WHITE PAPER

Engineered to Outperform:

The PolyScience Approach to Quality, Value, and Innovation

Prepared by PolyScience
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Executive Summary

It is easy for any manufacturer to claim the best quality, the best value, and the most innovation. What separates a genuine claim from a slogan is whether it holds up when you ask how each was achieved. This paper answers that question for PolyScience by tracing all three back to a single, consistent design philosophy: engineer in what off-the-shelf parts and conventional approaches can't deliver, target the total cost of ownership rather than the sticker price, and treat every regulatory or logistical constraint as an engineering problem to be solved years ahead of the deadline rather than a compliance box to be checked at the last minute.

The sections that follow walk through how that philosophy shows up concretely — in the components on the refrigerant circuit, in the way a chiller is sized to a customer's actual process, and in decisions made years before any market required them.

Pillar	What It Looks Like Elsewhere	The PolyScience Approach
Quality	Off-the-shelf components sized to the closest catalog fit; capacity control via on/off or PWM solenoid valves	Custom, purpose-built components where standard parts fall short; dual stepper valve control for precise, silent operation
Value	Purchase price is the headline number; water, energy, service, and refrigerant costs accumulate afterward	Design decisions — closed-loop cooling, hot gas bypass, early refrigerant transition — target total cost of ownership
Innovation	React to regulatory and logistics constraints as they arrive	Invest years ahead of a known constraint, then re-engineer around whatever limitation stands in the way

Table 1. A high-level comparison of conventional industry practice against PolyScience's design approach. Details on each pillar follow.

Quality: Engineered In, Not Inspected In

Quality is often treated as a final checkpoint — a set of tests a finished product has to pass. PolyScience treats it as a starting constraint that shapes decisions from the beginning of the design process, even when the easier path would be to accept a standard part or a conventional approach.

Purpose-Built Components, Not Catalog Substitutes

When PolyScience needed to hit a total refrigerant charge under 100 grams for its R290 chiller platform, no off-the-shelf condenser, filter drier, or evaporator was sized correctly for the job — standard components built for larger HFC charges simply could not deliver equivalent performance at a fraction of the refrigerant volume. Rather than compromise the platform's performance to fit available parts, PolyScience worked directly with component suppliers to design custom, low-volume versions of each part specifically for this application. That willingness to engineer a purpose-built solution, instead of adapting the product to whatever happened to be on a supplier's shelf, is a decision point that recurs throughout PolyScience's product development.

Precision Refrigerant Control

The same standard applies to how refrigerant flow itself is controlled. Conventional chillers typically manage capacity with a solenoid valve that snaps fully open or fully closed, or a pulse-width-modulated variant that approximates an intermediate position by rapidly toggling the same solenoid — both of which meter flow imprecisely and produce an audible click, chatter, or buzz as a byproduct. PolyScience's DuraChill CA series instead uses dual stepper motor-driven valves, which hold any intermediate position with proportional precision and operate silently, because they are not slamming a plunger shut or pulsing a coil. That is a more expensive and more complex approach to build — and it was chosen anyway, because it is the one that performs and holds up better.

Sized to the Application, Not the Catalog

Quality also shows up before a unit is ever built. PolyScience works directly with customers to size each chiller against their actual cooling load, rather than defaulting to the nearest standard capacity. A chiller that is correctly sized avoids both the higher cost and poor part-load performance of an oversized unit and the premature wear of an undersized one — so the reliability the product is designed for is the reliability it actually delivers in the field.

Value: What You Stop Paying For

Value is easiest to see in the costs a customer never has to pay in the first place. Several of PolyScience's core design decisions are built specifically to remove ongoing costs from a chiller's operating life, not just to lower its purchase price.

Eliminating Water and Sewer Costs

A closed-loop, recirculating chiller design replaces single-pass tap-water cooling, in which water is run through equipment once and sent down the drain. Single-pass cooling can require on the order of 40 times more water than a recirculating system to remove the same amount of heat, and every gallon is typically billed twice — once as fresh water, once as sewer discharge. A properly sized PolyScience chiller removes that cost from the customer's utility bill essentially for the life of the equipment.

Designing Out Wear and Energy Waste

Hot gas bypass — a feature of the DuraChill CA series — routes a metered portion of hot compressor discharge gas back into the evaporator under low-load conditions. That protects the evaporator from freeze-up, a potentially catastrophic failure mode, and extends compressor run time between cycles, which reduces both the energy penalty and the mechanical wear that comes with frequent starting and

stopping. As a side effect, it also gives the chiller a genuine supplemental heating capability — approximately one-quarter of rated cooling capacity at 20°C with no external load — without the cost or complexity of a separate heating element.

Getting Ahead of Regulatory Cost, Not Behind It

Perhaps the clearest value decision is the timing of PolyScience's refrigerant transition. PolyScience began investing in R290 (propane) production capability in 2018 — years before regulations such as the EU's F-Gas Regulation made low-GWP refrigerants mandatory. Refrigerants still built on the older HFC chemistries are already subject to shrinking production quotas in both the EU and the U.S., a dynamic that drove historical precedents like R-22 to sell for 8 to 15 times its pre-phaseout price once supply tightened. A customer buying a PolyScience R290 chiller today is not exposed to that scarcity-driven pricing, and is not staring down a forced equipment replacement once the next compliance deadline arrives.

Innovation: Solving Problems Others Avoid

The clearest evidence of innovation is usually not a single dramatic breakthrough — it's a pattern of choosing to solve a hard problem rather than route around it. Three decisions illustrate that pattern at PolyScience.

Redesigning Around a Shipping Constraint

IATA regulations classify any shipment of flammable refrigerant above 100 grams as hazardous goods, which can mean hazmat routing, added paperwork, and multi-day delays for something as simple as an evaluation unit. Rather than accept those delays as a cost of doing business with a flammable refrigerant, PolyScience engineered its R290 chiller platform to operate on a 99-gram charge — under the threshold — while still matching the heat-removal performance of its prior HFC-based platform. That required the custom component work described above; the shipping constraint is what made it necessary.

Reviving a Good Idea With Better Technology

PolyScience used hot gas bypass in earlier chiller generations, moved away from it for roughly two decades in favor of a simpler mechanical/magnetic valve, and has now returned to it on the DuraChill CA series — but implemented through stepper motor control instead of the magnetic valve that produced the older design's characteristic clicking and breathing sound. That is a meaningfully different kind of innovation than inventing something new: it is recognizing that a previously good idea was held back by its implementation, and fixing the implementation rather than discarding the idea.

Investing Years Ahead of the Requirement

The 2018 decision to build dedicated R290 production capability predates the regulatory deadlines driving the rest of the industry's transition by the better part of a decade. That gap is what allowed the engineering problems above — the sub-100-gram charge, the custom components, the safety infrastructure for handling a flammable refrigerant at scale — to be solved deliberately, rather than under the time pressure of an approaching compliance date.

The Common Thread

Quality, value, and innovation are usually presented as three separate claims. At PolyScience, they trace back to the same underlying pattern: identify where a standard part, a conventional control method, or an unaddressed constraint is limiting what a chiller can do, and treat that as an engineering problem worth solving rather than a limitation to be accepted. Custom components produce better quality. Designing out water, energy, wear, and regulatory exposure produces better value. Solving problems — a shipping threshold, an old design's noise, a looming regulation — before they become urgent produces genuine innovation. It is one design philosophy, expressed three ways.

See It for Yourself

The best way to evaluate any of these claims is against your own application. PolyScience is happy to provide an evaluation or demonstration chiller upon request, or to walk through how a specific platform — including the R290-based DuraChill CA series — would be sized and specified for your process.

Contact PolyScience to request an evaluation unit or a specification review.

Conclusion

None of the decisions described in this paper were the easiest available option. Custom, low-volume components cost more to develop than adapting to an off-the-shelf part. Stepper valve control is more complex to engineer than a solenoid. Investing in R290 production capability in 2018 meant spending years ahead of any deadline that required it. Each of those choices was made anyway, because each one produces a measurably better outcome for the customer — in reliability, in total cost of ownership, or in being positioned ahead of a constraint rather than behind it. That is the basis for PolyScience's claim to quality, value, and innovation: not the claim itself, but the specific engineering decisions behind it.

Specifications, capabilities, and figures referenced in this paper apply to specific PolyScience product platforms and vary by model. Consult PolyScience for model-specific specifications.