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ESR-1777

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Reissued 01/2018
This report is subject to renewal 01/2020.

DIVISION: 05 00 00—METALS
SECTION: 05 05 23—METAL FASTENINGS
DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 05 23—WOOD, PLASTIC, AND COMPOSITE FASTENINGS

REPORT HOLDER:

ET&F FASTENING SYSTEMS, INC.

29019 SOLON ROAD
SOLON, OHIO 44139

EVALUATION SUBJECT:

ET&F PANELFAST® KNURLED AGS-100 SERIES PNEUMATIC FASTENERS

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DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fastenings

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

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EVALUATION SUBJECT:

ET&F PANELFAST® KNURLED AGS-100 SERIES PNEUMATIC FASTENERS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2015, 2012 and 2009 *International Residential Code*® (IRC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Property evaluated:

Structural

2.0 USES

ET&F Panelfast® Knurled AGS-100 Series pneumatic fasteners are used to attach wood structural panel sheathing to cold-formed steel (CFS) framing to construct shear wall assemblies used to resist wind or seismic loads in structures assigned to the Seismic Design Categories (SDCs) shown in Table 1. The fasteners may be used under the IRC when an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 ET&F Panelfast® Knurled AGS-100 Series Pneumatic Fasteners:

ET&F Panelfast® Knurled AGS-100 Series pneumatic fasteners are power-actuated fasteners (PAFs) manufactured from steel wire complying with the chemical composition requirements in the manufacturer's quality documentation and are heat-treated to a hardness R_c of 52 to 54. The fasteners are coated with a proprietary coating and have a 0.100-inch- diameter (2.54 mm) knurled shank, a nominal $^5/_{16}$-inch-diameter (7.94 mm) head and a ballistic point. The AGS-100 Series pneumatic fasteners are available in three lengths, of $1^1/_2$, 2 and $2^1/_2$ inches (38, 51, 64 mm), with part numbers, respectively, of AGS-100-0150, AGS-100-0200 and AGS-100-0250. See Figure 1 for images of the fastener.

3.2 Shear Wall Assemblies:

The shear walls are constructed of wood structural panels attached to one side of cold-formed steel framing including top track, bottom track, vertical studs (including end posts or chord members) and blocking, using the ET&F Panelfast® Knurled AGS 100 Series Pneumatic fasteners. The shear walls are anchored to the supporting structure by steel hold-downs at both ends of the wall and anchors along the bottom track.

3.2.1 Wood Structural Panel Sheathing: The wood structural panel sheathing must be $^7/_{16}$-inch-thick (11.1 mm) OSB Exposure 1 with a span rating of $^{24}/_{16}$ complying with DOC PS-2; or $^{15}/_{32}$-inch-thick (11.9 mm) Structural I Grade, Exposure 1 plywood with a span rating of $^{32}/_{16}$ or better complying with DOC PS-1.

3.2.2 Steel Framing Members: Steel framing members, described in Section 3.2, must have the minimum thickness designation shown in Table 1,

and must be manufactured from steel complying with ASTM A653 SS Grade 50 or 33. Steel framing members with a thickness designation of 54 mils must have a minimum yield strength of 50 ksi (345 MPa), and steel framing members with a thickness designation of 43 mils or less must have a minimum yield strength of 33 ksi (228 MPa). The minimum flange width for steel studs and tracks, respectively, must be $1^5/_8$ inches (41.28 mm) and $1^1/_4$ inches (31.75 mm).

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 Lateral Resistance: Shear wall assemblies recognized in Table 1 are alternatives to the Type 1 shear walls prescribed in Section C2 of AISI S213, and must comply with all applicable requirements of Section C2 of AISI S213. The maximum aspect ratio (height-to-length ratio) that has been evaluated for the shear walls is 2:1. The shear walls described in this report may be used to resist lateral forces, including wind and seismic forces, in structures assigned to the SDCs shown in Table 1.

Shear wall assemblies recognized for use in structures assigned to SDCs A through F must comply with the following requirements:

- The assemblies may be assigned the following seismic design coefficients and factors: response modification coefficient, $R = 6^1/_2$; system overstrength factor, $\Omega_o = 3$; deflection amplification factor, $C_d = 4$.
- The assemblies must be limited to a maximum height of 65 feet (19.8 m) for SDCs D through F.
- The assemblies must comply with the special seismic requirements for shear walls in accordance with Section C5.1 of AISI S213.

Shear wall assemblies recognized for use in structures assigned to SDCs A and B only may be assigned the following seismic design coefficients and factors: the response modification coefficient, *R*, the system overstrength factor, Ω_o, and the deflection amplification factor, C_d, must be no greater than 3.Nominal lateral shear strength values for the wall assemblies are shown in Table 1. For ASD, the values in Table 1 must be divided by a safety factor, Ω, of 2.5 for seismic loads or 2.0 for wind loads, as applicable. For LRFD, the values in Table 1 must be multiplied by a resistance factor, Φ, of 0.60 for seismic loads or 0.65 for wind loads, as applicable.

The hold-downs at each end of the wall and the anchorage along the bottom of the shear wall must be selected by the registered design professional, considering both strength and stiffness requirements. The hold-downs must have adequate capacity to resist overturning of the shear wall due to wind or seismic loads. In multistory applications, accumulated overturning forces must be accounted for in the design of the hold-downs. The attachments between the bottom track of the shear wall and the supporting structure or foundation must be capable of transferring the applied shear loads to the supporting structure.

4.1.2 Lateral Deflection: Deflection of the shear walls due to the applied lateral shear load may be calculated using the equations shown in Figure 2.

4.2 Installation:

4.2.1 PAFs: The fasteners must be installed using ET&F specified pneumatic tools. The fasteners must pierce the sheathing pane ls being fastened, and protrude through the steel framing members a minimum of $^5/_{16}$ inch (7.94 mm). The heads of the fasteners must be flush with the sheathing. Over-driving of the fasteners into the sheathing is not permitted.

4.2.2 Shear Walls: The shear wall assemblies must be constructed in accordance with the IBC, this report and the approved plans. A copy of the approved plans must be available on the jobsite at all times during shear wall construction.

At each end of the shear wall a double stud must be used. The two studs must be placed web-to-web and must be fastened together with #8 hex head self-drilling tapping screws at 12 inches (305 mm) on center. Intermediate studs must be spaced as shown in Table 1. All studs must be fastened to the track with one #8 modified truss head self-drilling screw at each flange.

Hold-downs must be installed at each end of the shear wall. Fasteners or anchors connecting the bottom track to the supporting structure must be spaced a maximum of 2 feet (610 mm) on center.

Wood structural panel sheathing may be installed parallel or perpendicular to the CFS studs. All panel edges must be supported by framing or blocking. Flat strapping used as blocking must comply with Item 8 of Section C2.2 of AISI S213. Panels must be no less than 12 inches (305 mm) wide.

The PAFs must be installed a minimum of $^3/_8$ inch (9.5 mm) from the edges of the wood structural panel sheathing. The spacing of the fasteners must be a maximum of 12 inches (305 mm) on center in the field of the sheathing panels. The spacing of the fasteners at the edges of the sheathing panels must be as shown in Table 1.

4.3 Special Inspection:

Special inspections are required for the fastening and anchoring of the shear walls, in accordance with 2015 IBC Sections 1705.1.1, 1705.11.2 including Exception 2, and 1705.12.3 including Exception 2 (2012 Sections 1705.1.1, 1705.10.2 including Exception 2, and 1705.11.3 including Exception 2; 2009 IBC Sections 1704.15, 1706.3 including Exception 2 and 1707.4 including Exception 2). A statement of special inspections must be submitted to the code official in accordance with 2015 and 2012 IBC Section 1704.3 (2009 IBC Section 1705).

5.0 CONDITIONS OF USE

The ET&F Panelfast® Knurled AGS-100 Series pneumatic fasteners described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The ET&F fasteners must be manufactured and identified in accordance with this report.

5.2 Other components of the shear walls must comply with this report, the applicable code and applicable ICC-ES evaluation reports.

5.3 Fastener installation must comply with this report and the ET&F instructions. In the event of a conflict between this report and the ET&F instructions, the more restrictive requirements govern.

5.4 Shear wall aspect ratios (wall height/wall length) exceeding 2:1 are outside the scope of this report.

5.5 Type II shear walls (defined in Section C3 of AISI S213) constructed with the ET&F fasteners are outside the scope of this report.

5.6 .Calculations demonstrating that the applied lateral (in-plane) shear loads are less than the available shear wall strength must be submitted to the code official for approval. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.7 Calculations and details showing that the sheathing, the CFS framing and the foundation anchorage are adequate to resist the applied loads and comply with the applicable code provisions, including provisions in Sections C2 and C5 of AISI S213, must be submitted to the code official. The CFS framing must also be adequate to support the applied gravity loads. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

5.8 Calculations and details must be submitted to the code official showing how the lateral loads are transferred from the roof or floor diaphragm into the shear wall. These calculations and details must be

signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

5.9 When the shear wall assemblies are used above the first story, calculations and details must be submitted to the code official showing a complete load path for the transfer of lateral and overturning forces from the upper story shear walls to the foundation. These calculations and details must be signed and sealed by a registered design professional, when required by the statues of the jurisdiction in which the project is to be constructed.

5.10 Use of the fasteners is limited to dry locations.

5.11 The wood structural panel sheathing used on exterior walls must be protected by a weather-resistant exterior wall envelope.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Power-actuated Fasteners for Shear Wall Assemblies Constructed with Cold-formed Steel Framing and Wood Structural Panels (AC230), dated September 2015.

7.0 IDENTIFICATION

The cartons of ET&F Panelfast® Knurled AGS-100 Series pneumatic fasteners described in this report must be identified by a label bearing the manufacturer's name (ET&F Fastening Systems, Inc.) and catalog number (AGS-100), and the evaluation report number (ESR-1777). The head of each fastener must bear a logo or symbol with the letter "E" as shown in Figure 1.

TABLE 1—NOMINAL LATERAL SHEAR STRENGTH FOR SHEAR WALL ASSEMBLIES USING ET&F PANELFAST® AGS-100 SERIES PNEUMATIC FASTENERS[1,2,4,13]

SHEATHING MATERIAL	MINIMUM NOMINAL PANEL THICKNESS[1] (inch)	MINIMUM STEEL STUD, TRACK AND BLOCKING THICKNESS[2,3] (mils)	MAXIMUM STUD SPACING (inches)	NOMINAL SHEAR STRENGTH FOR SEISMIC DESIGN (plf)			APPLICABLE SEISMIC DESIGN CATEGORIES	NOMINAL SHEAR STRENGTH FOR WIND DESIGN (plf)			v_{defl}[4] (lb/ft)
				FASTENER SPACING AT PANEL EDGES (inches)				FASTENER SPACING AT PANEL EDGES (inches)			
				4	3	2		4	3	2	
OSB Rated Sheathing	7/16	33	24	—	—	919	A through F	—	—	1033	1314
		43	24	586	—	—	A and B	595	—	—	796
		43	16	—	795	—	A through F	—	861	—	1109
		43	16	—	—	1087		—	—	1196	1616
Plywood Structural I	15/32	43	16	—	921	—		—	1020	—	1440
		43	16	—	—	1336		—	—	1467	2235
		54	16	—	—	1840		—	—	2007	2850

For **SI:** 1 inch = 25.4 mm, 1 mil = 0.001 inch, 1 plf = 14.6 N/m, 1 lbf/ft = 14.6 N/m.

[1]Panel thicknesses shown are minimums. Greater thickness may be used with no increase in design values.
[2]Framing thicknesses shown are minimums. Greater thickness may be used with no increase in design values.
[3]Chords (studs at shear wall ends) must be a minimum of two studs back-to-back and of the same thickness as the framing specified in the table. See Section 4.2.2 for more details.
[4]For use in deflection calculations. See Figure 2.

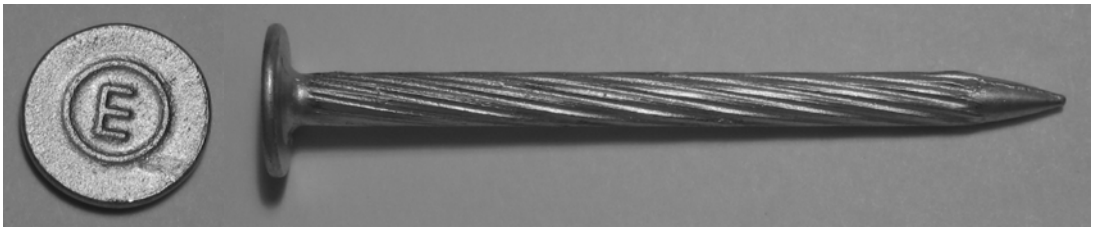

FIGURE 1—ET&F PANELFAST KNURLED AGS 100 SERIES FASTENER

Shear Wall Deflection

Shear wall deflection may be estimated using Eqs. 1 and 2, for OSB and plywood shear walls respectively.

$$\Delta_{OSB}=\frac{2}{3}\frac{vh^3}{E_sA_cb}+\omega_1\omega_2\frac{vh}{1.05Gt_{sheathing}}+\omega_1^{1.1}\omega_2\left(\frac{v^{2.129}}{\eta\cdot v_{defl}{}^{1.129}}\right)+\frac{h}{b}\Delta_{anchorage} \qquad \text{Eq. 1}$$

$$\Delta_{PWD}=\frac{2}{3}\frac{vh^3}{E_sA_cb}+\omega_1\omega_2\frac{vh}{1.85Gt_{sheathing}}+\omega_1^{0.75}\omega_2\left(\frac{v^{2.129}}{\eta\cdot v_{defl}{}^{1.129}}\right)+\frac{h}{b}\Delta_{anchorage} \qquad \text{Eq. 2}$$

Where,

A_c = gross cross-sectional area of the shear wall chord/boundary studs (fully braced), in^2 (mm^2)
b = width/length of the shear wall, in. (mm)
E_s = elastic modulus of steel, psi (MPa)
G = elastic shear modulus of wood structural panel, psi (MPa)
h = height of shear wall, in. (mm)
s = fastener spacing at the panel edges, in. (mm)
$t_{sheathing}$ = nominal thickness of wood structural panel, in. (mm)
t_{stud} = design thickness of cold-formed steel framing, in. (mm)
v = design shear, lb/in. (N/mm)
v_{defl} = deflection at peak strength of the shear wall, lb/in. (N/mm) (see Table 1)
$\Delta_{anchorage}$ = vertical uplift due to deformation of anchorage attachment, in. (mm)
η = 22.351 psi (0.154 MPa) for plywood and 14.407 psi (0.099 MPa) for OSB.
ω_1 = $s/6$ (s/152.4)
ω_2 = $0.0346/t_{stud}$ ($0.879/t_{stud}$)

FIGURE 2—DEFLECTION EQUATIONS