Calculation of Laser Beam Weld Specification for Automotive Sheet Steel

A laser beam weld specification, which provides a useful tool in vehicle body design and manufacturing, has been calculated.

BY P.-C. WANG

ABSTRACT. There is currently great interest in the use of laser beam welding as a joining method in vehicle fabrication and assembly. Unlike resistance spot welding where a great deal of work regarding the resistance spot weld (RSW) has been conducted, information on a laser beam weld (LBW) specification is very sparse. An analytical model has been developed to calculate the LBW specifications. The particular purpose of this model is to predict the LBW dimensions (bead width and length) that will give the equivalent fatigue resistance when compared with RSW. When combined with the corporate recommended procedure for determining the spot weld nugget diameter for a given metal thickness, the model can be used to calculate the corresponding LBW dimensions. The model has been validated by comparing the calculated values with measurements obtained from tensile tests. A mathematical relation between the sheet metal thickness, the weld bead length and the bead width was established based upon the cubic spline function. This relation provides a useful tool in vehicle body design and manufacturing.

Introduction

Laser beam welding offers a unique combination of high speed, precision and flexibility, compared with conventional resistance spot welding. This combination is especially attractive for vehicle fabrication and assembly. P.-C. WANG is with the Physics Dept., Research Staff, General Motors Corp., Warren, Mich. Automotive industry. A wide range of research activities have been undertaken, including laser beam delivery systems (Ref. 1), welding galvanized coated steels (Ref. 2) and mechanical behavior of laser-welded sheet steels (Refs. 3–6). However, the optimum laser beam weld (LBW) dimensions for a given metal thickness remains virtually unknown. These dimensions are henceforth referred to as LBW specification. To implement laser beam welding successfully in vehicle body fabrication, it is necessary to know the LBW specification.

The routine procedure in the automotive industry for determining the acceptable spot weld dimensions at a given sheet metal involves a series of tedious weldability and mechanical tests (Ref. 7). Ford (Refs. 8–10) found that the minimum acceptable resistance spot weld (RSW) nugget diameter (Fig. 1A) varies in discrete steps with sheet metal thickness. One of the General Motors’ procedures (Ref. 11) calls for the RSW nugget diameter to be proportional to the square root of the metal thickness for a nominal spot welding condition. Chrysler (Refs. 12–14) also developed RSW specifications for various automotive sheet steels. Unlike a RSW, which is specified completely by a weld nugget diameter for a given sheet metal, a LBW (Fig. 1B) has both a bead width and length. Here, we develop a model to calculate the LBW dimensions in automotive sheet steel application. The approach utilizes the General Motors RSW weld lobe determination procedure (Ref. 11) in conjunction with the fatigue life estimation models. We emphasize that the present model by no means aims to give a complete description of LBW specification, but should rather be regarded as a methodology which can be applied to estimate LBW dimensions. The J-integral model which will be used for specification development is described in the next section.

J-Integral Model

A fracture mechanics parameter, J-integral, is employed to derive an equation relating experimental data with the J-integral value. Details of this model are described in Refs. 15 and 16. For the sake of clarity and continuity, however, the relevant features of the model are recapitulated briefly here. To simplify the model development process, it is subdivided into three phases: 1) fatigue test data generation; 2) finite element J-integral calculation; and 3) correlation of fatigue test results with J-integral. Each step is briefly described below.

KEY WORDS

Laser Beam Welding
Automotive Steel
Sheet Steel
Specification
Mathematical Model
Sheet Metal Thickness
Weld Bead Length
Weld Bead Width
Spot Weld
Fatigue Life
Fatigue Data

Tables 1 and 2 list the dimensions for 15 groups of RSW and seven groups of laser beam welds (LBWs) used in model development. Fatigue test results for these RSWs and LBWs are plotted in Fig. 2A and B, respectively. A regression analysis was used to determine load vs. life curves for each weld. Note that the fatigue life of weld G is much higher than that for weld A. Fatigue life at a given value of load can exhibit a difference of more than one order of magnitude. The life difference is much larger than the data scatter within each group. The data suggest that fatigue life is strongly dependent on specimen geometry.

Finite Element J-Integral Calculation

The definition of the J-integral, as given by Rice (Ref. 17), is

\[ J = \int_{\Gamma} W dY - T \frac{\partial u}{\partial x} ds \]  

where \( \Gamma \) is an arbitrary counterclockwise contour enclosing the notch tip of Fig. 3, \( ds \) is an element of arc length along \( \Gamma \), \( W \) is the strain energy density \( (W = \int \sigma_{ij} \varepsilon_{ij} \text{d}V) \) where \( \sigma_{ij} \) and \( \varepsilon_{ij} \) are the stress tensor and strain tensor, respectively, \( T \) is the traction vector associated with the outward normal \( n \) to \( T \), and \( u \) is the displacement vector.

The integral can be carried out using a finite element method. The three-dimensional elements selected were 20-node brick and 20-node singular elements for use with the ABAQUS finite element code (Ref. 18). Singular elements were used around the intersection of the weld and the opening of the sheets, with 20-node brick elements used everywhere else. Detailed descriptions of the finite element models and loading and boundary conditions are given in Ref. 19 and will not be discussed here. The material was assumed to be linear elastic. Young's modulus and Poisson's ratio of the steel are 2.05 X 10^5 MPa (3.0 X 10^4 ksi) and 0.3, respectively. All calculations were performed on a Cray computer.

The J-integral values for a RSW with dimensions \( D/t = 4.6 \) and \( W/L = 1 \) (Fig. 1) are computed and shown in Fig. 4 for a load, \( P \), of 4 kN. As shown, J-integral

---

**Table 1 — Dimensions of Resistance Spot Welds**

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Sheet Thickness t (mm)</th>
<th>Nugget Diameter D (mm)</th>
<th>Sheet Width W (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annular-shaped</td>
<td>1.27</td>
<td>5.8</td>
<td>38</td>
</tr>
<tr>
<td>solid</td>
<td>0.76</td>
<td>5.0</td>
<td>50</td>
</tr>
<tr>
<td>A</td>
<td>1.6</td>
<td>7.0</td>
<td>40</td>
</tr>
<tr>
<td>B</td>
<td>1.6</td>
<td>7.0</td>
<td>50</td>
</tr>
<tr>
<td>C</td>
<td>1.6</td>
<td>7.0</td>
<td>100</td>
</tr>
<tr>
<td>D</td>
<td>0.8</td>
<td>4.8</td>
<td>50</td>
</tr>
<tr>
<td>E</td>
<td>3.2</td>
<td>10.5</td>
<td>50</td>
</tr>
<tr>
<td>F</td>
<td>1.4</td>
<td>6.2</td>
<td>50.8</td>
</tr>
<tr>
<td>G</td>
<td>1.6</td>
<td>6.0</td>
<td>30</td>
</tr>
<tr>
<td>H</td>
<td>1.4</td>
<td>6.0</td>
<td>50</td>
</tr>
<tr>
<td>I</td>
<td>1.6</td>
<td>7.6</td>
<td>50</td>
</tr>
<tr>
<td>J</td>
<td>1.4</td>
<td>6.5</td>
<td>51</td>
</tr>
<tr>
<td>K</td>
<td>1.6</td>
<td>7.6</td>
<td>50</td>
</tr>
<tr>
<td>L</td>
<td>0.8</td>
<td>4.9</td>
<td>50</td>
</tr>
</tbody>
</table>

Fatigue test results for: (above) resistance spot welds; (right) laser beam welds.
values are a function of position around the periphery of the weld. Similar results are obtained and shown in Fig. 5 for a LBW. Since the cracks initiated from the tip of the weld (Refs. 5, 15, 16), we use the maximum initial J-integral at the tip of the welds to measure the propensity for crack advance in a given weld geometry.

**Correlation of J-Integral Value with Fatigue Test Data**

By correlating the fatigue life with J-integral, it was found that the fatigue life of welds, $N_f$, at one applied stress range is related to its range of J-integral values

---

**Table 2 — Dimensions of Laser Beam Welds**

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Sheet Thickness (mm)</th>
<th>Bead Length (mm)</th>
<th>Bead Width (mm)</th>
<th>Joint Clearance (%)</th>
<th>Overlap (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.76</td>
<td>25.4</td>
<td>1.2</td>
<td>10</td>
<td>38.1</td>
</tr>
<tr>
<td>B</td>
<td>0.76</td>
<td>25.4</td>
<td>1.2</td>
<td>10</td>
<td>38.1</td>
</tr>
<tr>
<td>C</td>
<td>0.76</td>
<td>25.4</td>
<td>1.2</td>
<td>0</td>
<td>38.1</td>
</tr>
<tr>
<td>D</td>
<td>0.76</td>
<td>25.4</td>
<td>1.2</td>
<td>0</td>
<td>38.1</td>
</tr>
<tr>
<td>E</td>
<td>1.78</td>
<td>25.4</td>
<td>1.2</td>
<td>10</td>
<td>25.4</td>
</tr>
<tr>
<td>F</td>
<td>1.78</td>
<td>25.4</td>
<td>1.4</td>
<td>14</td>
<td>25.4</td>
</tr>
</tbody>
</table>

---

**Fig. 3** — Notch-tip coordinate systems and arbitrary line integral contour for: Left — resistance spot weld; right — laser beam weld.

**Fig. 5** — A — Schematic of half of the laser beam weld; B — variation of J-integral values with the periphery of the weld bead.
Fig. 6 — Correlation of J-integral value ($\Delta J$) with fatigue life ($N_f$) of: (above) resistance spot welds; (right) laser beam welds.

Fig. 7 — Flow chart illustrating the procedures used to determine the LBW specification.

Spot Weld Specification
(a) Select a thickness
(b) $D = 5.26t^{0.54}$

Fatigue Life of RSW
(c) Calculate $\Delta J$ value
(d) \[ N_{fs} = 1.72 \times 10^4 \left( \frac{\Delta J}{t} \right) \]

LBW Specification
(e) Let $N_{fs} = N_{fl}$
(f) Calculate $\Delta J$ value
(g) When $bW$ is fixed,

\[ \Delta J = \frac{t}{bD} \]

When $bD$ is fixed,

\[ \Delta J = \frac{t}{bW} \]

(h) Cubic spline fitting the calculated values

Development of Laser Beam Weld Specification

Specimen Geometry
In order to determine the LBW specification, a specimen geometry must be defined. Figure 1A and B shows the schematics of a RSW and transverse (weld perpendicular to the loading direction) LBW, respectively. They are widely used in vehicle body assembly. As shown in Fig. 1A, the steel sheets are assumed to have thickness $t$ and width $W$. A generalized weld nugget is assumed with diameter $D$. The steel sheets

(or strain energy release rate), $\Delta J$. Figure 6A and B shows the correlation for RSW and LBW, respectively. For each data point, the abscissa is the fatigue life data and the ordinate is the $\Delta J$ calculated from the applied load range, weld geometry, and material properties. A least squares fit through data points gives the following equations:

\[ N_{fs} = 1.72 \times 10^4 \left( \frac{\Delta J}{t} \right)^{2.59} \]

(for resistance spot weld) \hspace{0.5cm} (2)

\[ N_{fl} = 3.50 \times 10^4 \left( \frac{\Delta J}{t} \right)^{-2.33} \]

(for laser beam weld) \hspace{0.5cm} (3)

where $N_{fs}$ = cycle to failure for spot weld, $N_{fl}$ = cycle to failure for laser beam weld, $\Delta J_s$ = range of J-integral value for spot weld in kJ/m$^2$, and $\Delta J_l$ = range of J-integral value for laser beam weld in kJ/m$^2$.

Since Equations 2 and 3 were obtained from RSWs and LBWs which cover a range of sheet thicknesses, weld nugget sizes, bead widths and metal fit-up conditions, these equations should enable us to examine the effects of geometric variables on weld fatigue. These results are then used to determine the LBW width and length requirements.
are overlapped by a distance \( L \). Similarly, the LBW shown in Fig. 1B is composed of two steel sheets joined by a weld bead in the overlap region. The weld bead is assumed to have bead width \( b_W \) and bead length \( b_D \).

**Procedure**

Figure 7 presents an overall flow chart for determining the LBW specification. The step-by-step procedure is as follows:

1. **Spot Weld Specification**
   a) Select a metal thickness.
   b) Use recommended procedure to compute the RSW nugget size.
2. **Calculate Fatigue Life of a Spot Weld**
   a) For a given load, compute the J-integral value (Ref.17).
   b) Use a life estimation model to compute fatigue life.
3. **Calculate the Laser Beam Weld Specification**
   a) Let fatigue life of a LBW = fatigue life of a RSW.
   b) Compute the J-integral value for a LBW using the fatigue life estimation model.
   c) For a given J-integral value, compute the relation between the metal thickness, bead width and bead length.
4. **Establish a Mathematical Relation**
   a) Use cubic spline function (Ref. 20) to generate a mathematical relation between the metal thickness, bead length and bead width.

Each step in the above procedure is discussed in more detail below.

**Spot Weld Specification (Step 1)**

A RSW procedure for automotive applications has been developed through peel and tensile testing of lap-shear specimens (Ref. 11). Strength and failure mode were used as the criteria. In order to obtain the pull-out failure mode (Ref. 5), the weld nugget diameter must increase with metal thickness. An empirical expression giving the relation between metal thickness and nominal RSW nugget diameter was established (Ref. 11)

\[
D = 5.26 \cdot t^{0.34}
\]  

where \( t \) = metal thickness in mm, \( D \) = weld nugget diameter in mm.

This equation may be used in two ways, depending on what is known and what quantity is being derived. For example, the metal thickness can be used to estimate the satisfactory RSW which has a pulled button of a diameter, \( D \). Conversely, for a desired RSW nugget diameter, the required metal thickness can be determined using Equation 4.
Results and Discussion

Laser Beam Weld Specification

Since the primary concern for the automotive industry is the high cycle fatigue regime (>10^6 cycles), the LBW dimensions (bend width and length) are calculated to give equivalent fatigue resistance (at 2 X 10^6 cycles) as RSWs. Unlike a RSW where the specification needs only a weld nugget diameter for a given metal thickness, the LBW requires a bead width and length. To explore the relationship between weld bead width (bW) and length (bD) under various metal thicknesses, six different thicknesses (t = 0.5, 0.8, 1.1, 1.4, 1.7 and 2.0 mm /0.02, 0.032, 0.043, 0.055, 0.067 and 0.079 in.) were studied. Figure 9A shows the calculated weld bead length vs. bead width. As shown, the bead length decreases with increasing bead width. Since RSW nugget size does not change for a fixed metal thickness (Equation 4), the bead length and width will have an inverse relationship. Similarly, the region of the bead length and weld thickness for various bead widths has been determined using the same procedure. Figure 9B shows the calculated bead length vs. metal thickness for five different bead widths, bw = 0.8, 0.9, 1.0, 1.1 and 1.2 mm (0.032, 0.035, 0.039, 0.043 and 0.047 in.). As shown in Fig. 9B, at a fixed bead width, the bead length increases with increasing metal thickness. An increase in metal thickness results in an increase in RSW nugget size. At a fixed bead width, the bead length has to increase to obtain the equivalent fatigue resistance of a RSW.

Mathematical Representation

In order to obtain the continuous LBW specifications from the foregoing calculated results, a mathematical description of metal thickness, bead length and bead width was needed. A computer code based upon the cubic spline func-

Mathematical Representation (Step 4)

In order to obtain specifications for various metal thicknesses, we need a mathematical representation to describe the relation between the metal thickness, bead width and length of LBWs. The surface shown in Fig. 8 can be described by

\[ Z(x, y) = \sum_{i=1}^{N} \sum_{j=1}^{M} P_{ij} B_j(x) B_i(y) \]  

where \( B_j(x) \) and \( B_i(y) \) are cubic spline functions of \( x \) and \( y \), and \( P_{ij} \) is a set of coefficients defined to force the surface through a set of \( N \times M \) equally spaced calculated results. The cubic spline functions are defined at each calculated result \( x_i \) by

\[ B_j(x) = \begin{cases} 
0 & x < x_j - 2 \Delta h \\
\frac{(x - (x_j - 2 \Delta h))^3}{\Delta h} & x_j - 2 \Delta h < x < x_j - \Delta h \\
\frac{(x - (x_j - \Delta h))^3}{\Delta h} & x_j - \Delta h < x < x_j \\
\frac{(x - (x_j + \Delta h))^3}{\Delta h} & x_j < x < x_j + \Delta h \\
\frac{(x - (x_j + 2 \Delta h))^3}{\Delta h} & x_j + \Delta h < x < x_j + 2 \Delta h \\
0 & x > x_j + 2 \Delta h 
\end{cases} \]

where \( \Delta h \) is the spacing between the calculated results. By employing computer code and the foregoing calculated results, a mathematical description of the surface can be generated.

Fatigue Life Estimation (Step 2)

The J-integral model described previously was used to estimate the fatigue lives of RSW and LBW. Fatigue life estimation involved: 1) determining the material properties and load level applied to the weld; 2) calculating the J-integral value at the critical location, and 3) estimating the fatigue life using Equations 2 and 3. All calculations are based upon the assumption that welds are free of defects and under a constant amplitude R = 0 (i.e., \( R = \text{min} / \text{max load} \) ) loading condition. The results of these calculations are used in the next section for the determination of LBW specification.

Determination of the Laser Beam Weld Specification (Step 3)

From a design standpoint, it would be very useful to know the conversion specification between the RSW and LBW. Designers can easily substitute a LBW for RSW in vehicle structure design and still achieve equivalent fatigue performance. The following procedure was used to determine the LBW specification and is depicted in Step 3 of Fig. 7:

1) Let the fatigue life of a RSW, \( N_{RF} \), equal to that of a LBW, \( N_{LB} \).
2) Calculate the J-integral value for a LBW from Equation 3.
3) For given values of the metal thickness and bead width, determine the bead length from the J-integral value vs. bead length curve previously derived from a series of finite element calculations.
4) Alternatively, determine the bead width using a similar procedure.

Mathematical Representation (Step 4)

In order to obtain specifications for various metal thicknesses, we need a mathematical representation to describe the relation between the metal thickness, bead width and length of LBWs. The surface shown in Fig. 8 can be described by

\[ Z(x, y) = \sum_{i=1}^{N} \sum_{j=1}^{M} P_{ij} B_j(x) B_i(y) \]  

where \( B_j(x) \) and \( B_i(y) \) are cubic spline functions of \( x \) and \( y \), and \( P_{ij} \) is a set of coefficients defined to force the surface through a set of \( N \times M \) equally spaced calculated results. The cubic spline functions are defined at each calculated result \( x_i \) by

\[ B_j(x) = \begin{cases} 
0 & x < x_j - 2 \Delta h \\
\frac{(x - (x_j - 2 \Delta h))^3}{\Delta h} & x_j - 2 \Delta h < x < x_j - \Delta h \\
\frac{(x - (x_j - \Delta h))^3}{\Delta h} & x_j - \Delta h < x < x_j \\
\frac{(x - (x_j + \Delta h))^3}{\Delta h} & x_j < x < x_j + \Delta h \\
\frac{(x - (x_j + 2 \Delta h))^3}{\Delta h} & x_j + \Delta h < x < x_j + 2 \Delta h \\
0 & x > x_j + 2 \Delta h 
\end{cases} \]

where \( \Delta h \) is the spacing between the calculated results. By employing computer code and the foregoing calculated results, a mathematical description of the surface can be generated.
Table 3 — Weld Dimension for Laser Beam Weld for Corresponding Spot Weld

<table>
<thead>
<tr>
<th>Metal Thickness (mm)</th>
<th>Spot Weld Nugget Diameter (mm)</th>
<th>Laser Weld Bead Width (mm)</th>
<th>Laser Weld Bead Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>0.02</td>
<td>3.62</td>
<td>0.142</td>
</tr>
<tr>
<td>0.60</td>
<td>0.024</td>
<td>3.99</td>
<td>0.157</td>
</tr>
<tr>
<td>0.70</td>
<td>0.027</td>
<td>4.34</td>
<td>0.171</td>
</tr>
<tr>
<td>0.80</td>
<td>0.032</td>
<td>4.66</td>
<td>0.183</td>
</tr>
<tr>
<td>0.90</td>
<td>0.035</td>
<td>4.97</td>
<td>0.196</td>
</tr>
<tr>
<td>1.00</td>
<td>0.039</td>
<td>5.26</td>
<td>0.207</td>
</tr>
<tr>
<td>1.10</td>
<td>0.043</td>
<td>5.54</td>
<td>0.218</td>
</tr>
<tr>
<td>1.20</td>
<td>0.047</td>
<td>5.80</td>
<td>0.228</td>
</tr>
<tr>
<td>1.30</td>
<td>0.051</td>
<td>6.06</td>
<td>0.239</td>
</tr>
<tr>
<td>1.40</td>
<td>0.055</td>
<td>6.31</td>
<td>0.248</td>
</tr>
<tr>
<td>1.50</td>
<td>0.059</td>
<td>6.55</td>
<td>0.258</td>
</tr>
<tr>
<td>1.60</td>
<td>0.063</td>
<td>6.78</td>
<td>0.267</td>
</tr>
</tbody>
</table>

*Note: The table above lists the weld dimensions for laser beam welds corresponding to spot welds with varying metal thicknesses and nugget diameters. The weld bead width and length are provided for each combination.*
tion (Ref. 20) was developed to interpolate the calculated results. Table 3 gives the calculated LBW and RSW specifications. For a given metal thickness, the code can calculate the relation of bead width to bead length of a LBW. Figure 10 illustrates the interrelationship of metal thickness, bead width and bead length of LBWs. The vertical scale in Fig. 10 represents the weld bead length. The horizontal axes define the metal thickness and the bead width. A slice through the three-dimensional diagram of Fig. 10 at a fixed metal thickness gives the relation between the bead width and length. Similarly, a slice through the diagram at fixed bead width gives the relation between the metal thickness and bead length. The LBW specification obtained here should be useful in helping engineers to design and manufacture laser welded structural components.

Comparison with Experimental Results

To the best of our knowledge there are no experimental data in the published literature with which the calculations of LBW specification here can be verified. A verification fatigue testing program of this calculated LBW specification has been underway at General Motors Corp. As the testing program is not yet complete, we cannot make a detailed comparison with experimental results. However, there are some preliminary tensile test results (Ref. 21) that can be compared with the calculations. Lap-shear LBWs and RSWs were prepared using 1000 aluminum-killed sheet steel with a thickness of 1 mm (0.04 in.). To obtain the LBW dimensions which will give the equivalent tensile strength when compared with RSWs, LBWs with various bead lengths were fabricated. Table 4 shows the comparison between experimental data and the model calculations. As shown in Table 4, the model predicts a laser bead length of 13.75 mm, which slightly underestimates the experimental measurement of 15.28 mm. A possible explanation for the underestimation lies in the use of smaller RSW nugget diameter in the calculations (Table 4). This result suggests that Equation 4, employed to describe spot weld specification, has a strong influence on the LBW specification. It should be noted that there are other RSW specifications (Ref. 22). Since the model incorporated the geometrical changes, the model can be used to predict the LBW specifications provided that the appropriate RSW specifications are specified.

The model presented here is clearly not a complete representation of LBW specification because it only considers transverse lap-shear welds (welds perpendicular to the loading direction) under a tension load, and it only applies to welds with a range of metal thicknesses (0.5 to 2.0 mm; 0.02 to 0.079 in.) and bead widths (0.8 and 1.2 mm; 0.032 to 0.047 in.). It is, however, the first attempt to calculate the LBW specification. There is currently a plan to continue to pursue a systematic numerical and experimental program in this area to refine this model. This is not a simple task in view of the complexities of the various weld orientations and loading conditions.

Conclusions

An analytical model has been developed to calculate the laser beam weld (LBW) specifications. The particular purpose of this model is to predict the LBW dimensions (i.e., bead width and length) that will give the equivalent fatigue resistance when compared with resistance spot weld. When combined with GM’s recommended procedure for determining the spot weld nugget diameter for a given metal thickness, the model can be used to calculate the corresponding LBW dimensions. The model has been validated by comparing the calculated LBW values with measurements obtained from tensile tests.

A mathematical relation between the sheet metal thickness, the weld bead length and the bead width was established based upon the cubic spline function. This relation provides a useful tool in vehicle body design and manufacturing.
Acknowledgments

The author wishes to thank D. Salada for providing the experimental results and J. Speranza for invaluable discussions.

References


WRC Bulletin 370
February 1992

Recommendations Proposed by the PVRC Committee on Review of ASME Nuclear Codes and Standards Approved by the PVRC Steering Committee

The ASME Board on Nuclear Codes and Standards (BNCS) determined in 1986 that an overall technical review of existing ASME nuclear codes and standards was needed. The decision to initiate this study was reinforced by many factors, but most importantly by the need to capture a pool of knowledge and “lessons learned” from the existing generation of technical experts with codes and standards background.

Project responsibility was placed with the Pressure Vessel Research Council and activity initiated in January 1988. The direction was vested in a Steering Committee which had overview of six subcommittees.

The recommendations provided by nuclear utilities and industry were combined with the independent considerations and recommendations of the PVRC Subcommittees and Steering Committees.

Publication of this document was sponsored by the Steering Committee on the Review of ASME Nuclear Codes and Standards of the Pressure Vessel Research Council. The price of WRC Bulletin 370 is $30.00 per copy, plus $5.00 for U.S. and $10.00 for overseas, postage and handling. Orders should be sent with payment to the Welding Research Council, Room 1301, 345 E. 47th St., New York, NY 10017.