Economics of Welding

The Dollars and Cents behind the Arcs and Sparks
How much does welding actually cost??

How can the same weld, have different costs??
Real World Example

Requirement: 3/16” fillet weld 500 Feet

- **Welder A**
  - Follows WPS of 250amps
  - Creates 3/16” fillet depositing 35lbs of filler metal
  - Took 8 hours of labor
  - Costs: $380

- **Welder B**
  - Does not follows WPS and welds at 225amps
  - Overwelds by 1/16” (makes ¼”) fillet depositing 27lbs more filler metal
  - Took additional 27 hours of labor
  - Costs: $988

- **Welder C**
  - Does not follows WPS and welds at 180amps
  - Overwelds by 1/8” (makes 5/16”) fillet depositing 63lbs more filler metal
  - Took additional 70 hours of labor
  - Costs: $3600

This happens every day!!
My goal for today

• Everyone should understand that welds can cost different amounts and will know how to calculate the costs to make the most economical decision for your company, or at least know that resources exist to make this decision.
Topics covered

- Deposition Rate
- Deposition Efficiency
- Welding Process (SMAW, GMAW, FCAW, SAW)
- Joint Design
- Welding Volume
- Arc Time Factor

And their effect on Welding costs!
Deposition Rate

• Rate that weld metal can be deposited by a given electrode or welding wire, typically expressed in lbs/hr or kg/hr. It is based on continuous production, not allowing time for stops/starts/cleaning or inserting new electrodes.

• Deposition Rate is directly proportional to the welding current being used.

• On a Constant Current Machine – increasing the amperage increases the deposition rate

• For a constant voltage machine – increasing the wire feed speed increases the deposition rate
Deposition efficiency

• Relationship of the weight of weld metal deposited vs. the electrode consumed in making the weld. Mostly defined as a percentage.

• Example: 100lbs of coated electrodes with an efficiency of 65% will result in 65lbs of weld metal deposited.
SMAW
(Shielded Metal Arc Welding)

Direction of Travel

Metal Droplets
Deoxidizers
Slag Formers

ARC

Electrode Coating
Electrode Wire

Weld Bead & Slag
Molten Pool

The mission is to directly or indirectly put contractors and ironworkers to work
SMAW
(Shielded Metal Arc Welding Cont’d)

- **Advantages:**
  - Equipment is Simple and highly portable
  - No shielding gas or flux is required
  - Less sensitive to wind and drafts making it ideal for outdoors
  - Used in limited areas

- **Disadvantages:**
  - Travel Speeds and productivity are much lower
  - Fume Generation is very high
  - Training time is relatively higher than other processes
SMAW
(Shielded Metal arc welding cont’d)

<table>
<thead>
<tr>
<th>Electrode Size</th>
<th>Current (lbs/hr)</th>
<th>Voltage (lbs/hr)</th>
<th>Deposition Rates (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/32”</td>
<td>70-110</td>
<td>20-30</td>
<td>1.35-1.75</td>
</tr>
<tr>
<td>1/8”</td>
<td>110-140</td>
<td>20-30</td>
<td>2.3-2.7</td>
</tr>
<tr>
<td>5/32”</td>
<td>140-200</td>
<td>20-30</td>
<td>2.75-4.3</td>
</tr>
<tr>
<td>3/16”</td>
<td>200-300</td>
<td>20-30</td>
<td>4.8-5.6</td>
</tr>
</tbody>
</table>
### SMAW
(Shielded Metal Arc Welding Cont’d)

<table>
<thead>
<tr>
<th>Electrode Length</th>
<th>Deposition Efficiency</th>
<th>2” Stub Loss</th>
<th>3” Stub Loss</th>
<th>4” Stub Loss</th>
<th>5” Stub Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>12”</td>
<td>60%</td>
<td>50%</td>
<td>45%</td>
<td>40%</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>65%</td>
<td>54.2%</td>
<td>48.7%</td>
<td>43.3%</td>
<td>37.9%</td>
</tr>
<tr>
<td></td>
<td>70%</td>
<td>58.3%</td>
<td>52.5%</td>
<td>46.6%</td>
<td>40.8%</td>
</tr>
<tr>
<td>14”</td>
<td>60%</td>
<td>51.4%</td>
<td>47.1%</td>
<td>42.8%</td>
<td>38.5%</td>
</tr>
<tr>
<td></td>
<td>65%</td>
<td>55.7%</td>
<td>51.1%</td>
<td>46.4%</td>
<td>41.8%</td>
</tr>
<tr>
<td></td>
<td>70%</td>
<td>60%</td>
<td>55%</td>
<td>50%</td>
<td>45%</td>
</tr>
<tr>
<td>18”</td>
<td>60%</td>
<td>53.3%</td>
<td>50%</td>
<td>46.6%</td>
<td>43.3%</td>
</tr>
<tr>
<td></td>
<td>65%</td>
<td>57.7%</td>
<td>54.2%</td>
<td>50.5%</td>
<td>46.9%</td>
</tr>
<tr>
<td></td>
<td>70%</td>
<td>62.2%</td>
<td>58.3%</td>
<td>54.4%</td>
<td>50.5%</td>
</tr>
</tbody>
</table>
Gmaw
(Gas Metal Arc Welding)
GMAW
(Gas metal arc welding cont’d)

• Advantages:
  – Has high productivity rate compared to SMAW
  – Has low fume generation rate
  – Requires no de-slagging or cleaning between passes
  – High deposition efficiency
  – Provides low hydrogen deposit to aid in crack avoidance

• Disadvantages:
  – Requires more control of welding variables
  – Potential for lack of fusion when not properly applied
  – Sensitive to porosity formation due to less chemicals involved in shielding and slag formers
  – Requires more equipment and investment compared to SMAW
GMAW
(gas metal arc welding cont’d)

Transfer Mode – Short Arc

Transfer Mode – Spray Arc
**GMAW**

*(Gas metal arc welding cont’d)*

<table>
<thead>
<tr>
<th>Wire Dia.</th>
<th>Amps (WFS IPM)</th>
<th>Voltage</th>
<th>Deposition Rate (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.030</td>
<td>75-140 (190-350)</td>
<td>14-16</td>
<td>1.8-4.0</td>
</tr>
<tr>
<td>.035</td>
<td>90-160 (180-300)</td>
<td>15-19</td>
<td>2.1-4.1</td>
</tr>
<tr>
<td>.045</td>
<td>130-250 (125-200)</td>
<td>17-19</td>
<td>2.8-5.5</td>
</tr>
<tr>
<td>.052</td>
<td>150-250 (135-240)</td>
<td>17-20</td>
<td>3.7-6.25</td>
</tr>
</tbody>
</table>

**Deposition Rates – Short Arc**

(ER70S-X 75%Ar/25% CO2)

<table>
<thead>
<tr>
<th>Wire Dia.</th>
<th>Amps (WFS IPM)</th>
<th>Voltage</th>
<th>Deposition Rate (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.030</td>
<td>140-200 (440-650)</td>
<td>24-26</td>
<td>4.0-6.7</td>
</tr>
<tr>
<td>.035</td>
<td>180-230 (400-550)</td>
<td>25-27</td>
<td>6.3-8.0</td>
</tr>
<tr>
<td>.045</td>
<td>260-340 (300-500)</td>
<td>25-30</td>
<td>8.0-13.0</td>
</tr>
<tr>
<td>.052</td>
<td>275-400 (265-390)</td>
<td>26-33</td>
<td>8.3-13.5</td>
</tr>
<tr>
<td>1/16”</td>
<td>290-400 (180-280)</td>
<td>26-36</td>
<td>8.8-14.0</td>
</tr>
</tbody>
</table>

**Deposition Rates – Spray Arc**

(ER70S-X 98%Ar/2% CO2)

Dep. Efficiency 90-97%
FCAW
(FLUX CORED ARC WELDING)

Cored Wires

- GAS SHIELDED
- METAL CORE
- SELF SHIELDED
FCAW
(Flux Cored Arc Welding – Gas Shielded)

- **Advantages:**
  - High Productivity compared to SMAW
  - Excellent out of position welding capabilities
  - Handles mill scale and rust better than GMAW
  - Broader operating ranges compared to GMAW

- **Disadvantages:**
  - Fume generation is higher than other processes
  - Deslagging and cleaning is required between passes
  - Not all types are available in low hydrogen designation
  - Wind can disturb shielding gas and cause porosity
**FCAW**

*(Flux cored Arc Welding – Gas Shielded)*

Flux Cored Arc Welding Process - ER70T-X 100% CO2

<table>
<thead>
<tr>
<th>Wire dia</th>
<th>Amps (WFS IPM)</th>
<th>Voltage</th>
<th>Deposition Rate (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.045</td>
<td>145-265 (200-500)</td>
<td>24-29</td>
<td>3.6-9.3</td>
</tr>
<tr>
<td>.052</td>
<td>215-370 (280-600)</td>
<td>25-31</td>
<td>4.5-14.7</td>
</tr>
<tr>
<td>1/16&quot;</td>
<td>195-445 (150-500)</td>
<td>24-32</td>
<td>4.5-16.7</td>
</tr>
<tr>
<td>5/64&quot;</td>
<td>170-320 (125-300)</td>
<td>27-30</td>
<td>6.5-16.2</td>
</tr>
<tr>
<td>3/32&quot;</td>
<td>220-475 (100-300)</td>
<td>27-32</td>
<td>8.4-25</td>
</tr>
</tbody>
</table>

Dep. Efficiency 80-90%
MCAW
(Metal Cored Arc Welding)

Metal Cored Wires Have A Higher Current Density

Results:
- Higher Deposition Rates
- Better Penetration
- Better Side Wall Fusion
MCAW
(Metal Cored Arc Welding – Cont’d)

• Advantages
  – Higher Deposition Rate compare to GMAW/SMAW
  – Better Penetration compared to GMAW
  – Low Fume Generation
  – Out of Position capable (most beneficial with Pulse)
  – No Slag Clean up between passes
  – High Deposition Efficiency compared to FCAW/SMAW

• Disadvantages
  – High Argon shielding Gas needed
  – More radiant heat compared to FCAW/SMAW
  – Out of Position only capable with Short Arc or Pulse Transfer
  – Susceptible to Wind and loss of shielding gas
MCAW
(Metal Cored Arc Welding – Cont’d)

Metal Cored Arc Welding Process E70C-X 90%AR/10%CO2

<table>
<thead>
<tr>
<th>Wire Dia.</th>
<th>Amps (WFS IPM)</th>
<th>Voltage</th>
<th>Deposition Rate (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.045</td>
<td>170-360 (200-550)</td>
<td>24-33</td>
<td>5.2-13.9</td>
</tr>
<tr>
<td>.052</td>
<td>190-410 (180-530)</td>
<td>26-36</td>
<td>5.5-15.7</td>
</tr>
<tr>
<td>1/16”</td>
<td>230-510 (150-480)</td>
<td>26-36</td>
<td>6.2-20.7</td>
</tr>
</tbody>
</table>

Dep. Efficiency 91-99%
FCAW
(Flux Cored Arc Welding – Self Shielded)

An inside out Stick Electrode
FCAW
(Flux Cored Arc Welding – Self Shielded)

- Advantages
  - No External Shielding gas needed
  - Higher deposition rates compared to SMAW
  - Available for Low Carbon and Low Alloys steels
  - Can be used on Constant Current Welding Machines
  - Out of Position Welding capability makes it great for site work

- Disadvantages
  - Typically small welding operating parameters
  - Low Deposition efficiency
  - Very high Fume levels
  - Voltage Sensitive
FCAW
(Flush Cored Arc Welding – Self Shielded)

Flux Cored Arc Welding Process E7XTX – No Shielding Gas

<table>
<thead>
<tr>
<th>Wire Dia.</th>
<th>Amps (WFS IPM)</th>
<th>Voltage</th>
<th>Deposition Rate (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.035</td>
<td>80-200 (81-392)</td>
<td>15-17</td>
<td>.9-4.5</td>
</tr>
<tr>
<td>.045</td>
<td>95-225 (54-140)</td>
<td>15-18</td>
<td>.9-2.6</td>
</tr>
<tr>
<td>1/16</td>
<td>155-220 (150-275)</td>
<td>21-25</td>
<td>4.1-7.5</td>
</tr>
<tr>
<td>.072</td>
<td>184-355 (100-300)</td>
<td>17-24</td>
<td>3.6-10.6</td>
</tr>
<tr>
<td>5/64</td>
<td>275-600 (150-600)</td>
<td>22-31</td>
<td>6.4-25.8</td>
</tr>
<tr>
<td>3/32</td>
<td>265-615 (100-400)</td>
<td>22-29</td>
<td>6.1-25.8</td>
</tr>
</tbody>
</table>

Dep. Efficiency 74-82%
SAW
(Submerged Arc Welding)
SAW
(Submerged Arc Welding)

• Advantages
  – No visible arc radiation and very low fume
  – High deposition rates and efficiencies
  – Ability to produce welds that are generally sound and free from defects
  – Unaffected by wind or drafts
  – Ability to add electrodes for increased deposition

• Disadvantages
  – No visible arc, so tracking is more difficult
  – Addition of flux that must be handled and stores
  – Limited to flat and horizontal positions
  – Motion control is typically used which creates high initial investment
SAW
(Submerged Arc Welding)

SAW Process Carbon Steel 1.5-2lbs of Flux per lb. of Electrode

<table>
<thead>
<tr>
<th>Wire Dia</th>
<th>Amps (WFS IPM)</th>
<th>Voltage</th>
<th>Deposition Rate (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/32”</td>
<td>250-700 (55-180)</td>
<td>26-34</td>
<td>6.9-20</td>
</tr>
<tr>
<td>1/8”</td>
<td>300-900 (30-125)</td>
<td>28-36</td>
<td>8-28</td>
</tr>
<tr>
<td>5/32”</td>
<td>400-1000 (30-150)</td>
<td>28-38</td>
<td>9-48</td>
</tr>
<tr>
<td>3/16”</td>
<td>500-1300 (20-85)</td>
<td>32-40</td>
<td>10-42</td>
</tr>
<tr>
<td>1/4”</td>
<td>600-1600 (18-60)</td>
<td>34-42</td>
<td>15-55</td>
</tr>
</tbody>
</table>

Dep. Efficiency 97-99%
Types of Joint Designs

Fillet Weld

Square Bevel

K Bevel

Single V

Double V

Single Bevel

The mission is to directly or indirectly put contractors and ironworkers to work
Determining Total Cost of Weld

- Total Weld Cost = Total Arc Time + Non Arc Time + Filler Metal
How much will it cost to make the weld?

(Total Arc Time)

• Determine Weld Metal Volume Needed
• Determine Deposition rate for Given Process
• Calculate Total Time needed to make weld
Determine Weld Metal Volume

- First determine cross sectional area (Use Fillet Weld First)

- Toe Length’s will be Equal to Sides of a Triangle

- Calculation = Leg X Leg ÷ 2

- EX. Equal Leg ¼” Fillet Area = .03125 Sq.In

- Volume = Length X Area

- ¼” Fillet Weld 100’ Long = (.03125 X 1200)
  = 37.5 Cu. In

- Volume = Total Area X Density = 37.5 X
  .283 = 10.6125Lbs
Deposition Rate Comparison

Use the 100’ Long ¼” Fillet Weld Requiring 10.6125lbs of Weld Metal

- Use 1/8” E7018 SMAW Electrode
  - 120Amps = 2.6lbs/hr
  - $10.6125lbs ÷ 2.6lbs/hr = 4.08hrs
  - 4.08hrs * $35 L/OH = $142.8

- Use 1/16” E71T-8 FCAW-S
  - 205Amps = 6.6lbs/hr
  - $10.6125lbs ÷ 6.6lbs/hr = 1.61hrs
  - 1.61hrs * $35 L/OH = $56.35
Determine Filler Metal Needed

Use the 100’ Long ¼” Fillet Weld Requiring 10.6125lbs of Weld Metal

- Use 14” 1/8” E7018 SMAW Electrode
- 3” Stub Loss = 55% Dep. Efficiency
- 10.612lbs ÷ 55% = 19.3lbs
- 19.3lbs @ $2.00/lb = $38.60

- Use 1/16” E71T-8 FCAW-S
- 205Amps = 78.2%
- 10.612lbs ÷ 78.2% = 13.57lbs
- 13.57lbs @ 3.25/lb = $44.10
Determine Non Arc Time

- Factors Effecting Non-Arc Time
  - Interpass Cleaning
  - Electrode Change Out
  - Welder Position Change
  - Weld Joint Preparation
  - Fitting/Tacking

<table>
<thead>
<tr>
<th>Arc welding process</th>
<th>Duty cycle %</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMA (SMAW)</td>
<td>15 - 30</td>
</tr>
<tr>
<td>TIG (GTAW)</td>
<td>25 - 40</td>
</tr>
<tr>
<td>Mechanized TIG</td>
<td>80 - 90</td>
</tr>
<tr>
<td>MIG/MAG (GMAW)</td>
<td>30 - 45</td>
</tr>
<tr>
<td>Mechanized MIG/MAG</td>
<td>80 - 90</td>
</tr>
<tr>
<td>Sub Arc (SAW)</td>
<td>80 - 95</td>
</tr>
<tr>
<td>FCAW</td>
<td>25 - 45</td>
</tr>
<tr>
<td>Mechanised FCAW</td>
<td>70 - 85</td>
</tr>
<tr>
<td>MCAW</td>
<td>30 - 45</td>
</tr>
</tbody>
</table>

* http://www.twi-global.com/technical-knowledge/job-knowledge/welding-costs-096/
Determine Non Arc Time

Use the 100’ Long ¼” Fillet Weld Requiring 10.6125lbs of Weld Metal

- **SMAW – 25% Operating Factor**
  - 4.08hrs ÷ 25% OF = 16.32hrs
  - \(16.32 \text{hrs} \times $35 \text{ L/OH} = $571.20\)

- **FCAW – S – 35% Operating Factor**
  - 1.6hrs ÷ 35% OF = 4.57hrs
  - \(4.57 \text{hrs} \times $35 \text{ L/OH} = $159.95\)
Adding it All up

Arc Time + Non + FM = Total Cost

- **SMAW**
  - $142.8 + $571.2 + $38.6
  - = $752.6

- **FCAW-S**
  - $56.35 + $159.95 + $44.10
  - = $260.40

**Difference of $492.20**
Factors Effecting Weld Volume

- Overwelding Fillet Welds can have dramatic consequences.
- EX. 5/16” made instead of ¼” = 43% More Volume
- Exponential change in Cost of Weld
Let's do the Math

- 5/16” Fillet 100’ Long
- \( \frac{5/16” \times 5/16”}{2} = 0.0488 \text{ Sq.In} \)
- \( 0.0488 \times 1200 \times 0.283 \text{ lb/Cu In} = \)
- 16.57 lbs
Total Cost Comparison

1/8” E7018 Electrode @ 120Amps
- 16.57lbs ÷ 2.6lbs/hr = 6.37hrs
- 6.37hrs * $35/hr = $222.95
- 16.57lbs ÷ 55% = 30.12lbs
- 30.12lbs * $2.00/lb = $60.24
- 6.37hrs ÷ 25%OF = 25.48hrs
- 25.48hrs * $35/hr = $891.8
- $1,174.99

1/16” E71T-8 FCAW-S @ 205Amps
- 16.57lbs ÷ 6.6lbs/hr = 2.51hrs
- 2.51hrs * $35/hr = $87.85
- 16.57lbs ÷ 78.2% = 21.19lbs
- 21.19lbs * $3.25/lb = $68.87
- 2.51hrs ÷ 35%OF = 7.17hrs
- 7.17hrs * $35/hr = $250.95
- $407.67
Compare Ovewelding Costs

• SMAW
  • ¼” Fillet = $752.6
  • 5/16” Fillet = $1,174.99
  • Difference $422.39

• FCAW-S
  • ¼” Fillet = $260.40
  • 5/16” Fillet = $407.67
  • Difference $147.27
Lets Look at a Girder
Girder Specifications

- 50’ Long
- 3” Flange Thickness
- 2” Web Thickness
- Current Design
- Double Bevel Weld
- Root Face = 0
- Bevel Angle = 45°
- Unequal Fillet Outside of Groove
First Calculate the Joint Area

• Finding Cross sectional area of Triangle we use Trig
• TanΘ = Opposite Side ÷ Adjacent Side
• Therefore Tan(45)*1 = 1
• Cross Section = 1*1 ÷ .5 = .5 Sq. In
• .5 * 50’ *.283 = 84.9lbs per Weld
• 339.6lbs Total for Bevel
Calculate Joint Area of Fillet

- ½” Bottom Leg x 1” Top leg
- \(0.5 \times 1 \times 0.5 = 0.25\)
- \(0.25 \times 50' \times 0.283 = 42.45\)lbs per Weld
- 169.8lbs for Filets

- Total Weld Volume for Girder
- 339.6lbs Bevels
- 169.8lbs Filets
- 509.4lbs Total
Selecting Welding Process

- 3/32” Submerged Arc Welding
- 600 Amps
- Deposition Rate = 22lbs/hr
- 509.4lbs ÷ 22lbs = 23.15hrs
- 23.15hrs * $35 L/OH = $810.25

- 509.4lbs ÷ .99% Dep. Eff = 514.5lbs
- 514.5lbs *1.5 = 771.75lbs Flux
- (514.5 *$1.75)+(771.75*$1.75) = $2,250.94 FM Costs
- 23.15 ÷ 50%OF = 46.3hrs
- 46.3hrs * $35 L/OH = $1620.5
Total Cost for Girder Welding

- Total Arc Time = $810.25
- Total Non Arc Time = $1,620.50
- Total Filler Metals = $2,250.94

- Total Cost = $4,681.69
What Happens if we make some Changes

• Change Joint Design to Double Bevel with 3/16” Land
• 40° Bevel Angle

• Find the Leg Lengths
• 2-3/16” = 1.8125 ÷ 2 = .90625
• Tan(40) = .90625 ÷ B
• .839 * .90625 * .5 = .38
• .38 sq/In * 50’ * .283 = 64.55lbs
• 258.212lbs for Bevels
Calculating Total Weld Volume

- \(0.839 \times 0.5 \times 0.5 = 0.20975\)

- \(0.20975 \text{ sq.in} \times 50' \times 0.283 = 35.62\text{lbs}\)

- 142.48lbs for Filet Welds

- Bevel Weld Volume = 258.2lbs
- Filet Weld Volume = 142.48lbs
- Total Weld Volume = 400.68lbs
Changing the Weld Process

- Convert to Tandem 5/32 SAW
- Lead Wire = 700 Amps
- Trail Wire = 700 Amps
- Lead Deposition Rate = 19.5lbs
- Trail Deposition Rate = 19.5lbs
- Total Dep Rate = 39lbs/hr

- \[ \frac{400.68 \text{lbs}}{39 \text{lbs/hr}} = 10.27 \text{hrs} \]
- \[ 10.27 \text{hrs} \times 35 \text{ L/OH} = 359.45 \]
- \[ (400.68 \times 1.75) + (601.02 \times 1.75) = 1752.98 \text{ FM Cost} \]
- \[ 10.27 \text{hrs} \times 50\% \text{OF} = 20.54 \text{hrs} \]
- \[ 20.54 \text{hrs} \times 35 \text{ L/OH} = 718.90 \]
Difference in Total Costs

- Single Wire 3/32 @ 600Amps
- Double Bevel 45°
- Total Weld Cost = $4,681.69

- Tandem 5/32 SAW 700A/700A
- Double Bevel 40° 3/6” Root Face
- Total Weld Cost = $2,831.33

Difference = $1,850.36 39.5% Reduction
Finding information when its not provided

- Most MFG provide Dep. Rate charts for given amperages, however not all are correct.
- IE. Extended Stickout, or AC welding.
- Use a formula based on WFS to provide your deposition rate.
  - Dep Rate =
  - 13.33 X Dia X Dia X WFS X Dep EFF.
  - .045 E71T-1 @ 350IPM @ 82% EFF
  - $13.33 \times .045 \times .045 \times 350 \times .85 = 8.03$lbs/hr
Recap

• Information leads to Productivity
• Dep Rate
• Joint Design
• Efficiency
• Operating Factor
Thank you for your time!!

Questions??