01 (220.70)	2.2	0.1845 (0.469)	2	0.369 (0.937)	0.008386 (0.1374219)	0.06032 (0.3892)	12.245
36.18 (249.45)	30.64 (211.26)	2.0	0.1845 (0.469)	3	0.5535 (1.406)	0.01258 (0.2061493)	0.09048 (0.5837)	18.36
39.10 (269.59)	30.11 (207.60)	3.0	0.1845 (0.469)	4	0.738 (1.875)	0.01677 (0.2748111)	0.12064 (0.7783)	24.742
33.39 (230.22)	28.80 (198.57)	1.5	0.1845 (0.469)	6	1.107 (2.812)	0.02516 (0.4122985)	0.18096 (1.1675)	37.196
42.12 (290.41)	32.98 (227.39)	2.7	0.191 (0.485)	1	0.191 (0.485)	0.004499 (0.0737254)	0.03136 (0.2023)	6.435
39.69 (273.65)	31.53 (217.39)	2.2	0.191 (0.485)	2	0.382 (0.97)	0.008998 (0.147451)	0.06272 (0.4046)	12.889
35.17 (242.49)	29.49 (203.33)	2.0	0.191 (0.485)	3	0.573 (1.455)	0.01349 (0.221061)	0.09408 (0.607)	19.322
41.24 (284.34)	32.50 (224.08)	2.8	0.2025 (0.514)	1	0.2025 (0.514)	0.005471 (0.089654)	0.03536 (0.2281)	7.231
38.18 (263.24)	30.31 (208.98)	2.2	0.2025 (0.514)	2	0.405 (1.029)	0.01094 (0.179274)	0.07072 (0.4563)	14.409
34.40 (237.18)	29.21 (201.40)	1.8	0.2025 (0.514)	4	0.81 (2.057)	0.02188 (0.358549)	0.14144 (0.9125)	29.097

NOTES:

(1) ALL TENSILE SPECIMENS WERE ONE INCH WIDE.

(2) EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-6. FLUSH BEAD TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.125 IN. (0.318 CM) SHEET ALUMINUM ALLOY 2219-T87

U. T. S., KSI (MN/m²)	Y.S., 0.2% OFFSET KSI (MN/m²)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES³ (cc)	ACCUMULATIVE PORE AREA INCHES² (cm²)	CROSS-SECTIONAL PERCENT PORE AREA
40.10 (276.48)	27.01 (186.23)	2.70	0	0	0	0	0	0
39.04 (269.18)	26.98 (186.02)	2.66	0.0125 (0.0328)	5	0.0625 (0.1588)	0.00000622 (0.0001019)	0.00069 (0.00445)	0.601
38.68 (266.69)	27.10 (186.85)	2.33	0.0125 (0.0318)	10	0.125 (0.3175)	0.00001244 (0.0002039)	0.00138 (0.00890)	1.205
36.97 (254.90)	26.81 (184.85)	2.00	0.0125 (0.0318)	15	0.1875 (0.4763)	0.00001866 (0.0003058)	0.00207 (0.01335)	1.840
37.68 (259.80)	27.39 (188.85)	2.00	0.0125 (0.0318)	20	0.25 (0.635)	0.00002488 (0.0004077)	0.00276 (0.01781)	2.400
37.47 (258.34)	27.09 (186.78)	1.83	0.0125 (0.0318)	25	0.3125 (0.7938)	0.00003110 (0.0005096)	0.00345 (0.02226)	2.970
37.20 (256.49)	27.64 (190.58)	1.83	0.0125 (0.0318)	30	0.375 (0.9525)	0.00003732 (0.0006116)	0.00414 (0.02671)	3.600
38.69 (266.76)	28.71 (197.95)	1.83	0.0125 (0.0318)	33	0.4125 (1.0478)	0.00004105 (0.0006727)	0.00455 (0.02935)	4.030
37.33 (257.38)	25.83 (178.10)	2.83	0.019 (0.0483)	4	0.076 (0.1930)	0.00001629 (0.0002669)	0.00126 (0.00813)	1.103
36.48 (251.52)	26.49 (182.64)	2.50	0.019 (0.0483)	7	0.133 (0.3378)	0.0000285 (0.0004670)	0.00221 (0.01426)	1.885
36.05 (248.55)	26.98 (186.02)	2.50	0.019 (0.0483)	10	0.19 (0.4826)	0.00004072 (0.0006673)	0.00315 (0.02032)	2.751
36.98 (254.97)	26.47 (182.60)	2.33	0.019 (0.0483)	13	0.247 (0.6274)	0.00005294 (0.0008675)	0.00410 (0.02645)	3.611
36.48 (251.52)	27.33 (188.44)	2.00	0.019 (0.0483)	16	0.304 (0.7722)	0.00006515 (0.0010676)	0.00504 (0.03252)	4.326
35.92 (247.66)	26.99 (186.09)	2.00	0.019 (0.0483)	19	0.361 (0.9169)	0.00007737 (0.0012679)	0.00599 (0.03865)	5.282
35.94 (247.80)	26.61 (183.47)	2.17	0.019 (0.0483)	22	0.418 (1.0617)	0.00008958 (0.0014680)	0.00693 (0.04471)	5.979
37.43 (258.07)	27.65 (190.65)	2.00	0.019 (0.0483)	25	0.475 (1.2065)	0.0001018 (0.0016682)	0.00788 (0.05084)	6.848
36.42 (251.11)	26.54 (182.99)	2.17	0.029 (0.0737)	4	0.116 (0.2946)	0.0000626 (0.0010258)	0.00290 (0.01871)	2.596
35.88 (247.38)	26.36 (181.74)	2.67	0.029 (0.0737)	7	0.203 (0.5156)	0.0001096 (0.0017960)	0.00508 (0.03277)	4.409
35.75 (246.49)	26.39 (181.95)	2.33	0.029 (0.0737)	10	0.29 (0.7366)	0.0001565 (0.0025646)	0.00725 (0.04677)	6.343
35.07 (241.80)	26.42 (182.16)	1.67	0.029 (0.0737)	13	0.377 (0.9576)	0.0002035 (0.0033348)	0.00943 (0.06084)	8.400
34.03 (234.63)	25.88 (178.44)	1.50	0.029 (0.0737)	16	0.464 (1.1786)	0.0002504 (0.0041033)	0.01160 (0.07484)	10.247
39.52 (272.48)	26.98 (186.02)	2.83	0.0393 (0.0998)	1	0.0393 (0.0998)	0.00003882 (0.0006361)	0.00134 (0.00865)	1.166
36.49 (251.66)	26.53 (182.92)	2.16	0.0393 (0.0998)	3	0.1178 (0.2992)	0.0001165 (0.0019091)	0.00401 (0.02587)	3.534
35.35 (243.73)	25.95 (178.92)	2.50	0.0393 (0.0998)	5	0.1963 (0.4986)	0.0001941 (0.0031807)	0.00668 (0.04310)	5.779
34.49 (237.87)	26.57 (183.19)	2.00	0.0393 (0.0998)	7	0.2748 (0.6980)	0.0002717 (0.0044524)	0.00935 (0.06032)	8.125
33.47 (230.77)	25.43 (175.33)	1.83	0.0393 (0.0998)	9	0.3533 (0.8974)	0.0003494 (0.0057256)	0.01202 (0.07755)	10.483
33.04 (227.81)	25.77 (177.68)	1.67	0.0393 (0.0998)	11	0.4318 (1.0968)	0.000427 (0.0069973)	0.01470 (0.09484)	12.846
38.47 (265.24)	26.71 (184.16)	2.83	0.05 (0.127)	1	0.05 (0.127)	0.00008213 (0.0013459)	0.00217 (0.01400)	1.882
35.32 (243.52)	27.22 (187.68)	2.17	0.05 (0.127)	4	0.2 (0.508)	0.0003285 (0.0053832)	0.00869 (0.05606)	7.628
33.39 (230.22)	26.15 (180.30)	1.67	0.05 (0.127)	7	0.35 (0.889)	0.0005749 (0.0094209)	0.01520 (0.09806)	13.221
31.69 (218.49)	25.67 (176.99)	1.67	0.05 (0.127)	10	0.5 (1.27)	0.0008213 (0.0134587)	0.02172 (0.14013)	19.272
37.97 (261.79)	26.72 (184.23)	2.33	0.059 (0.15)	1	0.059 (0.1499)	0.0001344 (0.0022024)	0.00304 (0.01961)	2.620
34.97 (241.10)	26.44 (182.30)	2.50	0.059 (0.15)	2	0.118 (0.2997)	0.0002668 (0.0043721)	0.00608 (0.03923)	5.541
34.45 (237.53)	26.69 (184.02)	2.67	0.059 (0.15)	3	0.177 (0.4496)	0.0004002 (0.0065581)	0.00912 (0.05884)	8.068
33.66 (232.08)	26.12 (180.09)	2.00	0.059 (0.15)	4	0.236 (0.5994)	0.0005336 (0.0087441)	0.01216 (0.07845)	10.589
33.01 (227.60)	25.74 (177.47)	2.33	0.059 (0.15)	5	0.295 (0.7493)	0.000667 (0.0109302)	0.01520 (0.09806)	13.179
32.62 (224.91)	25.86 (178.30)	1.67	0.059 (0.15)	6	0.354 (0.8992)	0.0008004 (0.0131162)	0.01823 (0.11761)	15.719
31.60 (217.87)	25.93 (178.78)	2.00	0.059 (0.15)	7	0.413 (1.0490)	0.0009338 (0.0153022)	0.02127 (0.13723)	18.547

TABLE A-6. (Concluded)

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
30.55 (210.64)	24.62 (169.75)	1.67	0.059 (0.15)	8	0.472 (1.1989)	0.001067 (0.0174850)	0.02431 (0.15684)	21.844
37.32 (257.32)	26.92 (185.61)	3.00	0.07 (0.178)	1	0.070 (0.1778)	0.0002336 (0.0038280)	0.00437 (0.02819)	3.910
35.40 (244.08)	27.30 (18[illegible].23)	2.50	0.07 (0.178)	2	0.14 (0.3556)	0.0004672 (0.0076560)	0.00873 (0.05632)	7.575
33.46 (230.70)	26.32 ([illegible]1.47)	2.33	0.07 (0.178)	3	0.21 (0.5334)	0.0007008 (0.114841)	0.01310 (0.08452)	11.593
31.92 (220.09)	25.23 (173.96)	2.66	0.07 (0.178)	4	0.28 (0.7112)	0.0009344 (0.0153121)	0.01747 (0.11271)	15.283
30.74 (211.95)	24.67 (170.09)	2.00	0.07 (0.178)	5	0.35 (0.8890)	0.001168 (0.0191401)	0.02184 (0.14090)	18.694
29.62 (204.23)	23.96 (165.20)	2.00	0.07 (0.178)	6	0.42 (1.0663)	0.001402 (0.0229747)	0.02620 (0.16903)	23.045
28.95 (199.61)	23.20 (159.96)	2.00	0.07 (0.178)	7	0.49 (1.2446)	0.001635 (0.0267928)	0.03127 (0.20174)	26.979
36.37 (250.76)	27.70 (190.99)	2.50	0.0805 (0.204)	1	0.0805 (0.2045)	0.0003501 (0.0057371)	0.00570 (0.03677)	4.872
33.52 (231.12)	26.14 (180.23)	2.33	0.0805 (0.204)	2	0.161 (0.4089)	0.0007002 (0.0114742)	0.01140 (0.07355)	9.879
32.19 (221.94)	25.35 (174.78)	2.16	0.0805 (0.204)	3	0.242 (0.6147)	0.00105 (0.0172064)	0.01710 (0.11032)	14.729
29.89 (206.09)	24.42 (168.37)	2.50	0.0805 (0.204)	4	0.322 (0.8179)	0.0014 (0.0229419)	0.02280 (0.14710)	19.879
29.04 (200.23)	23.40 (161.34)	2.00	0.0805 (0.204)	5	0.403 (1.0236)	0.001751 (0.0286937)	0.02850 (0.18387)	24.047
27.16 (187.26)	21.99 (151.62)	1.33	0.0805 (0.204)	6	0.483 (1.2268)	0.00211 (0.0345767)	0.03420 (0.22064)	30.106

NOTES:
(1) ALL TENSILE SPECIMENS WERE ONE INCH WIDE
(2) EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-7. FLUSH BEAD TENSILE RESULTS FOR 0.250-IN. (0.635-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) ALUMINUM ALLOY 2219-T87

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
41.72 (287.65)	27.95 (192.71)	4.7	0	0	0	0	0	0
41.72 (287.65)	28.67 (197.67)	4.3	0.009 (0.0229)	1	0.009 (0.0229)	0.000000603 (0.00000988)	0.000066 (0.000426)	0.1104
41.43 (285.65)	27.31 (188.30)	4.5	0.009 (0.0229)	2	0.018 (0.0457)	0.000001206 (0.00001976)	0.000132 (0.000852)	0.2204
41.51 (286.20)	28.10 (193.74)	4.0	0.009 (0.0229)	3	0.027 (0.0686)	0.000001809 (0.00002964)	0.000198 (0.001277)	0.3328
41.39 (285.38)	27.85 (192.02)	4.2	0.009 (0.0229)	4	0. 036 (0.0914)	0.000002412 (0.00003953)	0.000264 (0.001703)	0.4430
41.28 (284.62)	27.46 (189.33)	3.7	0.009 (0.0229)	5	0.045 (0.1143)	0.000003015 (0.00004941)	0.00033 (0.002129)	0.5541
41.11 (283.45)	27.47 (189.40)	3.3	0.009 (0.0229)	6	0.054 (0.1372)	0.000003618 (0.00005929)	0.000396 (0.002555)	0.6681
40.80 (281.31)	27.52 (189.74)	3.8	0.009 (0.0229)	7	0.063 (0.1600)	0.000004221 (0.00006917)	0.000462 (0.002981)	0.7741
38.83 (267.73)	27.47 (189.40)	2.8	0.009 (0.0229)	8	0.072 (0.1829)	0.000004824 (0.00007905)	0.000528 (0.003406)	0.8946
41.48 (286.00)	27.27 (188.02)	4.5	0.0195 (0.0495)	1	0.0195 (0.0495)	0.000004235 (0.00006940)	0.0003315 (0.002139)	0.5538
41.57 (286.62)	27.94 (192.64)	4.5	0.0195 (0.0495)	2	0.039 (0.0991)	0.00000847 (0.0001388)	0.000663 (0.004277)	1.1111
41.88 (288.75)	27.72 (191.12)	4.2	0.0195 (0.0495)	3	0.0585 (0.1486)	0.000012705 (0.0002082)	0.0009945 (0.006416)	1.6771
41.89 (288.82)	27.66 (190.71)	4.5	0.0195 (0.0495)	4	0.078 (0.1981)	0.00001694 (0.0002776)	0.001326 (0.008555)	2.2532
40.88 (281.86)	28.25 (194.78)	3.2	0.0195 (0.0495)	5	0.0975 (0.2477)	0.000021175 (0.000347)	0.0016575 (0.010694)	2.7815
40.64 (280.20)	27.71 (191.05)	3.7	0.0195 (0.0495)	6	0.117 (0.2972)	0.00002541 (0.0004164)	0.001989 (0.012832)	3.3609
41.15 (283.72)	27.00 (186.16)	3.5	0.037 (0.0940)	1	0.037 (0.0940)	0.00003478 (0.0005699)	0.0012395 (0.007997)	2.1048
40.42 (278.69)	27.52 (189.74)	3.0	0.037 (0.0940)	2	0.074 (0.1880)	0.00006956 (0.0011399)	0.002479 (0.015994)	4.1705
37.84 (260.90)	27.27 (188.02)	3.3	0.037 (0.0940)	3	0.111 (0.2819)	0.00010434 (0.0017098)	0.0037185 (0.02399)	6.3132
38.91 (268.28)	27.53 (189.81)	3.0	0.0585 (0.1486)	1	0.0585 (0.1486)	0.0001344 (0.0022024)	0.0029585 (0.019087)	4.9498
35.01 (241.39)	26.06 (179.68)	2.8	0.0585 (0.1486)	2	0.117 (0.2972)	0.0002698 (0.0044048)	0.005917 (0.034277)	9.9212
37.43 (258.07)	26.07 (179.75)	2.8	0.0795 (0.2019)	1	0.0795 (0.2019)	0.0003011 (0.0049341)	0.005313 (0.034277)	8.990
32.33 (222.91)	23.72 (163.54)	3.0	0.0795 (0.2019)	2	0.159 (0.4039)	0.0006022 (0.0098683)	0.010626 (0.068555)	17.9553
34.09 (235.04)	25.04 (171.65)	2.8	0.1005 (0.2553)	1	0.1005 (0.2553)	0.0006572 (0.0107696)	0.0088 (0.056774)	14.8273
31.54 (217.46)	23.60 (162.72)	2.5	0.118 (0.2997)	1	0.118 (0.2997)	0.001048 (0.0171736)	0.01182 (0.076258)	19.8488
26.89 (185.40)	19.97 (137.69)	2.5	0.143 (0.3632)	1	0.143 (0.3632)	0.001886 (0.030905)	0.01752 (0.113032)	29.569

NOTE: EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-8. FLUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2219-T87

U. T. S., KSI (MN/m²)	Y. S., 0.2% OFFSET KSI (MN/m²)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES³ (cc)	ACCUMULATIVE PORE AREA INCHES² (cm²)	CROSS-SECTIONAL PERCENT PORE AREA
41.72 (287.65)	27.95 (192.71)	4.7	0	0	0	0	0	0
41.88 (288.75)	28.26 (194.85)	4.0	0.009 (0.0229)	2	0.018 (0.0457)	0.000001206 (0.00001976)	0.000132 (0.000852)	0.1112
41.36 (285.17)	27.80 (191.68)	3.7	0.009 (0.0229)	4	0.036 (0.0914)	0.000002412 (0.00003953)	0.000264 (0.001703)	0.2222
41.19 (284.00)	27.63 (190.50)	4.0	0.009 (0.0229)	6	0.054 (0.1372)	0.000003618 (0.00005929)	0.000396 (0.002555)	0.3345
39.89 (275.03)	27.33 (188.43)	4.0	0.009 (0.0229)	8	0.072 (0.1829)	0.000004824 (0.00007905)	0.000528 (0.003406)	0.4437
42.10 (290.27)	28.43 (196.02)	4.2	0.009 (0.0229)	10	0.090 (0.2286)	0.000006030 (0.00009881)	0.00066 (0.004258)	0.5509
40.57 (279.72)	27.81 (191.74)	3.5	0.009 (0.0229)	12	0.108 (0.2743)	0.000007236 (0.00011858)	0.000792 (0.005110)	0.665
41.04 (282.96)	28.09 (193.67)	3.3	0.009 (0.0229)	16	0.144 (0.3658)	0.000009648 (0.0001581)	0.001056 (0.006813)	0.88
41.81 (288.27)	27.69 (190.92)	4.0	0.0195 (0.0495)	2	0.039 (0.0991)	0.00000847 (0.0001388)	0.000663 (0.004277)	0.5586
40.29 (277.79)	27.72 (191.12)	2.8	0.0195 (0.0495)	4	0.078 (0.1981)	0.00001694 (0.0002776)	0.001326 (0.008555)	1.1143
41.42 (285.58)	28.50 (196.50)	3.5	0.0195 (0.0495)	6	0.117 (0.2972)	0.00002541 (0.0004164)	0.001989 (0.012832)	1.6688
41.00 (282.69)	27.00 (186.16)	4.2	0.0195 (0.0495)	8	0.156 (0.3962)	0.00003388 (0.0005520)	0.002652 (0.017110)	2.2361
40.09 (276.41)	27.15 (187.19)	3.3	0.0195 (0.0495)	10	0.195 (0.4953)	0.00004235 (0.000694)	0.003315 (0.021387)	2.7951
39.03 (269.10)	26.89 (185.40)	3.2	0.0195 (0.0495)	12	0.234 (0.5944)	0.00005082 (0.0008328)	0.003978 (0.025664)	3.3401
41.27 (284.55)	27.10 (186.85)	3.5	0.037 (0.0940)	1	0.037 (0.0940)	0.00003478 (0.0005699)	0.0012395 (0.007997)	1.0495
40.97 (282.48)	28.40 (195.81)	3.2	0.037 (0.0940)	2	0.074 (0.1880)	0.00006956 (0.0011399)	0.002479 (0.015994)	2.1044
40.32 (278.00)	27.44 (189.19)	3.3	0.037 (0.0940)	3	0.111 (0.2819)	0.00010434 (0.0017098)	0.0037185 (0.02399)	3.1353
39.47 (272.14)	27.29 (188.16)	3.5	0.037 (0.0940)	4	0.148 (0.3759)	0.00013912 (0.0022797)	0.004958 (0.031987)	4.1804
39.49 (272.28)	27.33 (188.43)	2.8	0.037 (0.0940)	5	0.185 (0.4699)	0.0001739 (0.0028497)	0.0061975 (0.039984)	5.2655
39.07 (269.38)	27.87 (192.16)	3.2	0.037 (0.0940)	6	0.222 (0.5639)	0.00020868 (0.0034197)	0.007437 (0.047981)	6.2286
41.34 (285.03)	28.05 (193.40)	3.2	0.0585 (0.1486)	1	0.0585 (0.1486)	0.0001344 (0.0022024)	0.0029585 (0.019087)	2.4924
38.64 (266.42)	26.58 (183.26)	3.7	0.0585 (0.1486)	2	0.117 (0.2972)	0.0002688 (0.0044048)	0.005917 (0.038174)	5.0272
38.79 (267.45)	26.69 (184.02)	3.5	0.0585 (0.1486)	3	0.1755 (0.4458)	0.0004032 (0.0066073)	0.0088755 (0.057261)	7.5344
36.30 (250.28)	25.93 (178.78)	2.8	0.0585 (0.1486)	4	0.234 (0.5944)	0.0005376 (0.0088097)	0.011834 (0.076348)	10.0288
38.81 (267.59)	26.58 (183.26)	3.0	0.0795 (0.2019)	1	0.0795 (0.2019)	0.0003011 (0.0049341)	0.005313 (0.034277)	4.476
37.46 (258.28)	25.47 (175.61)	3.5	0.0795 (0.2019)	2	0.159 (0.4039)	0.0006022 (0.0098683)	0.010626 (0.068555)	8.922
35.01 (241.39)	25.49 (175.75)	3.2	0.0795 (0.2019)	3	0.2385 (0.6058)	0.0009033 (0.0148024)	0.015939 (0.102832)	13.3604
37.91 (261.38)	26.42 (182.16)	3.0	0.1005 (0.2553)	1	0.1005 (0.2553)	0.0006572 (0.0107696)	0.0088 (0.056774)	7.464
34.95 (240.97)	24.75 (170.65)	3.0	0.1005 (0.2553)	2	0.201 (0.5106)	0.0013144 (0.0215392)	0.0176 (0.113548)	14.8398
35.90 (247.52)	25.63 (176.71)	3.2	0.118 (0.2997)	1	0.118 (0.2997)	0.001048 (0.0171736)	0.01182 (0.076258)	9.9663
31.34 (216.08)	23.70 (163.41)	2.5	0.118 (0.2997)	2	0.236 (0.5994)	0.002096 (0.0343473)	0.02364 (0.152516)	19.9326
33.94 (234.01)	24.34 (167.82)	3.0	0.143 (0.3632)	1	0.143 (0.3632)	0.001886 (0.030906)	0.01752 (0.113032)	14.7723
27.62 (190.43)	21.69 (149.55)	2.3	0.143 (0.3632)	2	0.286 (0.7264)	0.003772 (0.061812)	0.03504 (0.226064)	29.6196

NOTE EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-9. FLUSH BEAD TENSILE RESULTS FOR 1.00-IN. (2.54-CM) WIDE SPECIMENS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2219-T87

U. T. S., KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
41.72 (287.65)	27.95 (192.71)	4.7	0	0	0	0	0	0
42.17 (290.75)	28.36 (195.54)	4.5	0.009 (0.0229)	5	0.045 (0.1143)	0.000003015 (0.00004941)	0.00033 (0.002129)	0.138
42.56 (293.44)	28.19 (194.36)	3.8	0.009 (0.0229)	10	0.09 (0.2286)	0.00000603 (0.00009881)	0.00066 (0.004258)	0.2768
41.30 (284.76)	27.76 (191.40)	4.2	0.009 (0.0229)	15	0.135 (0.3429)	0.000009045 (0.00014822)	0.00099 (0.006387)	0.4144
42.57 (293.51)	28.51 (196.57)	4.0	0.009 (0.0229)	20	0.18 (0.4572)	0.00001206 (0.000197628)	0.00132 (0.008516)	0.5528
42.03 (289.79)	28.42 (195.95)	4.0	0.009 (0.0229)	25	0.225 (0.5715)	0.000015075 (0.000246953)	0.00165 (0.010645)	0.6968
41.81 (288.27)	28.63 (197.40)	4.2	0.009 (0.0229)	30	0.27 (0.6858)	0.00001809 (0.000296442)	0.00198 (0.012774)	0.8379
41.24 (284.34)	28.25 (194.78)	3.3	0.009 (0.0229)	33	0.297 (0.7544)	0.000019899 (0.000326086)	0.002178 (0.014052)	0.9186
42.23 (291.17)	27.82 (191.81)	4.5	0.0195 (0.0495)	1	0.0195 (0.0495)	0.000004235 (0.00006934)	0.0003315 (0.002139)	0.1397
41.30 (284.76)	28.11 (193.81)	3.0	0.0195 (0.0495)	4	0.078 (0.1981)	0.00001694 (0.0002776)	0.001326 (0.00855)	0.5516
40.37 (278.34)	28.03 (193.26)	3.5	0.0195 (0.0495)	7	0.1365 (0.3467)	0.000029645 (0.0004858)	0.0023205 (0.014971)	0.9713
41.47 (285.93)	28.61 (197.26)	3.3	0.0195 (0.0495)	10	0.195 (0.4953)	0.00004235 (0.000694)	0.003315 (0.02139)	1.3963
39.97 (275.59)	28.07 (193.54)	3.5	0.0195 (0.0495)	13	0.2535 (0.6439)	0.000055055 (0.0009022)	0.0043095 (0.0278)	1.8145
40.62 (280.07)	28.67 (197.67)	3.5	0.0195 (0.0495)	16	0.312 (0.7925)	0.00006776 (0.0011104)	0.005304 (0.03422)	2.222
39.38 (271.52)	27.74 (191.26)	3.3	0.0195 (0.0495)	19	0.3705 (0.9411)	0.000080465 (0.0013186)	0.0062985 (0.04064)	2.6587
39.67 (273.52)	28.82 (198.71)	3.3	0.0195 (0.0495)	22	0.429 (1.0897)	0.00009317 (0.0015268)	0.007293 (0.04705)	3.0733
39.81 (274.48)	28.56 (196.92)	2.8	0.0195 (0.0495)	25	0.4875 (1.2383)	0.000105875 (0.001735)	0.0082875 (0.05347)	3.4909
41.78 (288.06)	27.93 (192.57)	4.0	0.037 (0.094)	1	0.037 (0.094)	0.00003478 (0.0005699)	0.0012395 (0.007997)	0.5206
40.03 (276.00)	26.96 (185.88)	4.3	0.037 (0.094)	3	0.111 (0.2819)	0.00010434 (0.0017099)	0.0037185 (0.02399)	1.5500
39.84 (274.69)	28.00 (193.05)	3.5	0.037 (0.094)	5	0.185 (0.4699)	0.0001739 (0.0028497)	0.0061975 (0.039984)	2.592
38.60 (266.14)	27.81 (191.74)	3.3	0.037 (0.094)	7	0.259 (0.6579)	0.00024346 (0.00399)	0.0086765 (0.05598)	3.6502
38.38 (264.62)	27.88 (192.23)	3.5	0.037 (0.094)	8	0.296 (0.7518)	0.00027824 (0.00456)	0.009916 (0.06397)	4.149
38.50 (265.45)	28.04 (193.33)	3.2	0.037 (0.094)	9	0.333 (0.8458)	0.00031302 (0.005129)	0.0111555 (0.07197)	4.6637
38.41 (264.83)	28.11 (193.81)	2.8	0.037 (0.094)	10	0.37 (0.94)	0.0003478 (0.005699)	0.012395 (0.07997)	5.1732
37.82 (260.76)	27.22 (187.68)	3.0	0.037 (0.094)	11	0.407 (1.0338)	0.00038258 (0.006269)	0.0136345 (0.08732)	5.7216
39.24 (270.55)	27.84 (191.95)	3.2	0.037 (0.094)	12	0.444 (1.1278)	0.00041736 (0.006839)	0.014874 (0.09596)	6.226
41.29 (284.69)	28.75 (198.23)	3.5	0.0585 (0.1486)	1	0.0585 (0.1486)	0.0001344 (0.0022024)	0.0029585 (0.019087)	1.2488
40.18 (277.03)	28.17 (194.23)	3.7	0.0585 (0.1486)	2	0.117 (0.2972)	0.0002688 (0.0044049)	0.005917 (0.038174)	2.5072
39.23 (270.48)	28.40 (195.81)	3.5	0.0585 (0.1486)	3	0.1755 (0.4458)	0.0004032 (0.0066073)	0.0088755 (0.057261)	3.7449
39.05 (269.24)	28.12 (193.88)	3.2	0.0585 (0.1486)	4	0.234 (0.5944)	0.0005376 (0.0088097)	0.011834 (0.076348)	4.9911
38.27 (263.86)	26.89 (185.40)	3.5	0.0585 (0.1486)	5	0.2925 (0.7430)	0.000672 (0.011012)	0.0147925 (0.09544)	6.2787
38.51 (265.52)	28.20 (194.43)	2.8	0.0585 (0.1486)	6	0.351 (0.8915)	0.0008064 (0.0132145)	0.017751 (0.11452)	7.4741
38.06 (262.42)	27.76 (191.40)	3.3	0.0585 (0.1486)	7	0.4095 (1.0401)	0.0009408 (0.0154169)	0.0207095 (0.13361)	8.6796
37.59 (259.18)	27.12 (186.99)	2.8	0.0585 (0.1486)	8	0.468 (1.1887)	0.0010752 (0.0176194)	0.023668 (0.1527)	9.9195
40.72 (280.76)	28.11 (193.81)	3.3	0.0795 (0.2019)	1	0.0795 (0.2019)	0.0003011 (0.0049341)	0.005313 (0.034277)	2.2503
38.80 (267.52)	28.27 (194.92)	3.5	0.0795 (0.2019)	2	0.159 (0.4039)	0.0006022 (0.0098683)	0.010626 (0.068555)	4.5159
38.52 (265.59)	27.81 (191.74)	4.0	0.0795 (0.2019)	3	0.2385 (0.6058)	0.0009033 (0.0148024)	0.015939 (0.102832)	6.7282
36.73 (253.25)	26.10 (179.95)	3.7	0.795 (0.2019)	4	0.318 (0.8077)	0.0012044 (0.0197366)	0.021252 (0.13711)	8.8883

TABLE A-9. (Concluded)

U. T. S., KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
36.33 (250.49)	25.76 (177.61)	3.7	0.0795 (0.2019)	5	0.3975 (1.0097)	0.0015055 (0.0246707)	0.026565 (0.17139)	11.2326
36.16 (249.32)	25.78 (177.75)	3.2	0.0795 (0.2019)	6	0.477 (1.2116)	0.0018066 (0.029605)	0.031878 (0.20568)	13.3716
39.11 (269.66)	27.26 (187.95)	3.3	0.1005 (0.2553)	1	0.1005 (0.2553)	0.0006572 (0.0107696)	0.0088 (0.056774)	3.7021
38.05 (262.35)	27.20 (187.54)	3.3	0.1005 (0.2553)	2	0.201 (0.5105)	0.0013144 (0.0215392)	0.0176 (0.113548)	7.395
36.46 (251.38)	27.25 (187.88)	3.0	0.1005 (0.2553)	3	0.3015 (0.7658)	0.019716 (0.032309)	0.0264 (0.17032)	11.0738
35.01 (241.39)	25.33 (174.65)	3.3	0.1005 (0.2553)	4	0.402 (1.0211)	0.026288 (0.043078)	0.0352 (0.2271)	14.7837
33.94 (234.01)	25.37 (174.92)	2.8	0.1005 (0.2553)	5	0.5025 (1.2764)	0.03286 (0.053848)	0.044 (0.2839)	18.5263
38.32 (264.21)	27.61 (190.37)	3.0	0.118 (0.2997)	1	0.118 (0.2997)	0.001048 (0.0171736)	0.01182 (0.076258)	5.00
36.51 (251.73)	26.46 (182.44)	3.5	0.118 (0.2997)	2	0.236 (0.5994)	0.002096 (0.0343473)	0.02364 (0.152516)	9.9435
33.69 (232.29)	25.07 (172.85)	2.8	0.118 (0.2997)	3	0.354 (0.8992)	0.003144 (0.051521)	0.03546 (0.22877)	14.8992
33.14 (228.49)	24.56 (169.34)	2.5	0.118 (0.2997)	4	0.472 (1.1989)	0.004192 (0.068695)	0.04728 (0.30503)	19.7824
36.56 (252.07)	26.34 (181.61)	3.0	0.143 (0.3632)	1	0.143 (0.3632)	0.001886 (0.030906)	0.01752 (0.113032)	7.3061
34.43 (237.39)	24.74 (170.58)	3.2	0.143 (0.3632)	2	0.286 (0.7264)	0.003772 (0.061812)	0.03504 (0.226064)	14.6796
31.13 (214.64)	23.46 (161.75)	3.0	0.143 (0.3632)	3	0.429 (1.0897)	0.005658 (0.092718)	0.05256 (0.3391)	22.1679
28.95 (199.60)	22.51 (155.20)	2.8	0.143 (0.3632)	4	0.572 (1.4529)	0.007544 (0.12362)	0.07008 (0.4521)	29.834

NOTE: EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-10. FLUSH BEAD TENSILE RESULTS AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.50 IN. (1.27 CM) PLATE ALUMINUM ALLOY 2219-T87

U. T. S., KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME $INCHES^3$ (cc)	ACCUMULATIVE PORE AREA $INCHES^2$ (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
43.36 (298.96)	27.83 (191.88)	4.1	0	0	0	0	0	0
43.23 (298.06)	28.53 (196.71)	4.2	0.0125 (0.0318)	10	0.125 (0.318)	0.00001244 (0.0002039)	0.00138 (0.0089)	0.273
41.51 (286.20)	27.72 (191.12)	4.5	0.0125 (0.0318)	15	0.1875 (0.476)	0.00001866 (0.0003058)	0.00207 (0.0134)	0.413
42.27 (291.44)	27.64 (190.57)	4.0	0.0125 (0.0318)	20	0.25 (0.635)	0.00002488 (0.0004077)	0.00276 (0.0178)	0.549
40.42 (278.69)	27.17 (187.33)	3.8	0.0125 (0.0318)	25	0.3125 (0.794)	0.0000311 (0.0005096)	0.00345 (0.0223)	0.691
40.11 (276.55)	27.23 (187.75)	4.0	0.0125 (0.0318)	30	0.375 (0.953)	0.00003732 (0.0006116)	0.00414 (0.0267)	0.821
40.19 (277.10)	27.93 (192.57)	3.5	0.0125 (0.0318)	33	0.4125 (1.048)	0.00004105 (0.0006727)	0.00455 (0.0294)	0.906
43.14 (297.44)	28.30 (195.12)	3.5	0.019 (0.0483)	1	0.019 (0.048)	0.00000407 (0.0000667)	0.00032 (0.0021)	0.063
42.18 (290.82)	27.47 (189.40)	3.7	0.019 (0.0483)	4	0.076 (0.193)	0.00001629 (0.0002669)	0.00126 (0.0081)	0.25
41.42 (285.58)	27.52 (189.74)	3.2	0.019 (0.0483)	7	0.133 (0.338)	0.0000285 (0.000467)	0.00221 (0.0143)	0.439
41.69 (287.44)	27.17 (187.33)	4.0	0.019 (0.0483)	10	0.19 (0.483)	0.00004072 (0.0006673)	0.00315 (0.0203)	0.623
41.91 (288.96)	27.51 (189.68)	3.7	0.019 (0.0483)	13	0.247 (0.627)	0.00005294 (0.0008675)	0.0041 (0.0265)	0.817
40.28 (277.72)	26.90 (185.47)	3.0	0.019 (0.0483)	16	0.304 (0.772)	0.00006515 (0.0010676)	0.00504 (0.0325)	1.007
40.74 (280.89)	26.98 (186.02)	3.5	0.019 (0.0483)	19	0.361 (0.917)	0.00007737 (0.0012679)	0.00599 (0.0386)	1.207
40.50 (279.24)	26.89 (185.40)	3.5	0.019 (0.0483)	22	0.418 (1.062)	0.00008958 (0.001468)	0.00693 (0.0447)	1.364
40.89 (281.93)	27.76 (191.40)	3.5	0.019 (0.0483)	25	0.475 (1.207)	0.0001018 (0.0016682)	0.00788 (0.0508)	1.551
41.97 (289.37)	27.34 (188.50)	3.7	0.029 (0.0737)	1	0.029 (0.074)	0.00001565 (0.0002565)	0.00073 (0.0047)	0.144
41.47 (285.93)	28.05 (193.40)	3.5	0.029 (0.0737)	4	0.116 (0.295)	0.0000626 (0.0010258)	0.0029 (0.0187)	0.571
40.46 (278.96)	27.30 (188.23)	4.0	0.029 (0.0737)	7	0.203 (0.516)	0.0001096 (0.001796)	0.00508 (0.0328)	1.01
40.30 (277.86)	27.07 (186.64)	3.5	0.029 (0.0737)	10	0.29 (0.737)	0.0001565 (0.0025646)	0.00725 (0.0468)	1.433
41.09 (283.31)	26.46 (182.44)	3.5	0.029 (0.0737)	13	0.377 (0.958)	0.0002035 (0.0033348)	0.00943 (0.0608)	1.856
39.34 (271.24)	26.88 (185.33)	2.8	0.029 (0.0737)	16	0.464 (1.179)	0.0002504 (0.0041033)	0.0116 (0.0748)	2.314
42.37 (292.13)	28.11 (1[illegible].81)	3.5	0.0393 (0.0998)	1	0.0393 (0.10)	0.00003882 (0.0006361)	0.00134 (0.0086)	0.266
39.68 (273.59)	27.70 (190.99)	3.5	0.0393 (0.0998)	3	0.1178 (0.299)	0.0001165 (0.0019091)	0.00401 (0.0259)	0.805
40.81 (281.38)	27.11 (186.92)	3.5	0.0393 (0.0998)	5	0.1963 (0.499)	0.0001941 (0.0031807)	0.00668 (0.0431)	1.329
40.59 (279.86)	26.61 (183.47)	3.7	0.0393 (0.0998)	7	0.2748 (0.698)	0.0002717 (0.0044524)	0.00935 (0.0603)	1.837
40.04 (276.07)	25.76 (177.61)	3.5	0.0393 (0.0998)	9	0.3533 (0.897)	0.0003494 (0.0057256)	0.01202 (0.0775)	2.382
39.33 (271.17)	26.90 (185.47)	3.5	0.0393 (0.0998)	11	0.4318 (1.097)	0.000427 (0.0069973)	0.0147 (0.0948)	2.888
41.72 (287.65)	25.02 (172.51)	4.7	0.05 (0.127)	1	0.05 (0.127)	0.00008213 (0.0013459)	0.00217 (0.014)	0.432
41.02 (282.82)	26.48 (182.57)	4.3	0.05 (0.127)	4	0.2 (0.508)	0.0003285 (0.0053832)	0.00869 (0.0561)	1.731
40.63 (280.14)	26.50 (182.71)	3.5	0.05 (0.127)	7	0.35 (0.889)	0.0005749 (0.0094209)	0.0152 (0.0981)	2.991
40.47 (279.03)	27.05 (186.50)	3.5	0.05 (0.127)	10	0.5 (1.27)	0.0008213 (0.0134587)	0.02172 (0.1401)	4.282
41.81 (288.27)	27.10 (186.85)	3.8	0.059 (0.15)	1	0.059 (0.15)	0.0001334 (0.002186)	0.00304 (0.0196)	0.605
41.56 (286.55)	26.04 (179.54)	3.8	0.059 (0.15)	2	0.118 (0.30)	0.0002668 (0.0043721)	0.00608 (0.0392)	1.211
40.11 (276.55)	26.00 (179.26)	3.5	0.059 (0.15)	3	0.177 (0.45)	0.0004002 (0.0065581)	0.00912 (0.0588)	1.806
39.19 (270.21)	23.60 (162.72)	4.3	0.059 (0.15)	4	0.236 (0.599)	0.0005336 (0.0087441)	0.01216 (0.0785)	2.413
39.93 (275.31)	26.10 (179.95)	3.5	0.059 (0.15)	5	0.295 (0.749)	0.000667 (0.0109302)	0.0152 (0.0981)	3.045
39.25 (270.6[illegible])	26.70 (184.09)	3.5	0.059 (0.15)	6	0.354 (0.899)	0.0008004 (0.0131162)	0.01823 (0.1176)	3.619

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TABLE A-10. (Continued)

U. T. S., KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
40.92 (282.14)	24.87 (171.47)	3.8	0.059 (0.15)	7	0.413 (1.049)	0.0009338 (0.0153022)	0.02127 (0.1372)	4.244
39.19 (270.21)	26.29 (181.26)	3.7	0.059 (0.15)	8	0.472 (1.199)	0.001067 (0.017485)	0.02431 (0.1568)	4.854
42.37 (292.13)	26.83 (184.99)	3.5	0.07 (0.178)	1	0.07 (0.178)	0.0002336 (0.003828)	0.00437 (0.0282)	0.879
40.71 (280.69)	26.92 (185.61)	3.5	0.07 (0.178)	2	0.14 (0.356)	0.0004672 (0.007656)	0.00873 (0.0563)	1.72
39.95 (275.45)	27.33 (188.43)	3.5	0.07 (0.178)	3	0.21 (0.533)	0.0007008 (0.0114841)	0.0131 (0.0845)	2.597
40.56 (279.65)	25.71 (177.27)	4.2	0.07 (0.178)	4	0.28 (0.711)	0.0009344 (0.0153121)	0.01747 (0.1127)	3.447
39.48 (272.21)	27.10 (186.85)	3.7	0.07 (0.178)	5	0.35 (0.889)	0.001168 (0.0191401)	0.02184 (0.1409)	4.301
39.69 (273.65)	27.15 (187.19)	3.5	0.07 (0.178)	6	0.42 (1.067)	0.001402 (0.0229747)	0.0262 (0.169)	5.278
39.28 (270.83)	24.89 (171.61)	3.3	0.07 (0.178)	7	0.49 (1.245)	0.001635 (0.0267928)	0.03127 (0.2017)	6.152
41.53 (286.34)	27.33 (188.43)	3.7	0.0805 (0.204)	1	0.0805 (0.204)	0.0003501 (0.0057371)	0.0057 (0.0368)	1.127
41.49 (286.07)	27.[illegible] (191.68)	3.0	0.0805 (0.204)	2	0.161 (0.409)	0.0007002 (0.0114742)	0.0114 (0.0735)	2.257
40.08 (276.34)	27.72 (191.12)	3.3	0.0805 (0.204)	3	0.242 (0.614)	0.00105 (0.0172064)	0.0171 (0.1103)	3.394
39.27 (270.76)	24.58 (169.47)	4.3	0.0805 (0.204)	4	0.322 (0.818)	0.0014 (0.0229419)	0.0228 (0.1471)	4.503
39.73 (273.93)	25.86 (178.30)	4.0	0.0805 (0.204)	5	0.403 (1.024)	0.001751 (0.0286937)	0.0285 (0.1839)	5.653
37.97 (261.80)	25.12 (173.20)	4.0	0.0805 (0.204)	6	0.483 (1.227)	0.00211 (0.0345767)	0.0342 (0.2206)	6.837
41.81 (288.27)	26.71 (184.16)	3.3	0.088 (0.224)	1	0.088 (0.224)	0.000445 (0.0072922)	0.00678 (0.0437)	1.336
40.77 (281.10)	26.55 (183.06)	4.0	0.088 (0.224)	2	0.176 (0.447)	0.00089 (0.0145845)	0.01356 (0.0875)	2.687
40.[illegible] (276.21)	26.88 (185.33)	4.0	0.088 (0.224)	3	0.264 (0.671)	0.001335 (0.0218767)	0.02034 (0.1312)	4.012
38.89 (268.14)	26.69 (184.02)	3.5	0.088 (0.224)	4	0.352 (0.894)	0.00178 (0.029169)	0.02712 (0.175)	5.463
38.77 (267.31)	26.33 (181.54)	3.8	0.088 (0.224)	5	0.44 (1.118)	0.002225 (0.0364612)	0.03391 (0.2188)	6.763
41.42 (285.58)	27.89 (192.30)	3.0	0.099 (0.251)	1	0.099 (0.251)	0.0006443 (0.0105582)	0.00866 (0.0559)	1.716
39.29 (270.9[illegible])	26.80 (184.78)	3.7	0.099 (0.251)	2	0.198 (0.503)	0.001289 (0.0211229)	0.01733 (0.1118)	3.414
38.82 (273.17)	27.11 (186.92)	4.0	0.099 (0.251)	3	0.297 (0.754)	0.001933 (0.0316762)	0.02599 (0.1677)	5.139
38.65 (266.48)	27.08 (186.71)	3.0	0.099 (0.251)	4	0.396 (1.006)	0.002578 (0.0422459)	0.03465 (0.2235)	6.871
38.31 (264.14)	25.12 (173.20)	3.0	0.099 (0.251)	5	0.495 (1.257)	0.003222 (0.0527991)	0.04332 (0.2795)	8.677
42.11 (290.34)	27.09 (186.78)	3.0	0.109 (0.277)	1	0.109 (0.277)	0.000868 (0.014224)	0.01043 (0.0673)	2.077
40.25 (277.52)	27.45 (189.26)	2.8	0.109 (0.277)	2	0.218 (0.554)	0.001736 (0.0284479)	0.02087 (0.1346)	4.156
38.96 (268.62)	26.86 (185.19)	3.5	0.109 (0.277)	3	0.327 (0.831)	0.002604 (0.0426719)	0.0313 (0.2019)	6.144
39.27 (270.76)	26.72 (184.23)	3.5	0.109 (0.277)	4	0.436 (1.107)	0.003472 (0.0568959)	0.04174 (0.2695)	8.352
41.94 (289.17)	27.64 (190.57)	4.3	0.1205 (0.306)	1	0.1205 (0.306)	0.001135 (0.0185993)	0.01258 (0.0812)	2.497
40.57 (279.72)	26.65 (183.75)	3.5	0.1205 (0.306)	2	0.241 (0.612)	0.00227 (0.0371[illegible])	0.02516 (0.1623)	4.967
39.55 (272.69)	26.97 (185.95)	3.5	0.1205 (0.306)	3	0.3615 (0.918)	0.003405 (0.055798)	0.03774 (0.2435)	7.482
38.65 (266.48)	25.77 (177.68)	3.0	0.1205 (0.306)	4	0.482 (1.224)	0.00454 (0.0743973)	0.05032 (0.3246)	9.994
42.20 (290.96)	27.64 (190.57)	3.3	0.132 (0.335)	1	0.132 (0.335)	0.00146 (0.0239251)	0.01492 (0.0963)	2.97
39.86 (274.83)	28.39 (191.95)	3.3	0.132 (0.335)	2	0.264 (0.671)	0.00292 (0.0478502)	0.02984 (0.1925)	5.9
39.30 (270.97)	26.39 (181.95)	3.3	0.132 (0.335)	3	0.396 (1.006)	0.00438 (0.0717753)	0.04476 (0.2888)	9.037
38.38 (264.62)	26.08 (179.82)	3.5	0.132 (0.335)	4	0.528 (1.341)	0.00584 (0.0957005)	0.05968 (0.385)	11.952
41.13 (283.58)	26.88 (185.33)	3.5	0.1415 (0.359)	1	0.1415 (0.359)	0.001861 (0.0304963)	0.01726 (0.1114)	3.437

TABLE A-10. (Concluded)

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
38.91 (268.28)	26.07 (179.75)	4.0	0.1415 (0.359)	2	0.283 (0.719)	0.003722 (0.0609927)	0.03452 (0.2227)	6.828
39.07 (269.38)	27.77 (191.47)	2.8	0.1415 (0.359)	3	0.4245 (1.078)	0.005583 (0.091489)	0.05178 (0.3341)	10.408
36.77 (253.52)	25.52 (175.96)	2.8	0.1415 (0.359)	4	0.566 (1.438)	0.007444 (0.1219853)	0.06904 (0.4457)	13.639
40.65 (280.27)	27.07 (186.64)	3.8	0.1485 (0.377)	1	0.1485 (0.377)	0.002045 (0.0335115)	0.01853 (0.1195)	3.848
39.49 (272.28)	26.21 (180.71)	3.8	0.1485 (0.377)	2	0.297 (0.754)	0.00409 (0.0670231)	0.03706 (0.2391)	7.3
38.08 (262.55)	25.47 (175.61)	3.3	0.1485 (0.377)	3	0.4455 (1.132)	0.006135 (0.1005346)	0.05559 (0.3586)	11.28
40.71 (280.69)	26.93 (185.68)	3.5	0.1605 (0.408)	1	0.1605 (0.408)	0.0027 (0.0442451)	0.0223 (0.1439)	4.423
37.97 (261.80)	25.28 (174.30)	3.5	0.1605 (0.408)	2	0.3205 (0.814)	0.0054 (0.0884901)	0.0446 (0.2877)	8.816
36.77 (253.52)	24.09 (166.10)	3.3	0.1605 (0.408)	3	0.4815 (1.223)	0.0081 (0.1327352)	0.0669 (0.4316)	13.214
40.03 (276.00)	26.73 (184.30)	3.7	0.171 (0.434)	1	0.171 (0.434)	0.003346 (0.0548311)	0.02567 (0.1656)	5.127
37.91 (261.38)	25.65 (176.85)	4.8	0.171 (0.434)	2	0.342 (0.869)	0.006692 (0.1096622)	0.05134 (0.3312)	10.266
36.16 (249.32)	24.61 (169.68)	4.2	0.171 (0.434)	3	0.513 (1.303)	0.01004 (0.1645261)	0.07701 (0.4968)	15.331
38.24 (263.66)	25.76 (177.61)	3.5	0.1845 (0.469)	1	0.1845 (0.469)	0.004193 (0.068711)	0.03016 (0.1946)	6.174
37.44 (258.14)	25.58 (176.37)	3.8	0.1845 (0.469)	2	0.369 (0.937)	0.008386 (0.1374219)	0.06032 (0.3892)	12.002
33.48 (230.84)	24.02 (165.61)	3.2	0.1845 (0.469)	3	0.5535 (1.406)	0.01258 (0.2061493)	0.09048 (0.5837)	17.815
39.11 (269.66)	26.65 (183.75)	3.5	0.191 (0.485)	1	0.191 (0.485)	0.004499 (0.0737254)	0.03136 (0.2023)	6.217
36.35 (250.63)	24.25 (167.20)	3.8	0.191 (0.485)	2	0.382 (0.970)	0.008998 (0.147451)	0.06272 (0.4046)	12.425
32.72 (225.60)	[illegible].51 (164.17)	3.2	0.191 (0.485)	3	0.573 (1.455)	0.01349 (0.221061)	0.09408 (0.607)	18.667
37.76 (260.35)	25.67 (176.99)	3.8	0.2025 (0.514)	1	0.2025 (0.514)	0.005471 (0.089654)	0.03536 (0.2281)	6.954
36.40 (250.97)	25.17 (173.54)	3.8	0.2025 (0.514)	2	0.405 (1.029)	0.01094 (0.179274)	0.07072 (0.4563)	14.178

NOTES:

(1) ALL TENSILE SPECIMENS WERE ONE INCH WIDE.

(2) EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-11. FLUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AT -320° F (-196° C) AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (4043 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2014-T651

U. T. S., KSI (MN/m^2)	Y.S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
59.74 (411.90)	47.98 (330.81)	2.4	0	0	0	0	0	0
60.44 (416.72)	47.38 (326.68)	2.5	0.009 (0.0229)	2	0.018 (0.0457)	0.000001206 (0.00001976)	0.000132 (0.000852)	0.1051
59.44 (409.83)	48.19 (332.26)	2.5	0.009 (0.0229)	4	0.036 (0.0914)	0.000002412 (0.00003953)	0.000264 (0.001703)	0.2089
60.79 (419.13)	47.75 (329.23)	2.5	0.009 (0.0229)	6	0.054 (0.1372)	0.000003618 (0.00005929)	0.000396 (0.002555)	0.3281
55.79 (384.66)	48.68 (335.64)	2.3	0.009 (0.0229)	8	0.072 (0.1829)	0.000004824 (0.00007905)	0.000528 (0.003406)	0.4154
55.32 (381.42)	48.69 (335.71)	2.0	0.009 (0.0229)	10	0.09 (0.2286)	0.00000603 (0.00009881)	0.00066 (0.004258)	0.5375
55.65 (383.70)	47.59 (328.12)	2.5	0.009 (0.0229)	12	0.108 (0.2743)	0.000007236 (0.0001186)	0.000792 (0.0051)	0.6202
57.28 (394.93)	47.26 (325.85)	2.0	0.009 (0.0229)	14	0.126 (0.32)	0.000008442 (0.0001383)	0.000924 (0.005961)	0.7299
53.31 (367.56)	48.52 (334.54)	1.7	0.009 (0.0229)	16	0.144 (0.3658)	0.000009648 (0.0001581)	0.001056 (0.006813)	0.8315
54.39 (375.01)	47.10 (324.75)	1.3	0.0165 (0.0419)	2	0.033 (0.0838)	0.000005762 (0.00009442)	0.00048 (0.003097)	0.3855
54.46 (375.49)	46.50 (320.61)	1.7	0.0165 (0.0419)	4	0.066 (0.1676)	0.000011524 (0.00018884)	0.00096 (0.006194)	0.7512
52.62 (362.80)	47.85 (329.92)	1.7	0.0165 (0.0419)	6	0.099 (0.2515)	0.000017286 (0.00028327)	0.00144 (0.00929)	1.1456
52.51 (362.05)	46.57 (321.09)	1.5	0.0165 (0.0419)	8	0.132 (0.3353)	0.000023048 (0.0003777)	0.00192 (0.01239)	1.5292
51.87 (357.63)	47.49 (327.43)	2.0	0.0165 (0.0419)	10	0.165 (0.4191)	0.00002881 (0.0004721)	0.0024 (0.01548)	1.9512
53.15 (366.46)	47.46 (327.23)	1.8	0.0165 (0.0419)	12	0.198 (0.5029)	0.000034572 (0.0005665)	0.00288 (0.01858)	2.2677
52.98 (365.29)	46.71 (322.06)	2.0	0.039 (0.0991)	1	0.039 (0.0991)	0.000039 (0.0006391)	0.001368 (0.008826)	1.0814
53.20 (366.80)	47.34 (326.40)	1.8	0.039 (0.0991)	2	0.078 (0.1981)	0.000078 (0.0012782)	0.002736 (0.017652)	2.1509
51.71 (356.53)	46.94 (323.64)	1.2	0.039 (0.0991)	3	0.117 (0.2972)	0.000117 (0.0019173)	0.004104 (0.026477)	3.2163
50.96 (351.36)	46.22 (318.68)	2.0	0.039 (0.0991)	4	0.156 (0.3962)	0.000156 (0.0025564)	0.005472 (0.035303)	4.2386
52.06 (358.94)	48.05 (331.30)	1.3	0.039 (0.0991)	5	0.195 (0.4953)	0.000195 (0.0031955)	0.00684 (0.044129)	5.4415
50.28 (346.67)	47.41 (326.88)	1.5	0.039 (0.0991)	6	0.234 (0.5944)	0.000234 (0.0038346)	0.008208 (0.052955)	6.4579
55.58 (383.21)	48.44 (333.98)	1.8	0.059 (0.15)	1	0.059 (0.1499)	0.0001389 (0.0022762)	0.003007 (0.0194)	2.3696
52.85 (364.39)	45.21 (311.71)	1.8	0.059 (0.15)	2	0.118 (0.2997)	0.0002778 (0.0045523)	0.006014 (0.0388)	4.7021
50.53 (348.39)	46.06 (317.57)	1.5	0.059 (0.15)	3	0.177 (0.4496)	0.0004167 (0.0068285)	0.009021 (0.0582)	7.0920
48.02 (331.08)	45.19 (311.58)	2.0	0.059 (0.15)	4	0.236 (0.5994)	0.0005556 (0.0091047)	0.012028 (0.0776)	9.5008
54.36 (374.73)	47.10 (324.75)	1.8	0.0765 (0.1943)	1	0.0765 (0.1943)	0.0002856 (0.0046801)	0.005005 (0.03229)	3.9565
49.65 (342.33)	47.24 (325.71)	1.5	0.0765 (0.1943)	2	0.153 (0.3886)	0.0005712 (0.0093603)	0.01001 (0.06458)	7.8757
47.22 (325.57)	44.90 (309.58)	1.4	0.0765 (0.1943)	3	0.2295 (0.5829)	0.0008568 (0.01404)	0.015015 (0.096871)	11.8228
48.84 (336.74)	45.38 (312.89)	1.5	0.1005 (0.2553)	1	0.1005 (0.2553)	0.000661 (0.0108318)	0.008652 (0.055819)	6.9718
45.11 (311.02)	43.28 (298.41)	1.5	0.1005 (0.2553)	2	0.201 (0.5106)	0.001322 (0.021664)	0.017304 (0.111638)	13.7116
48.42 (333.85)	44.09 (303.99)	1.5	0.12 (0.3048)	1	0.12 (0.3048)	0.001078 (0.0176653)	0.01218 (0.07858)	9.5082
38.82 (267.66)	— —	1.5	0.12 (0.3048)	2	0.24 (0.6096)	0.002156 (0.035331)	0.02436 (0.15716)	19.2114
45.60 (314.40)	42.54 (293.30)	1.5	0.1455 (0.3696)	1	0.1455 (0.3696)	0.001946 (0.0318892)	0.01793 (0.11568)	14.2188
33.40 (230.29)	— —	1.5	0.1455 (0.3696)	2	0.291 (0.7391)	0.003892 (0.063778)	0.03586 (0.23135)	27.8416

NOTE EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.

TABLE A-12. FLUSH BEAD TENSILE RESULTS FOR 0.50-IN. (1.27-CM) WIDE SPECIMENS AT -320° F (-196° C) AND CORRESPONDING POROSITY MEASUREMENTS OF TIG WELDMENTS (2319 FILLER METAL) IN 0.250 IN. (0.635 CM) PLATE ALUMINUM ALLOY 2219-T87

U. T. S. KSI (MN/m^2)	Y. S., 0.2% OFFSET KSI (MN/m^2)	ELONGATION IN 2 INCH (5.08 cm) GAGE LENGTH, PERCENT	PORE DIAMETER INCHES (cm)	NUMBER OF PORES	ACCUMULATIVE PORE LINEAR INCHES (cm)	ACCUMULATIVE PORE VOLUME INCHES^3 (cc)	ACCUMULATIVE PORE AREA INCHES^2 (cm^2)	CROSS-SECTIONAL PERCENT PORE AREA
60.89 (419.82)	35.03 (241.52)	5.8	0	0	0	0	0	0
60.22 (415.20)	35.04 (241.59)	5.5	0.009 (0.0229)	2	0.018 (0.0457)	0.000001206 (0.00001976)	0.000132 (0.000852)	0.1126
57.54 (396.73)	36.40 (250.97)	4.0	0.009 (0.0229)	4	0.036 (0.0914)	0.000002412 (0.00003953)	0.000264 (0.001703)	0.2215
55.02 (379.35)	33.90 (233.73)	3.8	0.009 (0.0229)	6	0.054 (0.1372)	0.000003618 (0.00005929)	0.000396 (0.002555)	0.3325
58.81 (405.48)	36.21 (249.66)	5.0	0.009 (0.0229)	8	0.072 (0.1829)	0.000004824 (0.00007905)	0.000528 (0.003406)	0.4482
59.46 (409.96)	36.29 (250.21)	4.5	0.009 (0.0229)	10	0.090 (0.2286)	0.00000603 (0.00009881)	0.00066 (0.004258)	0.5532
55.63 (383.56)	36.11 (248.97)	3.7	0.009 (0.0229)	12	0.108 (0.2743)	0.000007236 (0.00011858)	0.000792 (0.00511)	0.6661
58.83 (405.62)	36.25 (249.94)	4.8	0.009 (0.0229)	14	0.126 (0.3200)	0.000008442 (0.00013834)	0.000924 (0.00596)	0.7857
57.61 (397.21)	34.43 (237.39)	4.7	0.009 (0.0229)	16	0.144 (0.3658)	0.000009648 (0.0001581)	0.001056 (0.006813)	0.8949
60.40 (416.45)	36.14 (249.18)	5.0	0.195 (0.0495)	2	0.039 (0.0991)	0.00000847 (0.0001388)	0.000663 (0.004277)	0.5567
58.70 (404.72)	35.86 (247.25)	4.7	0.0195 (0.0495)	4	0.078 (0.1981)	0.00001694 (0.0002776)	0.001326 (0.008555)	1.1218
58.69 (404.66)	35.18 (242.56)	4.5	0.0195 (0.0495)	6	0.117 (0.2972)	0.00002541 (0.0004164)	0.001989 (0.012832)	1.6827
57.64 (397.42)	35.83 (247.04)	4.2	0.0195 (0.0495)	8	0.156 (0.3962)	0.00003388 (0.000552)	0.002652 (0.01711)	2.2437
56.42 (389.00)	35.20 (242.70)	3.8	0.0195 (0.0495)	10	0.195 (0.4953)	0.00004235 (0.000694)	0.003315 (0.021387)	2.7881
57.40 (395.76)	34.68 (239.11)	4.0	0.0195 (0.0495)	12	0.234 (0.5944)	0.00005082 (0.0008328)	0.003978 (0.025664)	3.3485
57.26 (394.80)	35.43 (244.28)	4.3	0.037 (0.094)	1	0.037 (0.094)	0.00003478 (0.0005699)	0.0012395 (0.007997)	1.0576
56.78 (391.49)	35.15 (242.35)	4.0	0.037 (0.094)	2	0.074 (0.188)	0.00006956 (0.0011399)	0.002479 (0.015994)	2.0745
53.11 (366.18)	35.10 (242.01)	3.5	0.037 (0.094)	3	0.111 (0.2819)	0.00010434 (0.0017098)	0.0037185 (0.02399)	3.1301
55.42 (382.11)	34.16 (235.53)	4.0	0.037 (0.094)	4	0.148 (0.3759)	0.00013912 (0.0022797)	0.004958 (0.031987)	4.1981
54.12 (373.15)	34.66 (238.97)	3.6	0.037 (0.094)	5	0.185 (0.4699)	0.0001739 (0.0028497)	0.0061975 (0.039984)	5.2104
55.47 (382.45)	35.04 (241.59)	3.8	0.037 (0.094)	6	0.222 (0.5639)	0.00020868 (0.0034197)	0.007437 (0.047981)	6.2487
56.31 (388.25)	35.94 (247.80)	3.0	0.0585 (0.1486)	1	0.0585 (0.1486)	0.0001344 (0.0022024)	0.0029585 (0.019087)	2.5051
55.44 (382.25)	34.29 (236.42)	3.0	0.0585 (0.1486)	2	0.117 (0.2972)	0.0002688 (0.0044048)	0.005917 (0.038174)	4.989
53.75 (370.60)	33.90 (233.73)	3.2	0.0585 (0.1486)	3	0.1755 (0.4458)	0.0004032 (0.0066073)	0.0088755 (0.057261)	7.5472
49.46 (341.02)	35.07 (241.80)	3.0	0.0585 (0.1486)	4	0.234 (0.5944)	0.0005376 (0.0088097)	0.011834 (0.076348)	10.1145
54.67 (376.94)	35.16 (242.42)	3.5	0.0795 (0.2019)	1	0.0795 (0.2019)	0.0003011 (0.0049341)	0.005313 (0.034277)	4.4987
52.64 (362.94)	33.83 (233.25)	3.4	0.0795 (0.2019)	2	0.159 (0.4039)	0.0006022 (0.0098683)	0.010626 (0.068555)	9.0349
49.99 (344.67)	32.90 (226.84)	2.7	0.0795 (0.2019)	3	0.2385 (0.6058)	0.0009033 (0.0148024)	0.015939 (0.102832)	13.5510
51.66 (356.19)	33.38 (230.15)	3.0	0.1005 (0.2553)	1	0.1005 (0.2553)	0.0006572 (0.0107696)	0.0088 (0.056774)	7.4387
48.58 (334.95)	32.97 (227.32)	3.0	0.1005 (0.2553)	2	0.201 (0.5105)	0.0013144 (0.0215392)	0.0176 (0.113548)	14.7280
50.18 (345.98)	32.96 (227.25)	3.0	0.118 (0.2997)	1	0.118 (0.2997)	0.001048 (0.0171736)	0.01182 (0.076258)	9.9831
45.19 (311.58)	29.90 (206.15)	2.6	0.118 (0.2997)	2	0.236 (0.5994)	0.002096 (0.0343473)	0.02364 (0.152516)	19.8823
47.84 (329.85)	32.05 (220.98)	2.5	0.143 (0.3632)	1	0.143 (0.3632)	0.001886 (0.030906)	0.01752 (0.113032)	14.6857
38.83 (267.73)	27.39 (188.85)	2.4	0.143 (0.3632)	2	0.286 (0.7264)	0.003772 (0.061812)	0.03504 (0.226064)	29.7201
NOTE	EACH VALUE SHOWN IS THE AVERAGE OF THREE OR MORE TEST RESULTS.							

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