SLENDERWALL®

Building Envelopes for the 22nd Century

DESIGN CONSIDERATIONS

EASI SET® WORLDWIDE

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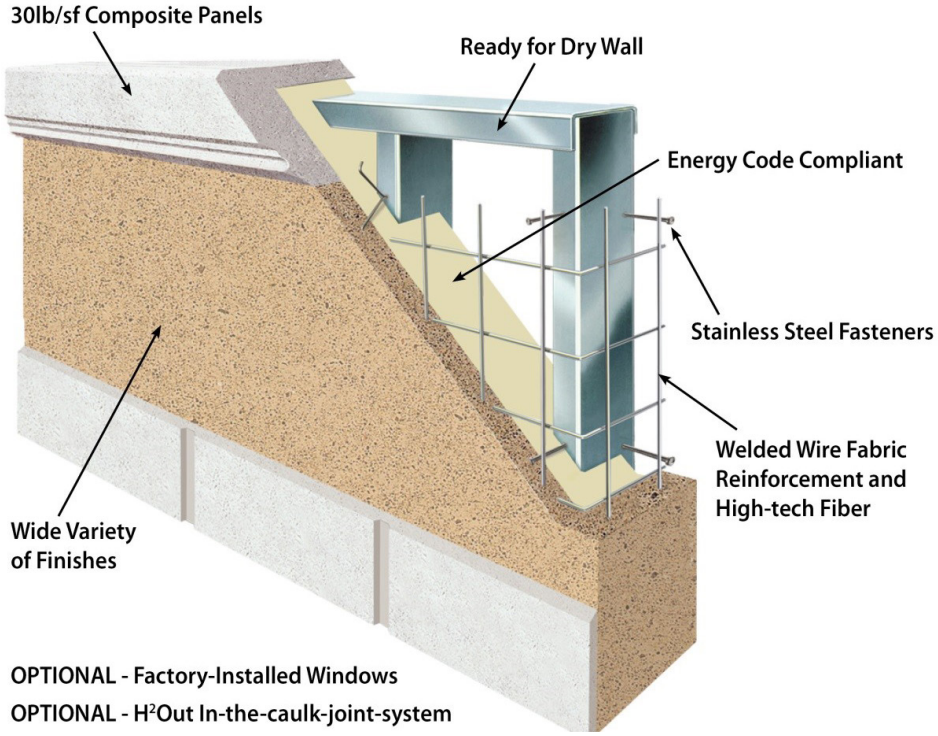
GENERAL DESIGN APPROACH *SLENDERWALL®*. designs are in compliance with IBC, ACI, AISC, IECC, PCI Design Handbook, CRSI Manual of Standard Practice, ASTM/ANSI/AWS and applicable state and local building codes. Additionally, EASI-SET® has completed numerous, independent, full-scale mock-up tests to account for structural, water, air, fire and thermal. For additional information, contact your nearest *SLENDERWALL®* producer, visit www.slenderwall.com/Contact/LocateManufacturer or contact EASI-SET® at 540-439-8911 or visit www.easiset.com.

PHYSICAL PROPERTIES The *SLENDERWALL®* system is a composite, lightweight panel system that takes advantage of the unique properties of steel and concrete to achieve a durable and aesthetically-pleasing building envelope system. Its exterior surface is 2-inches of reinforced architectural precast concrete. The panel's interior surface is 16-gauge, 6-inch galvanized studs on 2-foot centers, which is drywall ready. The composite section of steel studs and architectural precast concrete provides the system with strength and stiffness to allow the system to resist hurricane-level winds and seismic movement.

Securing the 2-inchconcretefacing to the steel frame are a series of proprietary THERMAGUARD® connectors, which are stainless-steel fasteners. These connectors not only securely anchor the concrete facing to the steel frame, but also provide the means to allow the concrete to respond independently to thermal gradients with a thermal break between the precast concrete and the stud frame. This reduces thermal transfer from the exterior to the interior of the building.



In addition to thermal transfer reduction, another proprietary technology, DURAFLEX 360°™, is utilized. This technology allows isolation of the exterior precast concrete skin from the structural stresses associated with wind loading, structural steel movement, expansion and contraction, and seismic movement.

The exterior 2-inch-thick architectural precast concrete face can be finished with a variety of textures, colors, shapes, applied products or finishes. *SLENDERWALL®* utilizes architectural concrete with galvanized wire mesh and PVA fibers.

PANELIZATION OPTIONS Optimizing the precast system includes reducing the production cost and increasing the speed of erection. The examples shown in the "P" Drawing Details in this Technical Design Guide illustrate the

several different ways panels can be combined or split up to achieve a desired result. Depending on panel sizes, shipping limitations, erection considerations and/or connection concepts, any one of these solutions may be the one best suited for your particular project. As shown in the "P" Drawing Details, it is desirable to maintain a minimum section of 18-inches of concrete around all openings and block-outs. Also, rough-opening-window-widths should be limited to 7-feet-0-inches, unless special designs are implemented. Consult your nearest *SLENDERWALL®* producer at www.slenderwall.com/Contact/LocateManufacturer or EASI-SET® at 540-439-8911 or visit www.easiset.com

In general, the economics of the design are driven by two key factors:

1. Size of panel
2. Form utilization (repetition of same form)

Because erection cost is typically considered on a fixed "per piece basis," it is generally advantageous to find ways to reduce the number of erected pieces by making panels as large as possible. Note, however, that panel size is often constrained by fabrication and shipping considerations. Panel sizes can also be affected by the hauling conditions particular to the project in question and/or site conditions that may result in weight or crane reach limitations. Site access must also be considered when determining maximum panel sizes. Generally, the maximum economical size to produce is 10-feet by 30-feet. The largest panel size that can be produced is 12-feet by 38-feet, but there could be significant additional shipping costs to consider

The second consideration in panelizing the building is form utilization or the number of form set-ups. The more times the same form can be used, the lower the fabrication cost per piece will be. Therefore, it is extremely useful to look for ways to make maximum use of the same forms by designing repetition into the shapes and sizes. This is especially important for buildings with brick finishes. The "A" Drawing Details in the Technical Design Guide show guidelines for laying out brick patterns that reduce cost.

Your EASI-SET® TEAM can assist you in making the most economical choices for your particular project

CONNECTIONS *SLENDERWALL®* connections are designed to allow panels to be erected as quickly as possible; thereby, shortening the overall project schedule.

Erectors may choose to attach any welded-on material well before the start of erection. They also may choose to utilize bolted connections to allow the precast to be set faster as well as to allow for greater panel adjustment. Final adjustments can then be made at a later time. Coordination between the various trades must allow connections to properly interface with other building materials. Included in this Guide are a number of typical connections that provide the designer with a solid basis for cost-effective and highly-efficient designs. Consult your *SLENDERWALL®* producer (www.slenderwall.com/Contact/LocateManufacturer) or EASI-SET® (540-439-8911 or www.easiset.com) for your particular project to help optimize the connections and provide overall economy of materials.
Gravity connections are typically spaced at 4-feet-0-inches on center with tie-backs located at 6-feet-0-inches on center. Based on actual panel size and loading conditions, these spacing guidelines may differ. This is why it is always best to involve a *SLENDERWALL®* producer or an EASI-SET® technical representative early on in the design process. This Guide also contains numerous connection concepts for various construction and/or building types. See the "S" Drawing Details in the Technical Design Guide.

Rotational movement of the structural support system and/or edge angles by imposed panel live and dead loads is the responsibility of the Engineer of Record (EOR) to analyze for both temporary landing gravity/torsional loads and permanent gravity/torsional loads.

The Engineer of Record is also responsible for verifying the strength and stiffness of the supporting structure. Because *SLENDERWALL®* panels utilize gravity supports at 4-foot-0-inches on center spacing, consideration must be given to limit possible adverse effects from torsional rotation or vertical deflection of the supporting structure. At no time should excessive torsional rotation of the supporting structure occur. The Engineer of Record must ensure that adequate bracing,

stiffeners, and edge angles have been provided to allow for the optimum performance of the envelope system Three basic types of deflection need to be considered and limited. These limitations will help ensure proper panel alignment and maintain adequate joint size. Each of these deflection limits should be noted on the Contract Documents and considered in the design of the supporting structure.

• **Deflection Type 1 - Deflection of the Supporting Structure Prior to Placement of the Panels:** Prior to the placement of the precast panels, and under application of the construction dead loads, the structure will undergo a certain amount of deflection. The EOR should ensure that these deflections are within code limits. This information should also be provided to the EASI-SET® TEAM and coordinated with the engineer during the early design phase so that appropriate connection designs can be developed. The effects of camber should also be included in this deflection limitation.

• **Deflection Type 2 - Additional Deflection of the Supporting Structure after Erection of the Precast Panels:** Once the panels are loaded onto the structure, the supporting structure could undergo an additional amount of deflection. It is extremely important to limit the amount of deflection at this critical phase as much as possible in order to allow the erector a minimal need for costly post-erection alignments. Therefore, it is recommended that this type of deflection be limited to 1/8-inch (preferred), with a maximum deflection of less than 1/4-inch.

• **Deflection Type 3 - Additional Long-Term Deflection of the Supporting Structure Due to the Effects of Superimposed Dead Load Plus Live Load:** After the panels have been erected, the supporting structure may undergo further deflection due to the application of additional dead and live loads. These deflections should be limited to reduce the possibility of long-term degradation of the panel joints and to ensure optimal performance of the envelope system.

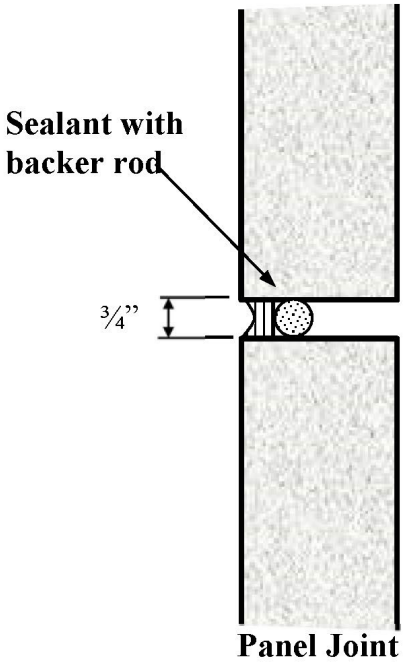
It cannot be over-emphasized that these deflections must be noted on the Contract Documents in addition to coordinating this during the design phase with your *SLENDERWALL®* producer (www.slenderwall.com/Contact/LocateManufacturer) or EASI-SET® (540-439-8911 or visit www.easiset.com). This information will be used in the design and detailing of the panels and their connections.

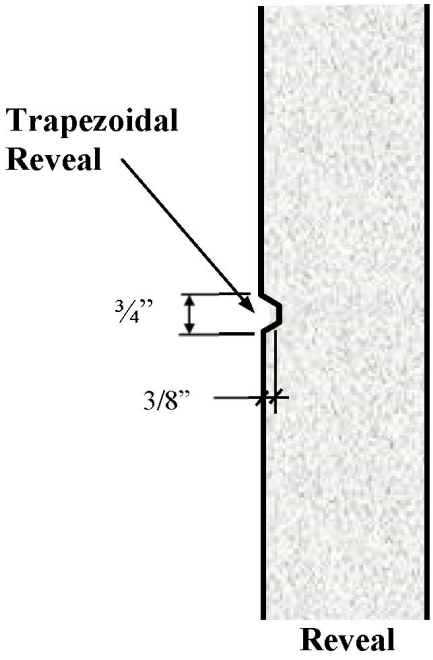
PANEL ERECTION *SLENDERWALL®* has a proprietary erection method available, Lift-and-Release™, that can speed up panel installation. With the Lift-and-Release™ system, *SLENDERWALL®* panels can be plumbed and aligned after the crane has unhooked and moved on using a turn-of-nut connection. See the "E" Drawing Details in the Technical Design Guide for more information on this system.

Experienced erection companies place safety first as they set panels according to required delivery sequences and schedules. They also carefully coordinate site access and storage priorities with the general contractor to maximize the number of panels set per day, minimizing the overall erection time frame. Field crews carefully execute the connection details according to the approved engineering design.

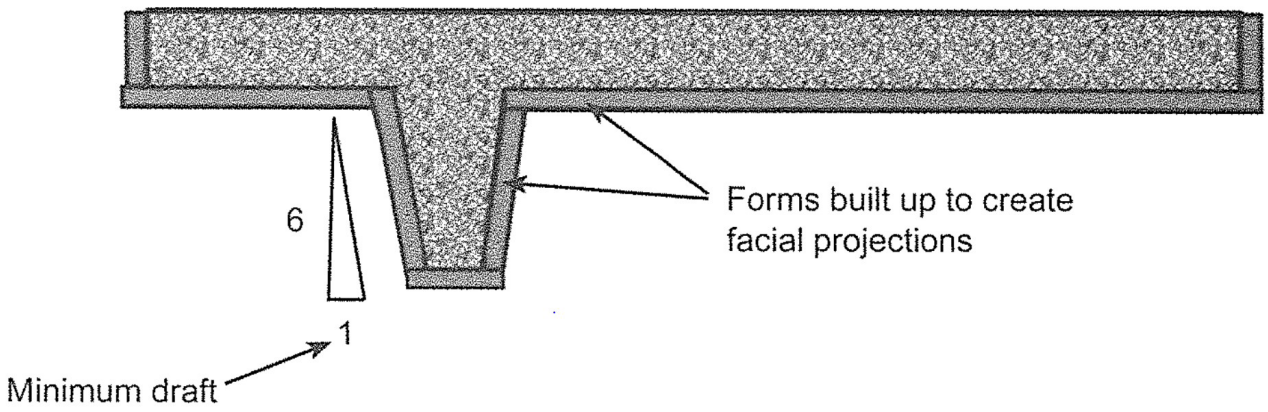
JOINTS AND REVEALS The size of the joint chosen on your project should be carefully considered. The EASI-SET® TEAM recommends a minimum nominal joint size of 3/4-inch, to account for production and erection tolerances and to help ensure a long lasting, watertight panel joint. Joints detailed less than 3/4-inch can, in some instances, result in actual panel joints being smaller than sealant sub-contractors cover under warranty. It's important to maintain a 3/4-inch joint between the precast and the window system for the very same reason. Also, it is strongly recommended that the sealant joints be inspected at regular intervals over time to ensure that degradation of the sealant has not occurred.

When selecting accent reveals or rustication lines, it's important to tie them in to the chosen joint size. Triangular reveals are not to be used because they are difficult to form. Instead, a trapezoidal reveal will provide a flat nailing surface for the form builders and help minimize possible nail-hole irregularities. When choosing a reveal, limit the depth to 3/8-inch. This is to maintain a minimum effective concrete thickness of 1-5/8-inches at all locations. See also the "A" Drawing Details in the Technical Design Guide for more information relating to joints and reveals.





FACIAL PROJECTIONS Facial projections can add a unique accent to your building project. Because these features are cast into the panels (face in form), a minimum draft dimension is necessary in order to be able to easily strip the panels out of the forms. Without proper draft, suction forces generated between the concrete and the form may cause the panels to bind up during stripping and possibly damage the panel and/or the forms. To ensure this does not occur, the EASI-SET® TEAM recommends a minimum draft of 1:6 on facial projections, as illustrated in the sketch below. See the "A" Drawing Details in the Technical Design Guide for more specific dimensional limitations. Note that facial projections tend to increase production costs, since forms need to be built up to accommodate this feature.



PANEL FINISHES, ARCHITECTURAL BRICK AND SECOND NATURE™ ARCHITECTURAL PRECAST CONCRETE BRICK (APCB) Whenever possible, utilizing local aggregates and materials will help minimize cost. Your EASI-SET® TEAM will help guide you through the available ranges of materials, finishes, color combinations and applied materials to help provide that one-of-a-kind look. Choosing from a sandblast finish, acid etch, exposed aggregate, thin brick, granite facing, or many other finishes will provide the unique building accent that best emulates your design intent. Available exclusively with the *SLENDERWALL®* system is a proprietary finish of precast concrete architectural brick cast integrally into the panel. This finish, Second Nature™

Architectural Precast Concrete Brick (APCB) provides the level of quality necessary for Class "A" commercial projects. The "A" Drawing Details in the Technical Design Guide provide excellent guidelines for maximizing form utilization and optimizing the aesthetic quality of the envelope.

GLAZING INTERFACE Glass, glazing, curtain-wall systems interface with the *SLENDERWALL®*. system in a similar fashion as with 6-inch-thick architectural precast concrete systems. The most economical design is a flush-faced design where the window system is in alignment with the exterior face of the *SLENDERWALL®* system (see "A" Drawing in the Technical Design Guide). This allows the window frame to overlap the 2-inch-thick *SLENDERWALL®* precast. An optional upgrade allows glazing to be set back from the face of the *SLENDERWALL®* precast (see "A" Drawing in the Technical Design Guide). A precast return is introduced to produce the desired set-back. The maximum standard return is 4-inches, plus the thermal break dimension from the face of the panel. Wood blocking is then field-applied to the frame around the window opening to support the glazing system.

It is important to note that the weight of the window system cannot bear on the precast in the *SLENDERWALL®* panel. All window loads must be transferred into the steel-stud back-up frame. Refer to the "A" Drawing Detail in the Technical Design Guide for details of the window head, jambs, and sill.

FIRE BLOCK In many cases, the building must be designed with a fire-rated floor system. This typically means that the cavity between the edge of the floor slab and to the back of precast within the *SLENDERWALL®* panel needs to incorporate a fire-block or other fire safety design. This cavity can be filled with a mineral-wool fireproofing material. A pourable smoke seal material may or may not be used on top of the fire-blocking material.

There are several UL rated assemblies utilizing proprietary fire safety material that can be used to provide the required fire safety design. Refer to "A" Drawing Detail in the Technical Design Guide for the typical Fire Block detail at slab edges.

FIRE RATING A *SLENDERWALL®* panel tested in accordance with ASTM E119 and ASTM E2226 (hose stream) achieved a one and two-hour fire rating.

PENETRATIONS Penetrations through the precast that may be required for wall hydrants, pipe penetrations and light fixtures can be cast into the panels provided the coordination for location and size is done early enough in the shop drawing development. Ideally, the location and size of these penetrations should be provided to the EAST-SET® TEAM about 8-weeks prior to fabrication. This is to ensure that the information can be incorporated into the shop and fabrication drawings in adequate time. For openings less than 10-inches square, it is recommended that the penetrations be field cut. However, in no instance should the steel stud frame be cut.

INTERIOR-FINISH APPLICATIONS The *SLENDERWALL®* system is designed to accept numerous types of interior finishes. These finishes can be applied directly to the steel stud framing. When detailing the interior finish applied directly to the back of the steel stud frame, a note should be made in the plans and specifications that the differences in allowable tolerances between production and installation of the *SLENDERWALL®* panels may need to be accommodated by the interior-finishing contractor. They should also be made aware that the standard *SLENDERWALL®* steel frame incorporates 16-gauge vertical studs and 14-gauge top and bottom tracks.

In some cases, where four (4) *SLENDERWALL®* panels intersect or are in a long uninterrupted corridor, the designer may elect to introduce a 5/8-inch or 1-inch horizontal hat channel to "true up" the wall system before the interior finish is applied.

SLAB-EDGE/COLUMN-FACE LOCATIONS The slab-edge/column-face location should be clearly defined on the Contract Documents. A 1 ½-inch dimension is required between the edge of slab or column face and the back of the *SLENDERWALL®* steel stud frame to account for tolerances both in the slab and column as well as the precast. Particular attention must be paid to slab-edge/column-face conditions along skewed or curved building edges, as these areas often

cause the most difficulty during layout.

PROJECT TIMELINE In order to optimize the *SLENDERWALL®* system, it is highly recommended that the EASI-SET® TEAM be involved in the coordination of details, connections and panelization options early in the design development phase. Because plant availability may vary, it is best to award the *SLENDERWALL®* contract prior to the other trades. This will also facilitate incorporation of *SLENDERWALL®* connections into the Contract Documents. The timeline below represents a typical project schedule, incorporating *SLENDERWALL®*.

SLENDERWALL® TIMELINE

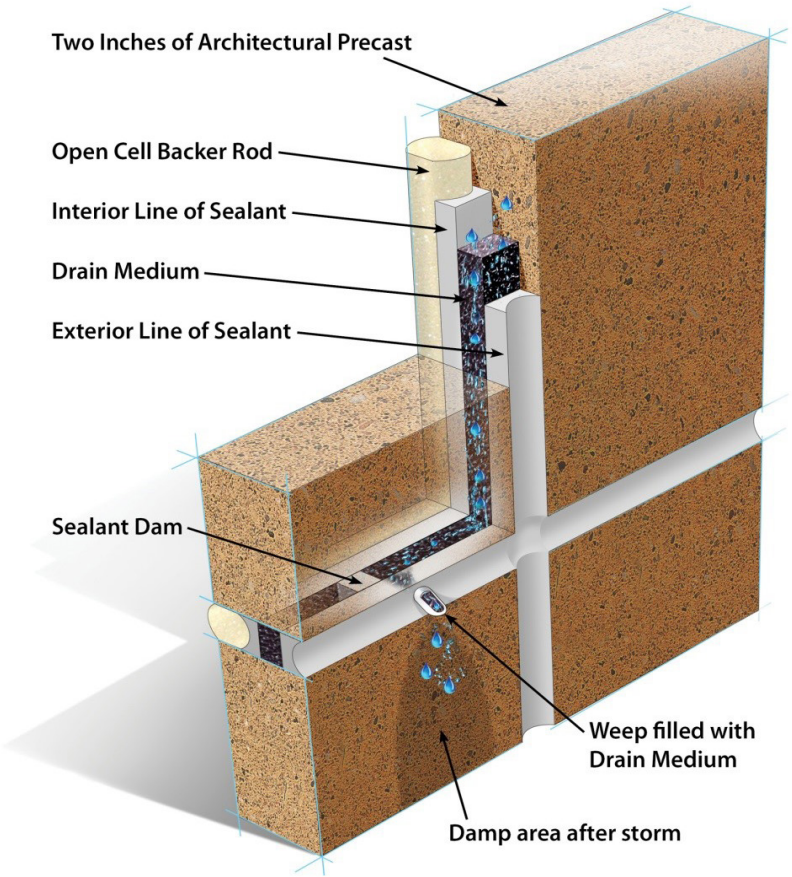
1. T + 0 — *SLENDERWALL®* **Contract Award**
2. T + 3 weeks — Start *SLENDERWALL®* **Shop Drawings**
3. T + 15 weeks — Start *SLENDERWALL®* **Production**
4. T + TBD weeks (per Con. Sch.) — Start *SLENDERWALL®* **Delivery**

Note that the timeline depicts representative durations to achieve maximum economy. Depending upon project complexity and project size, these durations may vary. Allowing for optimal lead times and production rates will help keep costs low and quality high. The EASI-SET® TEAM can assist you in preparing a more detailed SLENDERWALL® schedule for integration into the overall project timeline.

THERMAL PERFORMANCE *SLENDERWALL®* is the precast industry's only 100% thermal-break plus air-barrier panel connection system. This proprietary connection, THERMAGUARD®, uses a stainless steel fastener with a thermal break between the concrete panel and the stud frame, which prevents corrosion and reduces thermal transfer.

SLENDERWALL® also offers a foamed-in-place closed-cell polyurethane continuous-insulation, which provides insulation and water and air barriers.

MOISTURE The *SLENDERWALL®* envelope resists water penetration by employing the face-seal method. This is accomplished by completely sealing the exposed face. The concrete mix incorporates an integral water repellant admixture, which has proven to significantly reduce water penetration. Additionally, all joints use a single layer or a double layer of sealant applied from the exterior. A secondary in-the-sealant-joint water drainage protection/detection system exclusive to *SLENDERWALL®*, H2Out®, also can be utilized if designed into the *SLENDERWALL®* envelope. Dow Corning and other major manufacturers have warrantied the use of their sealants in H2Out® applications. (Copies of approval letters are available upon request.)



The optional sprayed polyurethane closed-cell foam insulation having a minimum density of 2.0 pcf (32.0 kg/m3) with a minimum thickness of 1½-inches in the stud cavity, provides the vapor/air barrier. Additionally, other optional vapor/air barriers can be applied, as per the contract specification.

LEED (LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN) The LEED Green Building Rating System is a voluntary, consensus-based program for developing high-performance sustainable buildings. LEED emphasizes seven state-of-the-art strategies: location & transportation; sustainable sites; water efficiency; energy & atmosphere; material & resources; indoor environmental quality; and innovation. The *SLENDERWALL®* system can contribute points toward obtaining LEED Certification for new building construction. Points can be contributed for items such as recycled materials, locally available raw materials reduced energy requirements, reduced waste, innovative designs, etc. Contact the EASI-SET® TEAM for more specific details.

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