# ASTM Standards for Metal Jacketing



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April 1, 2017

NIA National Insulation Association

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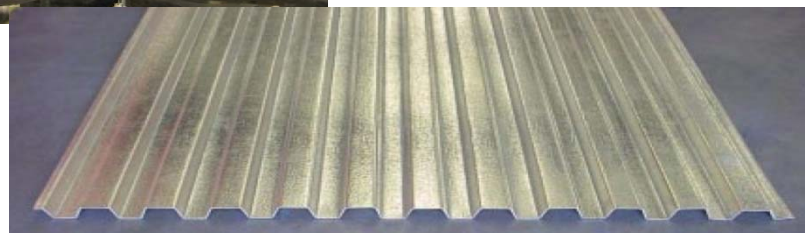

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# Purpose of ASTM Metal Jacketing Standards

- Provide industry consensus standards that:
  - Help ensure high quality materials are used
  - Make it easier for specifiers and facility owners to specify high quality materials
  - Identify key attributes and requirements for materials
  - Simplify specifications
  - Make it easier for manufacturers, distributors, and contractors to demonstrate that materials meet requirements for high quality
  - Improve the performance of insulation systems in our industry
  - Project specifications determine whether compliance to these ASTM standards is required

# The Two ASTM Metal Jacketing Standards

- Both were created to formalize best practices and requirements for metal jacketing beyond just the metal alloy
- C1729 - Specification for Aluminum Jacketing for Insulation
  - Historically, only the aluminum metal alloy standard, ASTM B209, was referenced in specifications
  - B209 requirements incorporated into C1729
- C1767 - Specification for Stainless Steel Jacketing for Insulation
  - Historically, one of 3 stainless steel metal alloy standards, ASTM A167, A240, or A480, was referenced in specifications
  - A240 requirements incorporated into C1767

# History of ASTM Metal Jacketing Standards

| ASTM Action | C1729 Aluminum | C1767 Stainless |
|---|---|---|
| Work began | 2008* | 2011** |
| 1st subcommittee ballot | 2009 | 2012 |
| 1st main committee ballot | 2010 | 2012 |
| Standard first approved | 2010 | 2012 |
| Current version | 2016 | 2016 |

*Started by Mike Scoby
**Language was heavily borrowed from C1729

- This author is the current chair for C1729 and C1767
- Both standards are in continuous maintenance mode

# Classification System Used for Metal Jacketing

- Most ASTM material standards cover multiple categories of materials
  - Mineral fiber insulation classified by maximum use temperature
  - PIR insulation classified by density/strength
- This categorization is normal and common
  - Key decision is, how thorough is this categorization?

<u>Benefits of a Thorough Standard</u>

- Fewer standards required
  - Lower cost to purchase the standards from ASTM
- Fewer standards to keep updated by industry volunteers
  - Lower cost and effort to update
- More information is in one document

Vs.

<u>Disadvantages of a Thorough Standard</u>

- Harder to understand
- More complex classification structure
- Lengthier standard

# Classification System Used for Metal Jacketing

- C1729 (aluminum) and C1767 (stainless) use similar classification systems
  - Types: based on outer surface treatment and emittance
    - Bare, painted (various kinds), or plastic film coated
  - Grades: based on metal alloy
    - C1729 = 3105/3003, 1100, 3004, Alclad 3004, or 5052
    - C1767 = T304 or T316
  - Classes: based on moisture barrier used on interior surface
    - Polyfilm, polykraft, painted, or bare


# Classification System Used for Metal Jacketing

- Very thorough classification system
- Designed to be inclusive of all aluminum and stainless jacketing being used in all applications
  - Pipe, elbows, tanks, breeching, equipment, deep corrugated, box-rib, etc.
- Designed to address **global** aluminum and stainless jacketing usage
- Has expanded over time to include newer exterior surface treatments
  - PVF films, PVdF paint systems

# Key Property Requirements

- C1729 (aluminum) and C1767 (stainless) jacketing
  - Must meet specified classifications (Type, Grade, and Class)
    - Outer surface treatment, alloy, and moisture barrier
  - Outer surface treatment (Type):
    - Bare
    - Painted with pigmented paint (grey, white, colors)
    - Painted with unpigmented paint (clear)
    - Plastic film coated (e.g. PVF)
    - Painted with PVdF paint system
  - Metal Alloy (Grade)
    - Must meet chemical composition and physical properties required in ASTM metal alloy standard (B209 for alum. and A240 for S.S.)
    - Aluminum alloy: varies by application (pipes, elbows, sheets, deep corrugated, box rib, tanks, etc.)
    - Stainless alloy: varies by corrosion resistance desired (T304 vs. T316)
  - Moisture barrier on interior surface to retard corrosion
    - Required on pipe
    - Recommended in most other applications

# Key Property Requirements of C1729 & C1767

- Dimensions—all the sizes important to contractors:
  - Thickness per included table and depends on:
    - Insulation diameter—larger requires greater thickness
    - Insulation rigidity—less rigid requires greater thickness (alum only)
    - Required thickness does NOT include any coatings, embossing, or corrugations
  - Thickness tolerance per included table
  - Recommended lengths and widths and required tolerances are listed
    - Vary depending on sheets vs. rolls
    - Vary depending on “flat” vs. deep corrugated vs. box rib
  - Recommended repeat patterns for deep corrugated and box rib are listed
  - Required overlaps for cut & roll
  - Required overlaps for 2-piece elbows
    - Heel, throat, & butt/end joints

# Key Property Requirements

- Details on Thickness Requirements

**C1729 - TABLE 3 Minimum Thickness for Pipe Jacketing**

| Outer Insulation Diameter (in.) | Minimum Allowable Aluminum Thickness (in.) | |
|---|---|---|
| | Rigid Insulation | Non-Rigid Insulation |
| ≤ 8 | 0.016 | 0.016 |
| over 8 through 11 | 0.016 | 0.020 |
| over 11 through 24 | 0.016 | 0.024 |
| over 24 through 36 | 0.020 | 0.032 |
| over 36 | 0.024 | 0.040 |

**C1767 - TABLE 2 Minimum Thickness for Pipe Jacketing**

| Nominal Outer Insulation Diameter (in.) | Minimum Allowable Stainless Steel Nominal Thickness (inches) |
|---|---|
| ≤ 8 | 0.010 |
| over 8 thru 11 | 0.010 |
| over 11 thru 24 | 0.010 |
| over 24 thru 36 | 0.016) |
| over 36 | 0.020 |

"Non-rigid" defined as compressive strength < 15 psi

# Key Property Requirements

- C1729 (aluminum) & C1767 (stainless) jacketing
  - Physical property requirements
    - Flammability via ASTM E84 must be ≤ 25/50 flame spread/smoke developed
      - Tested with any moisture barrier and outer surface treatment in place
    - Emittance of outer surface
      - ≥ 0.1 (aluminum) or ≥ 0.3 (stainless) for bare (Type I)
      - ≥ 0.5 for unpigmented paint (Type III) (alum only)
      - ≥ 0.8 for pigmented paint (Type II & V)
      - ≥ 0.85 for plastic film (Type IV)

# Key Property Requirements

- C1729 (aluminum) & C1767 (stainless) jacketing
  - **Moisture barrier requirements**
    - **Film type moisture barriers (polykraft & polyfilm) must be "factory applied and heat laminated"**
      - **Glued on moisture barriers are not permitted**
    - **Pinhole detections ≤ 5 per 50 ft$^2$ for all moisture barrier classes**
    - **Water vapor transmission rate**
      - **≤ 0.1 g/100 in2-day for polyfilm**
      - **≤ 1.1 g/100 in2-day for polykraft (more than 10 times higher)**

polykraft

painted

polyfilm

# Key Property Requirements

- C1729 (aluminum) & C1767 (stainless) jacketing
  - Painted exterior requirements
    - Thickness of paint—varies by Type (II, III, or V)
    - Pencil hardness of paint
    - Additional requirements for PVdF paint system
  - Exterior film and paint application requirements
    - Films must be:
      - Factory applied to the metal jacketing outer surface using heat lamination with a thermally activated adhesive
      - A minimum of 1.5 mils thick
    - Paints must be:
      - Factory applied and baked on to the outer surface

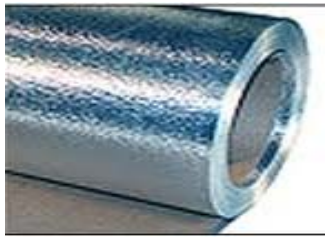
# Key Property Requirements

- C1729 (aluminum) & C1767 (stainless) jacketing
  - General requirements
    - No visual defect that will affect performance
    - Free of laminated separations, holes, rips, tears, scratches, dents, non-uniform edges, or creases
  - Tanks
    - Horizontal cylinders must not use 3/16 corrugated or deep corrugated
    - Vertical vessels of <8 ft diameter can use any finish
    - Vertical vessels of ≥8 ft diameter shall use deep corrugated jacketing

# Key Property Requirements

- C1729 (aluminum) & C1767 (stainless) jacketing
  - Additional optional requirements not core to the standard but can be agreed to by buyer and seller
    - Safety edge or safety hem
    - Finish can be specified to be smooth, 3/16” corrugated, or stucco embossed
      - Specifier/owner aesthetic preference—very little performance difference





# Example of Incomplete or Vague Spec. Language—Use of C1729 to clarify

- The example of specification language in the following slides is meant to show:
  - The importance of clear specification language
  - The difficulty of complying with unclear specs
  - The risk of using unclear words in specs
  - The potential for mistakes when unclear words are used
  - The use of ASTM metal jacketing standards to clarify specifications
- Example is actual specification language but company name has been removed

# Example of Poor Spec. Language

- **Actual Spec Language**
  - **"Metal jacketing on pipe shall be aluminum**
  - **Aluminum jacketing shall be ASTM B209 Grade 3003 with H14 or H16 temper**
  - **Corrosion inhibitor shall be applied on the internal face of the aluminum jacket for waterproofing, with an efficiency of 400 gr/m²"**


- **Problems with Spec Language**
  - **Jacketing thickness is not specified**
  - **Cluttered with detailed information about temper & alloy**
  - **"Waterproofing" language suggests a plastic film since paints are not considered "waterproof"**
  - **"Efficiency of 400 gr/m²" language implies a paint**
    - **Films are not specified in this manner**
  - **Lack of clarity on type of paint and where it is applied**
  - **Language is unclear**
  - **Leaves key material/design decisions up to contractor**
    - **Unfair to ask contractor to act as engineer/specifier**
  - **Lots of jacketing aspects are not specified**

# Example with Improved Spec. Language

- Assume specifier wanted a moisture barrier as “waterproof” as possible (polyfilm)
- *“Metal jacketing on straight pipe shall be stucco embossed aluminum alloy 3003 or 3105 with bare exterior, have a polyfilm moisture barrier, and shall comply with ASTM C1729, Type I, Grade 1, Class A”*
  - Spec reader quickly knows what is specified in general
    - Stucco embossed, bare exterior, 3105 or 3003 aluminum alloy, polyfilm moisture barrier
  - Short, concise, and yet VERY thorough spec language since it relies on the comprehensive content of C1729


# General Example: What about Elbows?

- Specification sections for jacketing often neglect to mention anything about jacketing on elbows
- Gore elbows or 2-piece elbows?
  - 2-piece jacketing elbows can be different than straight pipe jacketing
    - For aluminum, it is usually different in alloy and more
  - 2-piece jacketing elbows can still have a moisture barrier although not polykraft
  - Can use ASTM metal jacketing standards in spec.
    - *"Metal jacketing elbows shall be two-piece, smooth finish, 1100 alloy aluminum, have a polyfilm moisture barrier, clear paint exterior, & comply with ASTM C1729 Type III, Grade 3, Class A"*
      - Referencing C1729 provides same benefits to spec as for straight pipe
      - Sho gh spec language sir s on the comprehensive content of C1729


# General Example: What about Tanks?

- Specification sections for jacketing on tanks often have the same sort of problems described above
  - Tank specifications would also benefit from using the ASTM metal jacketing standards
    - Improve clarity
    - Assure thoroughness
    - Help with understanding of dimensions
    - Assure proper jacketing design
      - E.g., No deep corrugated sheets on horizontal tanks
    - Assure high quality


# Conclusions re: ASTM Metal Jacketing Standards

- Metal jacketing has historically not had good industry standards and no ASTM standards
  - Job specs would only require compliance to metal alloy standards
    - Compliance to alloy standards is important but not enough for use of metal as insulation jacketing

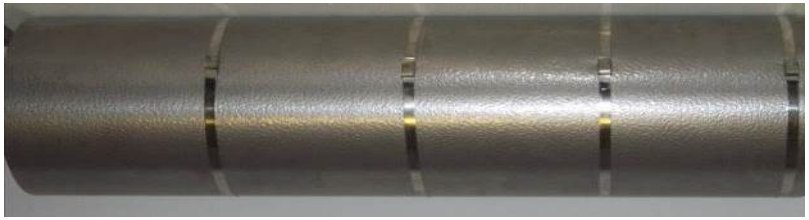
- ASTM standards for aluminum jacketing in 2010 and stainless jktg. in 2012 were created
  - C1729 = Standard for aluminum jacketing
  - C1767 = Standard for stainless jacketing

# Conclusions re: ASTM Metal Jacketing Standards

- ASTM jacketing specs are very detailed with thorough classification systems
  - Identify key performance attributes and requirements for all aspects of metal jacketing
    - Pipe, elbows, tanks, sheets, etc.
- Simplify specification writing and compliance
  - Help assure high quality materials are used
  - Help to appropriately leave material/design decisions up to the specifier not the contractor
  - Help make specifying of metal jacketing consistent
  - Reduce misunderstanding or misinterpretation of jacketing specs
  - Helps clean the market of obsolete or poor performing jacketing materials
- Improve the performance of insulation systems in our industry

# Conclusions: What Should Contractors & Distributors Do with this Information?

- Be aware of the ASTM metal jacketing standards
- Watch for appearance of these in job specs
  - Fairly new standards
    - Adoption by specifiers is occurring but will take time
  - Comply with the requirements in the standards
- Metal jacketing manufacturers who are active in the ASTM organization are the best source of more information about these standards



# QUESTIONS?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