(SI Units)
\[ P_1 = 50 \times (\sin 10 \text{ deg}) \times 180 = 62 \text{ mm} \]

Net section between holes

(U.S. Customary Units)
\[ P_1 - D = 2.482 - 1.282 = 1.15 \text{ in.} \]

(SI Units)
\[ P_1 - D = 62 - 32 = 30 \text{ mm} \]

Effective length of net section to carry load in the direction of highest stress is

(U.S. Customary Units)
\[ 2 \times 2.391 \times 30 = 144 \text{ mm} \]

(in millimeters, the value of thickness divided by 25 shall be used)

Effective area to carry stress is

(U.S. Customary Units)
\[ 5.5 \times 1.25 = 6.875 \text{ in}^2 \]

(SI Units)
\[ 144 \times 32 = 4600 \text{ mm}^2 \]

This is less than the area of 7.165 in.\(^2\) (4620 mm\(^2\)) in the nozzle, so the net section between the rivets is not adequate.

PREHEATING

A-100

DELETED

Table A-75-1

<table>
<thead>
<tr>
<th>Ligament (Figure A-75-1)</th>
<th>θ, deg</th>
<th>cos θ</th>
<th>( F \cos θ )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>85</td>
<td>0.087</td>
<td>0.072 [Note (1)]</td>
</tr>
<tr>
<td>1</td>
<td>70</td>
<td>0.342</td>
<td>0.255</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>0.649</td>
<td>0.7</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>0.866</td>
<td>0.88</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>0.985</td>
<td>0.96</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>2.391</td>
</tr>
</tbody>
</table>

NOTE:
(1) Multiplied by 0.5 because of half-length ligament.

A-101 HEATING AND COOLING RATES FOR POSTWELD HEAT TREATMENT

A-101.1 Heating and cooling rates for weldments and materials should be established by the Manufacturer. These rates should be sufficient to avoid inducing distortion, residual stresses, cracking, and other detrimental effects into the weldment during postweld heat treatment. Heating and cooling rates should be established based, in part, upon successful past practice for specific materials and thicknesses, by using other Codes and Standards as a guide, or by engineering analysis.

A-101.2 For thicknesses of 2 in or greater, the following rates of heating and cooling should be applied; however, these rates should not be applied to P-No. 7 and P-No. 101 welded base materials:

(a) Above 800°F (425°C), the heating rate should not exceed 600°F/hr (335°C/h) divided by the thickness in inches, but in no case should it be more than 600°F/hr (335°C/h).

(b) Above 800°F (425°C), the cooling rate should not exceed 600°F/hr (335°C/h) divided by the thickness in inches, but in no case should it be more than 600°F/hr (335°C/h).

(c) The rates of heating and cooling need not be less than 100°F/hr (55°C/h).

From 800°F (425°C) or below, the pressure part should be cooled in still air.

ROUNDED INDICATION CHARTS

A-250 ACCEPTANCE STANDARD FOR RADIOGRAPHICALLY DETERMINED ROUNDED INDICATIONS IN WELDS

A-250.1 Applicability of These Standards. These standards are applicable to ferritic, austenitic, and nonferrous materials.

A-250.2 Terminology.

A-250.2.1 Rounded Indications. Indications with a maximum length of three times the width or less on the radiograph are defined as rounded indications. These indications may be circular, elliptical, conical, or irregular in shape and may have tails. When evaluating the size of an indication, the tail shall be included. The indication may be from any imperfection in the weld, such as porosity, slag, or tungsten.

A-250.2.2 Aligned Indications. A sequence of four or more rounded indications shall be considered to be aligned when they touch a line parallel to the length of the weld drawn through the center of the two outer rounded indications.

A-250.2.3 Thickness t. t is the thickness of the weld, excluding any allowable reinforcement. For a butt weld joining two parts having different thicknesses at
C-7 THE THERMAL CYCLE, PWHT

It is important to control the following four aspects of the thermal cycle associated with heating operations: temperature uniformity, the heating rate above a specified temperature, the specified hold temperature and time, and the cooling rate down to a specified temperature.

(a) Maximum Temperature Differences for PWHT. During heating and cooling, the maximum temperature difference within the heated band shall be 250°F (139°C), or as limited by the maximum axial temperature gradient.

(b) The Maximum Heating Rate. Above 800°F (425°C), the rate of heating shall not be more than 400°F/hr (222°C/h) divided by the maximum material thickness in inches (millimeters), but in no case more than 400°F/hr (222°C/h).

(c) The Maximum Hold Temperature and Time. During hold, the requirements for the maximum hold temperature and time shall be as defined in PW-39.

(d) The Maximum Cooling Rate. Above 800°F (425°C), the rate of cooling shall not be more than 500°F/hr (278°C/h) divided by the maximum material thickness in inches (millimeters), but in no case more than 500°F/hr (278°C/h).

C-8 INSULATION

(a) Classification of Insulation. The requirements for the gradient control band width are based upon insulation R values of 2°F·ft²·hr·Btu to 4°F·ft²·hr·Btu (0.35°C-m²/W to 0.70°C-m²/W). Refractory ceramic fiber insulation with a density of 6 lbs/ft³ to 8 lbs/ft³ (96.1 kg/m³ to 128.1 kg/m³) meets this requirement. A layer at least 1 in. (25 mm) thick shall be used for temperatures up to 1,200°F (650°C); and a layer at least 2 in. (50 mm) thick shall be used for temperatures above 1,200°F (650°C).

(b) Attachment of Insulation. The pieces of insulation shall be sized such that the piece(s) are wrapped around the component, the component surfaces shall be fully covered, with the ends of the insulation either butted against each other or overlapped to preclude heat loss. No gaps shall be permitted in the insulation layer, and any inadvertent gaps shall be filled with insulation. The insulation may be held in place with banding or tie wire. The insulation shall not be compressed to less than three-quarters of its original thickness during banding or tying.

(c) During heating, the insulation has a tendency to shrink and thus create gaps. Inspection shall therefore be carried out at various times during the heating cycle to identify and rectify any gaps that may occur during the heating.

(d) When multiple layers of insulation are used, the seams shall be staggered to minimize the possibility of gaps.

(e) The insulation shall extend beyond the edge of the heated band out to the edge of the gradient control band to diminish heat loss and to ensure that the permissible maximum axial temperature gradient from heated to unheated sections is not exceeded.

C-9 QUALITY ASSURANCE SYSTEM

C-9.1 INTRODUCTION

To ensure that local heating operations are in compliance with various codes, standards, practices, or specifications, all heating shall be performed in accordance with an established quality assurance system.

All work shall be performed in accordance with a written quality assurance system. This system shall be described in a Quality Assurance Manual and shall define the organizational structure, responsibilities, procedures, processes, and resources for implementing quality management. The written description of the quality assurance system shall be available for review.

C-9.2 PROCESS CONTROL

(in millimeters, the value of thickness divided by 25 shall be used)

C-9.3 DOCUMENTATION

A record of the thermal cycle shall be produced. The temperature resolution of the record shall be within 5°F (3°C), and the time resolution shall be within 5 min.

(a) The record of the thermal cycle shall be submitted to the customer upon the completion of local heating. The record of the thermal cycle shall contain information such as the temperature and time scales and correspondence between thermocouple numbers on the record and those on the drawing/sketch. The records provided may be either electronic or printed copy.

(b) Copies of the procedures, drawings/sketches, Certificates of Conformance for thermocouples and extension wire, and calibration records for temperature-recording devices shall be submitted to the customer along with the record of the thermal cycle for each weld or group of welds.

(c) Form C-9.3-1, Standard Documentation Checklist for Local Heating, shall be used as a basis for provision of documentation. This checklist and supporting documentation shall be submitted to the customer at the completion of local heating.