FASTER WELDING ON FIELD WITH INNERSHIELD®

www.lincolnelectriceurope.com
DIY OUTDOOR/INDOOR EQUIPMENT PACKAGES TO SATISFY YOUR REQUIREMENTS

TOTAL SOLUTION TO WORK WITH INNERSHIELD®

INNERSHIELD® wires

INNERSHIELD® GUNS

COMPLETE RANGE OF PPE FOR YOUR PROTECTION

HIGH PRODUCTIVITY SOLUTION

A COMPLETE PORTFOLIO FOR SEVERAL APPLICATIONS

SELF-POWERED CARRIAGES FOR MECHANIZED ALL POSITIONAL WELDING

COMPLETE RANGE OF PPE FOR YOUR PROTECTION

EQUIPMENT PACKAGES TO SATISFY YOUR REQUIREMENTS

CROSSLINC® TECHNOLOGY TO REGULATE WELDING PARAMETERS FROM THE WIRE FEEDER

FASTER WELDING ON FIELD WITH INNERSHIELD®

www.lincolnelectric-europe.com
LINCOLN ELECTRIC INVENTED
THE FIRST SELF-SHIELDED
FLUX-CORED WIRE

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1. Green Rod or Strip
2. Formation
3. Butt Seam
4. Lap Seam
5. Outer Steel Sheath
6. Inner Flux Core

INNERSHIELD®
THE RIGHT SOLUTION
FOR OUTDOOR WELDING, ADVANTAGES
OVER OTHER COMMON PROCESSES

www.lincolnelectriceurope.com FASTER WELDING ON FIELD WITH INNERSHIELD®

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INNERSHIELD® – THE RIGHT SOLUTION FOR OUTDOOR WELDING OVER STICK WELDING PROCESS

Welding cost (€/kg)*

-70% up to

Welding time (h)**

-85% up to

INNERSHIELD® ADVANTAGES OVER STICK WELDING PROCESS
- Continuous process
- Longer Arc time and increased operating factor
- Higher deposition rates
- Increased productivity
- Fewer stops and starts = fewer defects

COST SAVING EXAMPLE BETWEEN INNERSHIELD® AND SMAW PROCESSES

APPLICATION
BASE MATERIAL: S355
Thickness: 10 mm
Joint type: A5 FW in PB (2f)

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>SMAW BASIC 7018-1</th>
<th>FCAW-S NR-233</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding modality</td>
<td>manual</td>
<td>semi-automatic</td>
</tr>
<tr>
<td>Current (A)</td>
<td>140-180</td>
<td>240-250</td>
</tr>
<tr>
<td>Diameter (mm)</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Deposition rate (kg/h)</td>
<td>1.7</td>
<td>2.7</td>
</tr>
</tbody>
</table>

COST STUDY FOR 1000 METERS OF WELD PER YEAR

<table>
<thead>
<tr>
<th>WELDING COST</th>
<th>€/kg</th>
<th>€/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire</td>
<td>3</td>
<td>15.00</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>0.65</td>
<td>0.80</td>
</tr>
<tr>
<td>Weight per meter weld (kg/m)</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>Cost per meter weld (€/m)</td>
<td>1.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Total cost (€/kg)</td>
<td>5</td>
<td>19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRODUCTION COST</th>
<th>€/h</th>
<th>€/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour cost</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Duty cycle (%)</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Weight per meter weld (kg/m)</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>Time per meter weld (h/m)</td>
<td>0.75</td>
<td>0.34</td>
</tr>
<tr>
<td>Cost per meter weld (€/m)</td>
<td>31</td>
<td>18</td>
</tr>
<tr>
<td>Total welding time (h)</td>
<td>752</td>
<td>341</td>
</tr>
<tr>
<td>Total cost (€)</td>
<td>31,127</td>
<td>17,942</td>
</tr>
</tbody>
</table>

SAVINGS
TIME -55% (-51 days)
COST -42% (-13 000 €)

INNERSHIELD® – SEMI-AUTOMATIC GAS-LESS PROCESS ALLOWS YOU TO SAVE TIME AND COST

Contact us to calculate your ROI

www.lincolnelectriceurope.com
FOR MORE PRODUCTIVITY, MOVE FROM SMAW TO FCAW.
CHOOSE INNERSHIELD® IF...

➢ THE USE OF GAS BOTTLES
TYPICAL ISSUES USING GAS

• supply of right gas mixture
• regular delivery of bottles on field
• safe gas bottle handling
• protected store
• continue maintenance of hoses and gas pressure regulators (cost/time lost, gas leakage, dedicated person in charge of)

➢ THE WIND
REPRESENTS AN ISSUE

INNERSHIELD® ALLOWS:

• Welding under wind speeds up to 50 km/h and favourable operating characteristics without losing mechanical properties
• Less defects such as porosity and wormholes
• No need to invest in barriers to protect the welding from wind

INNERSHIELD® ADVANTAGES

• Eliminate cylinder rental cost
• Lower maintenance costs: (simpler gun and feeder).
• No requirement for tenting to protect welding point from wind.
• Innershield® wires have excellent feedability and root penetration and allows use of long CTWD to enter in narrow groove.
• Deal with surface contaminants, such mill scale, rust, coating, better than solid wire.
**INNERSHIELD® – THE PROCESS**

Lincoln Electric Company invented the FCAW-S process in 1958, with the Innershield® line of electrodes (Innershield® wires). Innershield® is an important process for steel fabrication in many industries, particularly when done outdoors. It is a primary welding process for structural steel building erection.

### TYPICAL APPLICATIONS
- Steel Structure
- Offshore
- Shipbuilding
- Field Maintenance
- Pipelines
- Heavy plate fabrication
- Sheet metal
- General fabrication
- Rail welding
- Home work – DIY

### TYPICALLY MADE IN LARGE DIAMETERS
- from 1,6 to 3,0 mm
- some in smaller sizes: 0,9 mm to 1,2 mm

### AVAILABLE IN VARIETY OF PACKAGES
- from 0,4 kg to 22,7 kg
- bulk reels & drums 227 kg, 273 kg

### AVAILABLE IN VARIETY OF FORMULATIONS FOR:
- mild steel or low-alloy
- flat & horizontal position only or all positions

### MAIN INNERSHIELD® TYPES*

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4,5 kg</strong></td>
<td>0,9 1,1 1,7 2,0</td>
</tr>
<tr>
<td><strong>5,7 kg</strong></td>
<td>0,9 1,1 1,7 2,0</td>
</tr>
<tr>
<td><strong>6,4 kg</strong></td>
<td>0,9 1,1 1,7 2,0</td>
</tr>
<tr>
<td><strong>11,3 kg</strong></td>
<td>1,6 2,0 2,4 3,0</td>
</tr>
<tr>
<td><strong>22,7 kg</strong></td>
<td>1,6 2,0 2,4 3,0</td>
</tr>
</tbody>
</table>

*Non-exhaustive list. More wires available in www.lincolnelectric.eu

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When required:
- Welders need to be qualified according to EN 287-1; training of 1 week is recommended to master the technique.
- Welding procedure shall be qualified according to EN ISO15614-1. (*)

(*) Lincoln Electric can provide support for welder training and procedure qualification

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All Innershield® wire are classified according to EN ISO 17632 and are suitable for welding steel structures according to EN 1090.
QUALITY CONTROL

Innershield® is a process widely used worldwide in a great variety of applications. Innershield® wires are object of strict quality control in production to grant consistent performances.

Innershield® wires are approved by third parties such as ABS, DNV, LRS (see product data sheet for better reference).

Some Innershield® products are used for building construction in the seismically active regions of the US, where the stringent requirements of AWS D1.1 Structural Welding Code-Steel, and the D1.8 Seismic Welding Supplement apply.

Product: Innershield® NR®-440Ni2
Classification: E71T8-Ni2-JH8
E71T8-A4-Ni2-H8
AWS A5,36:2016, ASME SFA-5,36

Mechanical Properties of Weld Metal

Tensile Strength, MPa (ksi) [70-90] [58 min.] 580 [84]
Yield Strength, 0.2% Offset, MPa (ksi) [58 min.] 450 [65]
Elongation % 22 min. 26

Average Impact Energy Joules @ -40°F [ft-lbs @ -40°F] [20 min.] 49 [36]
24, 50, 50 [53, 36, 37]

Average Hardness, HRB Info. Only 87

Chemical Composition of Weld Metal (weight %)

C 0.12 max. 0.02
Mn 1.50 max. 1.06
Si 0.60 max. 0.18
S 0.03 max. 0.019
P 0.010 max. 0.010
Ni 1.00-2.75 1.94
Al 1.0 max. 0.8

Diffusible Hydrogen (per AWS A4.4) E71T8-Ni2-JH8 Requirements RESULTS

Required Size for Classification V6 in V6 in (6.6 mm)
Current Type/Polarity DC- DC-
Nominal Voltage, V 20 20
Nominal Current, A 290 290
Wire Feed Speed, cm/min (in/min) 622 (24.6)
Average Heat Input, kJ/mm (kJ/in) (25-95) 1,352 (53.8)
Travel Speed, cm/min (in/min) 26 (1.02)
Contact Tip to Work Distance, mm (in) 22 (0.87)
Pass/Layers 20/6 20/6
Preheat Temperature, °C (°F) (60 min.) 25 (73)
Interpass Temperature, °C (°F) (90 min.) 25 (77)
Postweld Heat Treatment As-welded As-welded

Chemical Composition of Weld Metal (weight %)

CVN up to -50°C (for specific products)
**MAIN PRODUCTS**

**Innershield® NR®-211-MP**
- Versatile welding capability on a variety of base materials
- High operator appeal and good bead appearance
- Easy slag removal
- Fast freezing characteristics accommodate poor fit-up
- Restricted to 12 mm plate thickness

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Approvals</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS A5.36</td>
<td>EN ISO 17632-B</td>
<td>C, Mn, Si, P</td>
<td>$\sigma_{0,2}$, RM, Elongation (%)</td>
</tr>
<tr>
<td>E71T9-N2-A2-C53</td>
<td>T465T9-N1-A-H15</td>
<td>0.20</td>
<td>0.65</td>
</tr>
</tbody>
</table>

**Applications**
- Sheet or thin gauge metal
- Galvanized sheet metal
- Robotic/hard automation
- General fabrication

**Innershield® NR®-233**
- New design increases wire stiffness to aid feedability and promotes smooth arc transfer
- High deposition rates for out-of-position welding
- Meets AWS D1.8 requirements
- Welders of all skill levels benefit from the easy to control arc and forgiving weld puddle even out of position

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Approvals</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS A5.36</td>
<td>EN ISO 17632-B</td>
<td>C, Mn, Si, P</td>
<td>$\sigma_{0,2}$, RM, Elongation (%)</td>
</tr>
<tr>
<td>E71T9-A2-C53-H11</td>
<td>T49 3 T8-1 N A-UH10</td>
<td>0.05-0.20</td>
<td>0.61-0.65</td>
</tr>
</tbody>
</table>

**Applications**
- General & Seismic structural steel erection and fabrication
- Ship and barge fabrication
- Vertical up and overhead fillets and groove welds

**Innershield® NR®-203 Nickel (1%)**
- Designed to produce a nickel bearing weld deposit
- Produces weld deposits with impact toughness exceeding 27 J at 29°C
- Color match on weathering steels
- Handles poor fit-up
- Root bead capability

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Approvals</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS A5.36</td>
<td>EN ISO 17632-B</td>
<td>C, Mn, Si, Ni, P</td>
<td>$\sigma_{0,2}$, RM, Elongation (%)</td>
</tr>
<tr>
<td>E71T9-A2-N1-H6</td>
<td>T42 3 T110 N Y N</td>
<td>0.21</td>
<td>0.65</td>
</tr>
</tbody>
</table>

**Applications**
- Roundabout groove welds on heavy wall tubular construction
- Offshore
- Bridges and other structural components made from weathering steels
- Structural fabrication
- NACE applications

**Innershield® NR®-555**
- Impact 100J@-50°C
- Self-shielded electrode designed for welding in structural applications
- Welder friendly operability and flat bead face in out-of-position fillets and groove welds
- Meets AWS D1.8 seismic lot waiver requirements
- ProTech® foil bag packaging shields against moisture, prevents rust and prolongs storage life

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Approvals</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS A5.36</td>
<td>EN ISO 17632-A</td>
<td>C, Mn, Ni, S, P</td>
<td>$\sigma_{0,2}$, RM, Elongation (%)</td>
</tr>
<tr>
<td>E81T8-A5-K8-H</td>
<td>T4365Z Y N1 N100</td>
<td>0.05</td>
<td>1.84</td>
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</tbody>
</table>
**Innershield® NR®-311Ni**
- Designed for improved handling of poor fit-up on heavy wall tubes and gaps up to 9.5 mm with 6.4 mm offset
- Fast freezing slag with excellent wash-in
- Root bead capability without back-up bars

**Applications**
- Fillet and lap welds
- Horizontal and square edge butt welds, such as column-to-column structural connections
- Deep groove welds
- Structural fabrication
- Weathering steels

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>E70T-8-2</th>
<th>EN ISO 17632-B T42 2 1,5Ni W N</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.06-0.08</td>
<td>Mn 1.25-1.40</td>
<td>Si 0.18-0.22</td>
<td>Rp0.2 1.29-1.56</td>
</tr>
<tr>
<td>P</td>
<td>0.80</td>
<td>Al 470-515</td>
<td>RM 575-615</td>
<td>27-30</td>
</tr>
</tbody>
</table>

**Innershield® NR®-232**
- Self shielded: easiest equipment arrangement
- Deposit rate up to 3 kg/h, out of position
- Excellent low temperature impact toughness
- Ideal for fillet welding and filling
- For single and multi-pass welds
- Size diameter 1.7mm suitable for contaminated or primed plate

**Applications**
- Structural fabrication, including those subject to seismic requirements
- General plate fabrication
- Hull plate and stiffener welding on ships and barges
- Machinery parts, tanks, hoppers, racks and scaffolding

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>E70T-8</th>
<th>EN ISO 17632-A T42 2 Y N 2 H15</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.18</td>
<td>Mn 0.65</td>
<td>Si 0.27</td>
<td>Rp0.2 440</td>
</tr>
<tr>
<td>P</td>
<td>0.55</td>
<td>Al 460-520</td>
<td>RM 575-615</td>
<td>25-31</td>
</tr>
</tbody>
</table>

**Innershield® NR®-232-H**
- High deposition rates for out-of-position welding
- Penetrating arc
- Fast freezing, easy to remove slag system
- Lower level of diffusible Hydrogen than NR-232

**Applications**
- Structural fabrication, including those subject to seismic requirements
- General plate fabrication
- Hull plate and stiffener welding on ships and barges
- Machinery parts, tanks, hoppers, racks and scaffolding

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>E70T-8-H</th>
<th>EN ISO 17632-A T42 2 Y N 2 H10</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
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<tbody>
<tr>
<td>C</td>
<td>0.18</td>
<td>Mn 0.65</td>
<td>Si 0.27</td>
<td>Rp0.2 460-520</td>
</tr>
<tr>
<td>P</td>
<td>0.55</td>
<td>Al 460-520</td>
<td>RM 575-615</td>
<td>25-31</td>
</tr>
</tbody>
</table>

**Innershield® NR®-305**
- NR-305 is a self-shielded flux cored wire
- Not intended for out-of-position welding, but can be used on 15° max. downhill and 5° max. uphill applications
- High deposit rates and fast travel speed
- Easy handling
- Recommended for maximum productivity, downhand welding

**Applications**
- General plate fabrication
- Structural fabrication, including those subject to seismic requirements
- Shipyards, stiffener welding on barges
- Bridges and offshore rigs
- Welding over tack welds made with stick electrode

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>E70T-8-H</th>
<th>EN ISO 17632-A T42 2 Y N 2 H10</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.09</td>
<td>Mn 0.9</td>
<td>Si 0.2</td>
<td>Rp0.2 470</td>
</tr>
<tr>
<td>P</td>
<td>0.80</td>
<td>Al 550</td>
<td>RM 24-28</td>
<td>27-40</td>
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</tbody>
</table>

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FASTER WELDING ON FIELD WITH INNERSHIELD®
**INNERSHIELD® FOR SPECIAL APPLICATIONS: OFF-SHORE, RAIL, PIPELINE**

### RAIL TRACK

**Innershield® NS-3M**
- Versatile welding capability on a variety of base materials
- High operator appeal and good bead appearance
- Easy slag removal
- Fast freezing characteristics help accommodate poor fit-up

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Approvals</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS A5.20 / AWS A5.36</td>
<td>E70T-4</td>
<td>C Mn Si S P</td>
<td>RP0.2 RM Elongation (%)</td>
</tr>
<tr>
<td>EN ISO 17632-A</td>
<td>T38 Z VN 3</td>
<td>0.05-0.20 0.61-0.65</td>
<td>≤ 0.01 ≤ 0.03</td>
</tr>
</tbody>
</table>

### OFFSHORE

**Innershield® NR®-440Ni2**
- Designed help provide optimal weldability in narrow TKY joints and poor fit up conditions
- Expect fast travel speeds and a flat bead face when using vertical-up or vertical-down welding techniques
- Low temperature impact toughness, meets ABS 4YSA and AWS J classification
- Meets H8 diffusible hydrogen requirements over a range of humidity levels

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Approvals</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS 5.29</td>
<td>E71T8-Ni2-TH</td>
<td>C Mn Si Ni S P</td>
<td>RP0.2 RM Elongation (%) Impact ISO-V (J) -40°C</td>
</tr>
<tr>
<td>EN ISO 17632-A</td>
<td>ABS, DNV, LR</td>
<td>0.01-0.03 0.74-1.30 0.01-0.03</td>
<td>1.77-2.30 0.002-0.004</td>
</tr>
</tbody>
</table>

### PIPELINE

**Pipeliner® NR®-208-XP**
- Vertical down hot, fill and cap pass welding of up to X80 grade pipe
- Capable of producing weld deposits with impact toughness exceeding 122 J at -40°C

**Specifications**

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Chemistry</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS A5.16</td>
<td></td>
<td>RP0.2 RM Elongation (%) Impact ISO-V (J) -40°C</td>
</tr>
<tr>
<td>E81T8-A4-K12</td>
<td>C Mn Si S P</td>
<td>2.30-2.20 0.04-0.007</td>
</tr>
</tbody>
</table>
INNERSHIELD® SELECTION CRITERIA

SELECTION BASED ON MECHANICAL PROPERTIES OF STRUCTURAL STEEL

Yield

-50 / -40
-20
0

CVN testing temperature °C

Innershield® NR®-555:
EN 10025-4: S460ML, EN 10025-3: S460NL,
EN 10025-4: S420ML, EN 10025-3: S420NL,
EN 10025-4: S460M, EN 10025-3: S460N,
EN 10025-4: S420M, EN 10025-3: S420N

Innershield® NR®-440Ni2:
EN 10025-4: S355ML, EN 10025-3: S355NL,
EN 10025-4: S275ML, EN 10025-3: S275Ni.

Innershield® NR®-233, Innershield® NR®-203Ni,
Innershield® NR®-232 & 232-H, Innershield® NR®-305,
Innershield® NR®-311Ni:
EN 10025-4: S355M, EN 10025-3: S355N,
EN 10025-2: S355J2, EN 10025-4: S275M,
EN 10025-2: S355J2, EN 10025-4: S235JR,
EN 10025-2: S235J0

Innershield® NR®-211-MP:
EN 10025-2: S355M, EN 10025-2: S355J0,
EN 10025-2: S275M, EN 10025-2: S235JR,
EN 10025-2: S235J0

* Suitable for weathering steel according to AWS D1.1 & D1.5

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FASTER WELDING ON FIELD WITH INNERSHIELD®

SELECTION BASED ON WELDING POSITION:

<table>
<thead>
<tr>
<th>Product</th>
<th>Welding position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innershield® NR®-233</td>
<td>All except vertical down</td>
</tr>
<tr>
<td>Innershield® NR®-203Ni</td>
<td>ALL</td>
</tr>
<tr>
<td>Innershield® NR®-440Ni2</td>
<td>ALL</td>
</tr>
<tr>
<td>Innershield® NR®-555</td>
<td>All except vertical up</td>
</tr>
<tr>
<td>Innershield® NR®-211-MP</td>
<td>Flat and horizontal</td>
</tr>
<tr>
<td>Innershield® NR®-311Ni*</td>
<td>Only vertical down</td>
</tr>
<tr>
<td>Pipeliner® 208-XP</td>
<td>All except vertical down</td>
</tr>
<tr>
<td>Innershield® NR®-305*</td>
<td>Flat and horizontal</td>
</tr>
<tr>
<td>Innershield® NS-3M</td>
<td>Flat and horizontal</td>
</tr>
</tbody>
</table>

* Innershield® for high deposition rate
WHICH EQUIPMENT AND ACCESSORIES FOR WELDING WITH INNERSHIELD®?

1 DIY

**Speedtec® 180C/200C**
- Multiprocess
- Easy to change polarity
- 220A/1phase
- Portable

2 OUTDOOR / INDOOR

**Flextec® 350X**
- Easy to setup and easy to operate
- Rugged and flexible enough to be used in most construction, fabrication, shipbuilding and other heavy-duty applications with LN25X or ACTIV8X—rugged, compact and connected wire feeders:
  - CrossLinc Technology allows for remote output control over the welding leads. No control cable needed!
  - True Voltage Technology™ (TVT™) automatically compensates for voltage drops across long welding cables.

3 OUTDOOR

**Vantage® 410 with LN-25 PRO**
- Reliable Engine 4 cylinder 1800 RPM Kubota diesel engine runs smooth and quiet
- Low Noise 97,0dB sound power, one of quietest 400amps engine-driven welders available

CROSSSLINC® TECHNOLOGY

CrossLinc technology feeders enable voltage control at the feeder, while eliminating the extra cable. The result helps improve safety greater safety, quality, and productivity on the work site.

<table>
<thead>
<tr>
<th>ACROSS-THE-ARC</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fewer cables</td>
<td>No voltage control at feeder</td>
</tr>
<tr>
<td></td>
<td>Low cost</td>
<td>Difficult to adjust procedures</td>
</tr>
<tr>
<td></td>
<td>Less jobsite cable clutter</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTROL CABLE</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Voltage control at feeder</td>
<td>More cables</td>
</tr>
<tr>
<td></td>
<td>Correct procedures for every weld</td>
<td>More jobsite clutter</td>
</tr>
<tr>
<td></td>
<td>Easier to adjust for voltage drop</td>
<td>Greater expense</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More difficult movement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CROSSSLINC® TECHNOLOGY</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Voltage control at feeder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fewer cables</td>
<td></td>
</tr>
<tr>
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<td>Less jobsite clutter</td>
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</tr>
<tr>
<td></td>
<td>Correct procedures for every weld</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Easy adjustment for voltage drop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased arc time</td>
<td></td>
</tr>
</tbody>
</table>
THE ULTIMATE IN WELDER PROTECTION

Flip’air LS / Zephyr LS
Electronic autodarkening helmets with air flow system.

Cleanspace 2™
This unique method of personal respiratory protection delivers significant benefits to workers in industry.

DEDICATED GUNS FOR INNERSHIELD®

Lincoln Electric offers a complete line of guns designed specifically for Innershield® process. Unlike MIG guns, Innershield® guns do not need to utilize the flow of shielding gas through them to help dissipate heat. Innershield® guns are rugged and durable, yet lightweight. Bestesellers among the Innershield® guns are the K126™ classic and K115.

• Rugged
• Durable
• Lightweight
• Easy to handle

K115 & K126 your choice for rugged and durable guns

K115
450A, Ø 2,4 to 3,0

K126® Classic
350A, Ø 1,6 to 2,4

To connect the Innershield® torch with feeder having EUROconnector, use the adapter code K10343
INDUSTRIAL APPLICATIONS: SOME EXAMPLES

OIL / WATER STORAGE TANKS

For the welding of large tanks, to improve the welder productivity, consider Innershield® over SMAW or GMAW processes.

To reduce welding time versus SMAW process, steel piling can be welded with Innershield.

Filler metal: Innershield® NR®-311Ni diam. 2,4 mm
Thickness: 30 mm

Typical parameters for 2G position welding using Innershield® NR-232 diam. 1,7 mm.
Thickness range: 13-18 mm
Equipment: Flextec 350, feeder LN 25X with crossLinc technology.

Approximate welding parameters for 2G position using mechanization:

<table>
<thead>
<tr>
<th>Pass</th>
<th>Weld Joint with Passes</th>
<th>Polarity</th>
<th>Voltage, Volts</th>
<th>WFS, m/min, [amps]</th>
<th>Stickout, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>1</td>
<td>DC-</td>
<td>18.0-21.0</td>
<td>2.8-3.6 [200-250]</td>
<td>12-28</td>
</tr>
<tr>
<td>Fill</td>
<td>2</td>
<td>DC-</td>
<td>18.0-21.0</td>
<td>2.8-3.6 [200-250]</td>
<td>12-20</td>
</tr>
<tr>
<td>Cap</td>
<td>3</td>
<td>DC-</td>
<td>18.0-21.0</td>
<td>2.8-3.6 [200-250]</td>
<td>12-20</td>
</tr>
</tbody>
</table>

Innershield® to improve productivity vs. SMAW

www.lincolnelectric.com
**OFF SHORE**

**INNERSHIELD® NR®-440Ni2**

Innershield® NR®-440Ni2 is a best in class electrode primarily for use in the offshore industry on T-Y-K connections and poor fit up conditions.

- Excellent Charpy V-Notch toughness: >200 J @-40°C in AWS joint configuration
- CTOD tested up to @-10°C
- Low diffusible hydrogen levels: Meets Agency H5 level (ABS, LRS, DNV)
- Great weldability in all positions: Has both vertical up and vertical down welding capability
- Higher deposition rate than SMAW process

**INNERSHIELD® NR®-440Ni2 VS. COMPETITOR’S FCAW-S**

![Impact Toughness in TKY Joint (3G position)](image1)

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>CVN (J)</th>
<th>CVN (ft-lbf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

![Impact Toughness in 3G ABS Butt Joint](image2)

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>CVN (J)</th>
<th>CVN (ft-lbf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**lower cost using Innershield® NR440Ni2 over stick electrode**
**Tensile (ASTM E8)** All weld metal, 6,35 mm (0.250 in) diameter

- \( R_p,0.2 \) (YS 0.2%) 515 MPa
- \( R_m \) (UTS) 609 MPa
- \( A_t \) (Elong.) 27%

**Charpy V-Notch (ASTM E23)** Mid-wall, 10 mm

-29°C (-20°F) 45 J

**CTOD (BS 7448 part 2) NP, SENB Bx2B**

-10°C (+14°F) 0.49 mm

---

**Mechanical test results (weld metal, as-welded)**

**Pipe procedures**

**Welding Procedures**

<table>
<thead>
<tr>
<th>Pass 1 (Root)</th>
<th>1,2 mm Pipeliner® 70S-G (ER70S-G) STT process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass 2-6</td>
<td>2,0mm Pipeliner® NR-208-XP (E81T8-G)</td>
</tr>
<tr>
<td>Position</td>
<td>5G Horizontal Fixed</td>
</tr>
<tr>
<td>Progression</td>
<td>Vertical-down all passes</td>
</tr>
</tbody>
</table>

Up to 2,0 Kg/h of deposition rate in PG position with Pipeliner® 208xp 2,0 mm diameter and higher operating factor than SMAW process.
RAIL TRACK WELDING

How to weld a rail track type "70" (Rm 685 N/mm²)

Recommended filler metal for rail track

<table>
<thead>
<tr>
<th>Rail track</th>
<th>&quot;70&quot; (Rm 685 N/mm²)</th>
<th>&quot;90&quot; (Rm 885 N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint</td>
<td>Innershield® N5-3M</td>
<td>Innershield® N5-3M</td>
</tr>
<tr>
<td>Surfacing</td>
<td>Innershield® N5-3M</td>
<td>Lincore 33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wearshield BU</td>
</tr>
</tbody>
</table>

In case of rail track type "90" (Rm 885 N/mm²), the last 6mm have to be welded with harfacing filler metal such as Lincore 33 (FCAW-S) or Wearshield BU (SMAW) to grant proper resistance to wearing.

MAINTENANCE WORK, REPARATION, GRATING, FENCE, GALVANIZED GUARDRAIL...

Use Innershield® NR®-211-MP with Speedtec® 180C / 200C very smooth spray arc transfer for easier operation, minimal spatter and easy slag removal.

Welding with NR®-211-MP diameter 0,9 mm can be done using normal GMAW torch (LGS 150 G). It is recommended to use the appropriate nozzle for Innershield® K10468.
EXAMPLES OF MECHANIZED APPLICATIONS
WELDYCAR AND INNERSHIELD®

Effective mechanization can help improve productivity

EXAMPLE OF COST SAVING ACHIEVEMENT USING INNERSHIELD® AND MECHANIZATION VERSUS MANUAL WELDING

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>Wire [€/kg]</th>
<th>Efficiency [%]</th>
<th>Weight per meter weld [kg/m]</th>
<th>Cost per meter weld [€/m]</th>
<th>Total cost [€/kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMAW</td>
<td>3</td>
<td>0,65</td>
<td>0,23</td>
<td>1,3</td>
<td>1,3</td>
</tr>
<tr>
<td>FCAW-S</td>
<td>15,00</td>
<td>0,80</td>
<td>0,23</td>
<td>4,3</td>
<td>4,3</td>
</tr>
</tbody>
</table>

COST Calculation FCAW-SS VS MMA

WELDING COST

<table>
<thead>
<tr>
<th>Time per meter weld [h/m]</th>
<th>Cost per meter weld [€/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour cost [€/h]</td>
<td>0,75</td>
</tr>
<tr>
<td>Operating factor [%]</td>
<td>40</td>
</tr>
</tbody>
</table>

PRODUCTION COST

<table>
<thead>
<tr>
<th>Weight per meter weld [kg/m]</th>
<th>Cost per meter weld [€/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost [€/kg]</td>
<td>18</td>
</tr>
<tr>
<td>Wire Feed Speed (m/min)</td>
<td>31</td>
</tr>
</tbody>
</table>

Innershield® NR305 for high deposition rate in flat welding position

<table>
<thead>
<tr>
<th>Diameter, Polarity</th>
<th>CTWD (mm)</th>
<th>Wire Feed Speed (m/min)</th>
<th>Voltage [V]</th>
<th>Approx. Current (A)</th>
<th>Deposition rate (kg/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,0 mm, DC+</td>
<td>35-51</td>
<td>4,4</td>
<td>20-22</td>
<td>300</td>
<td>4,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5,6</td>
<td>21-23</td>
<td>330</td>
<td>5,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,6</td>
<td>22-24</td>
<td>360</td>
<td>5,9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,6</td>
<td>24-26</td>
<td>375</td>
<td>6,9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8,3</td>
<td>25-27</td>
<td>400</td>
<td>7,4</td>
</tr>
<tr>
<td>2,4 mm, DC+</td>
<td>41-54</td>
<td>4,1</td>
<td>21-23</td>
<td>330</td>
<td>5,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,1</td>
<td>24-26</td>
<td>425</td>
<td>7,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,6</td>
<td>27-29</td>
<td>475</td>
<td>9,5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,2</td>
<td>33-35</td>
<td>525</td>
<td>12,7</td>
</tr>
</tbody>
</table>

Want to learn more?
Please contact us to book an appointment.
On overall it is important that Innershield® wires are welded following appropriate guidelines, for this reason please consult our brochure "Innershield® wire: FCAW-s welding guide" or ask directly.
BEING PRESENT LOCALLY
MAKES US MORE AWARE GLOBALLY

125 YEARS OF EXPERIENCE

325+ GLOBAL R&D TEAM

3.0 BILLION USD REVENUE

11,000 EMPLOYEES WORLDWIDE

TEST RESULTS
Test results for mechanical properties, deposit or electrode composition and diffusible hydrogen levels were obtained from a weld produced and tested according to prescribed standards, and should not be assumed to be the expected results in a particular application or weldment. Actual results will vary depending on many factors, including, but not limited to, weld procedure, plate chemistry and temperature, weldment design and fabrication methods. Users are cautioned to confirm by qualification testing, or other appropriate means, the suitability of any welding consumable and procedure before use in the intended application.

CUSTOMER ASSISTANCE POLICY
The business of The Lincoln Electric Company® is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or advice about their use of our products. Our employees respond to inquiries to the best of their ability based on information provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or advice. Moreover, the provision of such information or advice does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or advice, including any implied warranty of merchantability or any warranty of fitness for any customers’ particular purpose is specifically disclaimed.

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