HVAC & the Energy Code

Manuals J and S in the IECC

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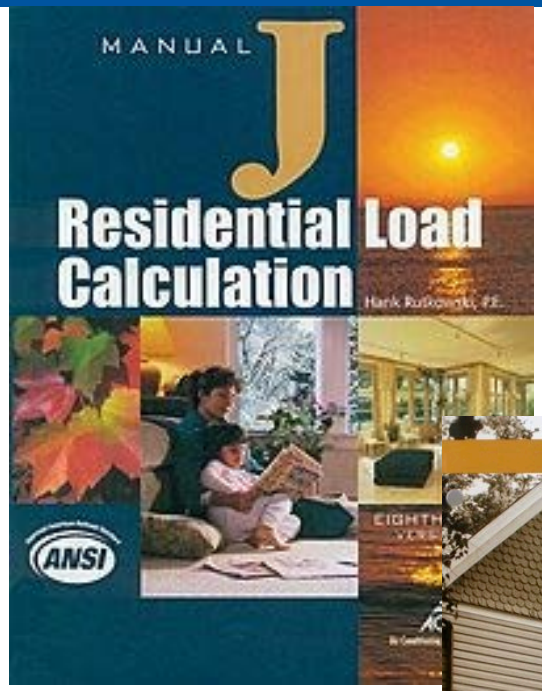
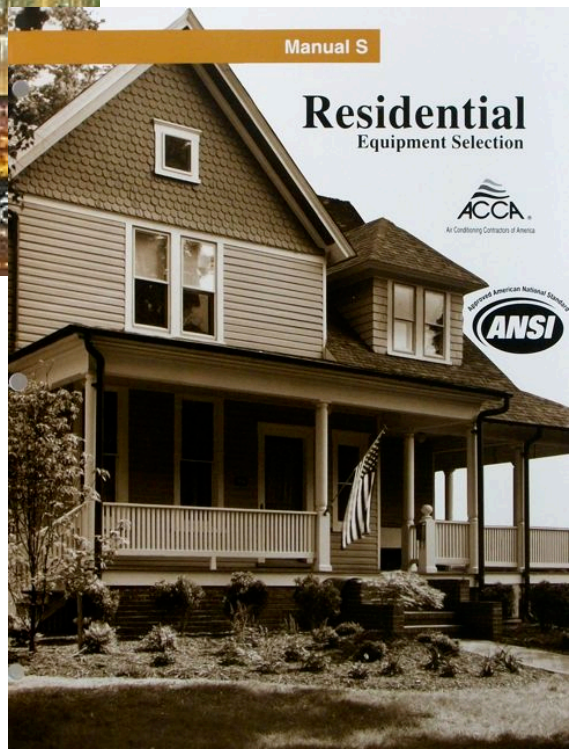
AUSTIN ENERGY® GREEN BUILDING

Manuals J & S

Manual J is a procedure for calculating building heating and cooling loads based on detailed inputs and conditions.





Manual S is a procedure for selecting appropriate equipment based on accurately calculated loads.

Loads and system sizing

- Heating/cooling calculations have been required by the energy code for more than two decades – but seldom enforced
- Earlier codes required systems be sized per Manual J – but Manual J is a load calculation procedure
- Finally corrected in 2012 IECC – Manual J for loads, Manual S for equipment selection based on loads
- What about Manual D? (More on this later)

Why is this important?

- What value is a mechanical system that doesn't address the loads and keep occupants comfortable?
- Oversized systems
  - contribute to peak electricity demand
  - Don't deliver rated efficiencies due to short-cycling
  - Can have a shorter service life
  - Do a poor job of handling latent loads in humid climates

Need for mechanical cooling

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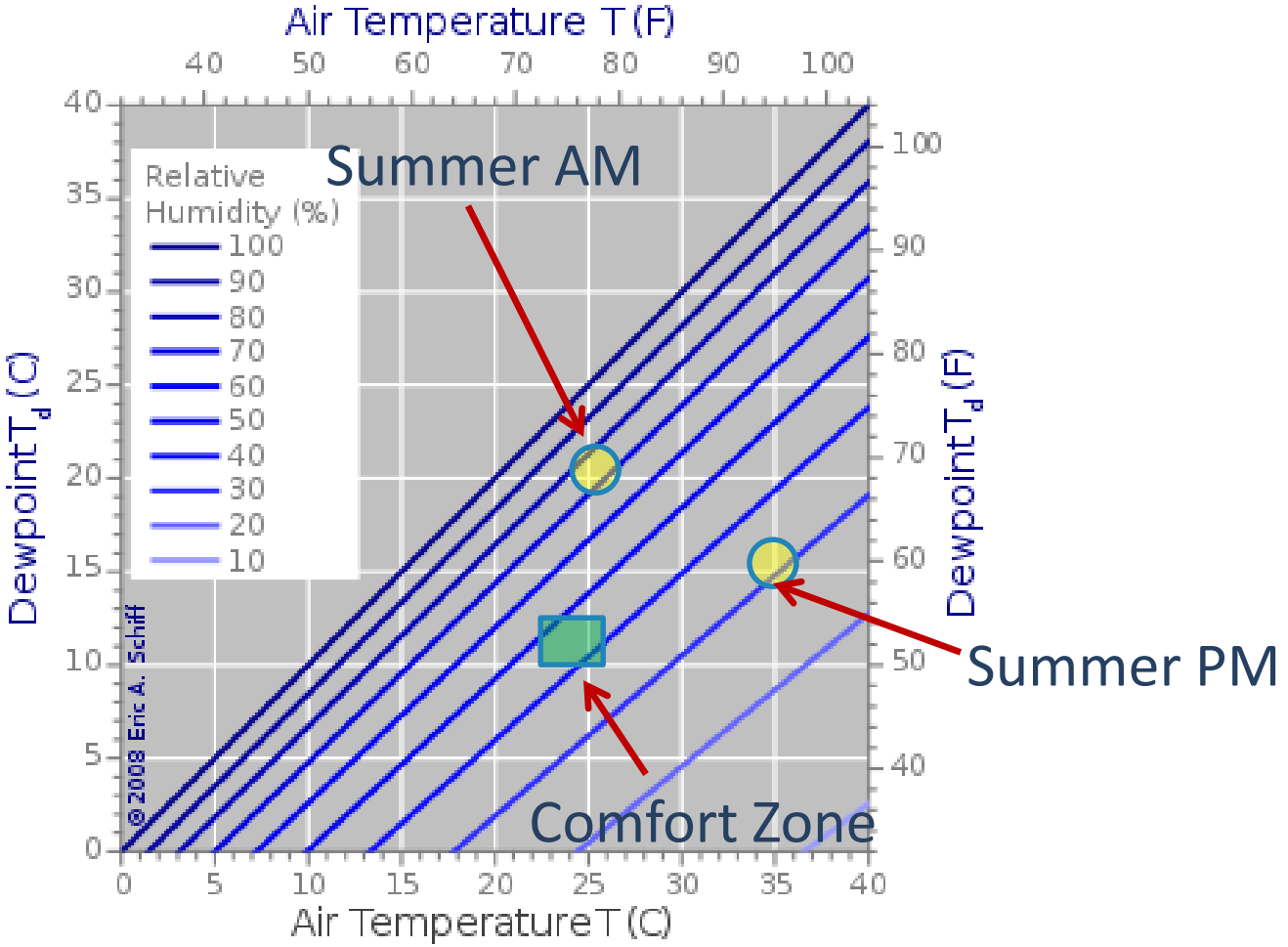
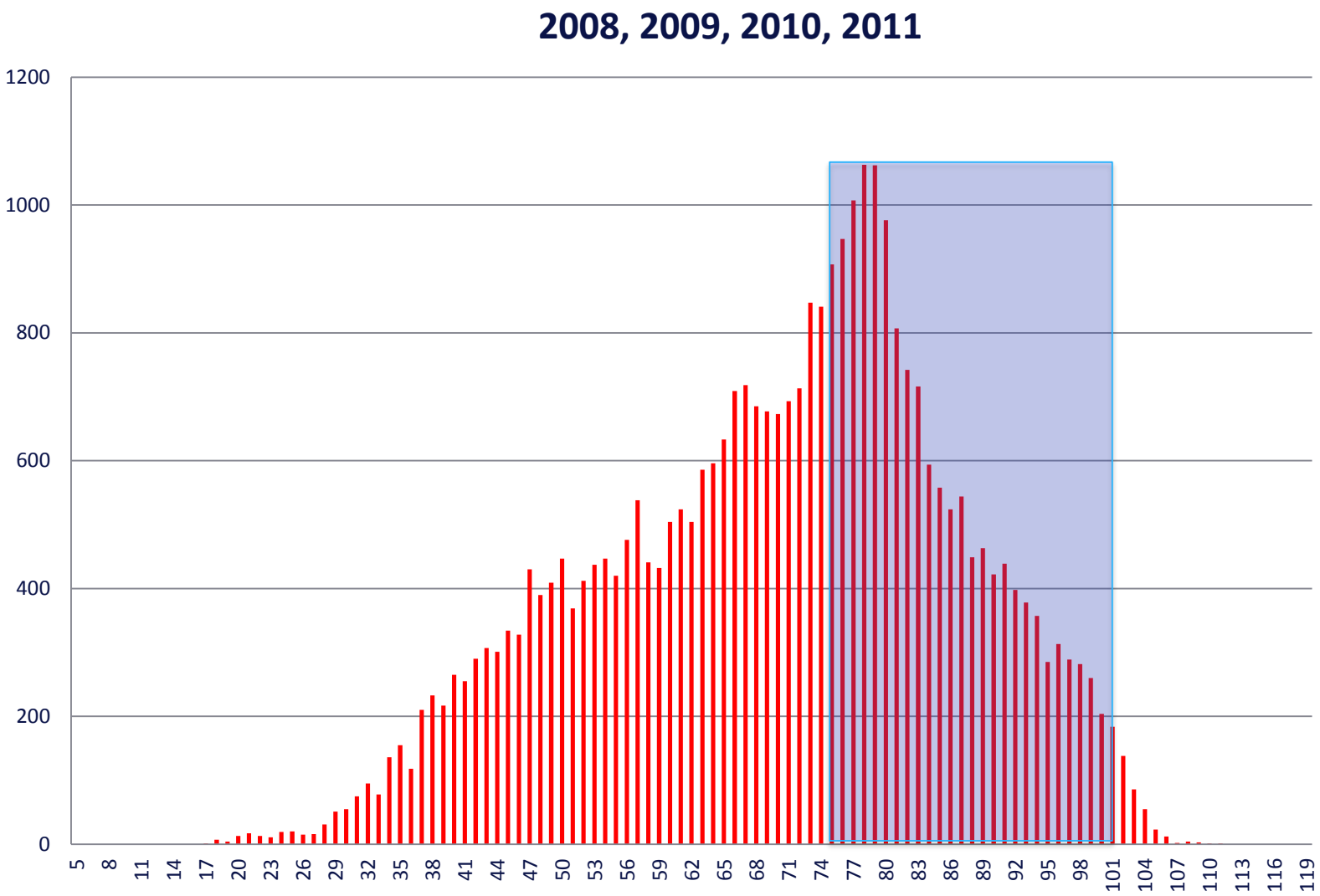


Hours at temperature – Austin, Texas



Value of accurate load calcs, right sizing

- With advances in code and cooling system efficiency, Austin Energy now requires one-half the energy to cool the same square footage compared to a decade ago
- Comparison between peak demand in 2017 and previous peak in 2011
  - Customers (meters) increased 10%
  - Peak demand only increased .5%
- Some of that demand reduction resulted from demand management, improvements in existing buildings and distributed solar

Getting Loads and Equipment Right

- Required . . .
  - Grasp of construction concepts
  - Accurate information from architect, designer, specifier (is it code compliant?)
  - Appropriate/accurate design temperatures for location
  - Reviewers that can review quickly
  - Contractors that actually install equipment based on plans and specs
  - Knowledgeable 3rd party testing contractors

Elements that influence loads, performance

- Construction inputs: surface area, R-values (assemblies), shading, added loads (fireplace, appliances, occupants)
- Fenestration U-value and SHGC, orientation
- Roof material, roof color and radiant barrier
- Construction types (tight, average, etc.)
- Air handler location, duct layout/insulation
- With introduction of high efficacy lighting, cooling loads have decreased, heating loads have increased slightly

So what's most important?

- "Air conditioning" is all about "air"
  - How much
  - Where it goes (based on room loads)
  - How well it's distributed
  - How much heat it gains (or loses)
- Code only addresses how much air is lost from the system
- Austin's energy code requires +/- 20% of design air flow for each supply register, +/- 10% for system

Elements of good air distribution

- Central location of air handler
- Good plenum/duct design and construction
- Optimal air velocity at supply terminals
- Returns sized for air flow
- Low pressure drop/high MERV filter
- Unobstructed pathways for return air (RAPS, return ducts, jump-over ducts)
- Bedrooms (closed doorways) are a challenge to air movement, comfort
- Use Manual D!

Other reasons “air” can’t be ignored

Don’t ignore duct loads

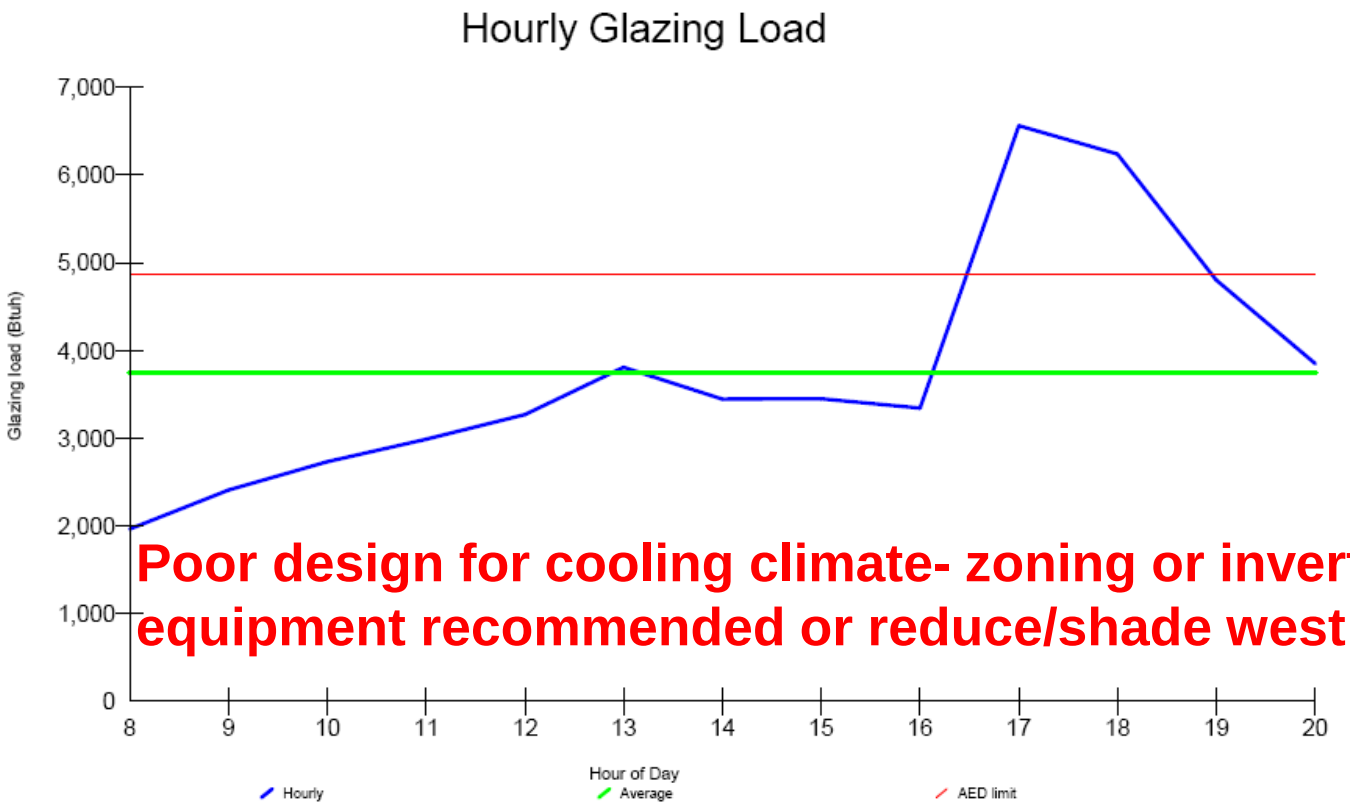
- Manual J calculates duct loss and gains from both leakage and thermal transfer, but uses an ASHRAE standard more suitable for metal ducts
- Duct screen inputs are not shown on Manual J report – have to deduce them from resulting loads
- Watch for duct location, duct insulation, roof RB, roof cladding
- “Extremely “ or “notably” sealed should be selected
- Duct loads should not exceed 10 - 12% of total loads

Recognizing problems

- Manual J reports can often reveal either climate-inappropriate design or code violations
- Certain values will be the norm for your climate, building types – with a little experience you can spot the errors easily
- Watch for “fudging” of values to falsely boost loads
- Sometimes folks just get it wrong
- Consider offering corrections a teaching opportunity

Design should match climate

Test for Adequate Exposure Diversity



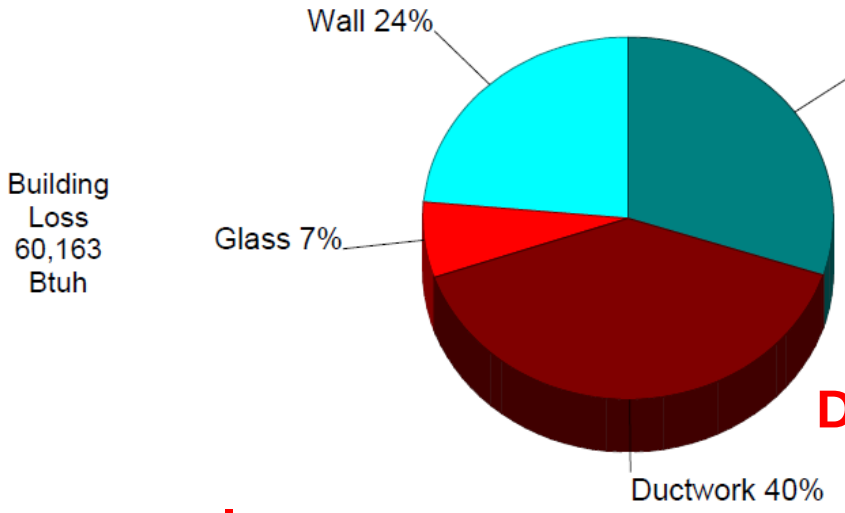
Poor design for cooling climate- zoning or inverter equipment recommended or reduce/shade west glazing

Maximum hourly glazing load exceeds average by 75.0%.

Zone does not have adequate exposure diversity (AED), based on AED limit of 30%.

AED excursion: 3585 Btuh (PFG - ALP)

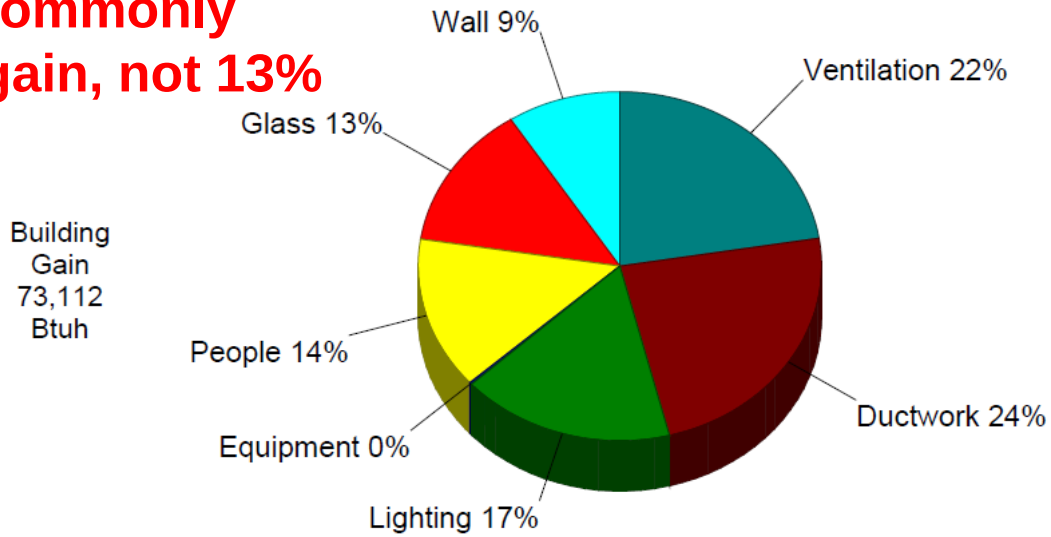
Problems Here . . .



So is ventilation!

Duct loss too high!

Gain from glazing is commonly 30 – 40% of sensible gain, not 13%



Errors add up . . .

System 1 001 Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Res Glass: Glazing-Residential glazing, u-value 0.17, SHGC 0.3	569.2	4,055	0	9,798	9,798
13C-5ocw: Wall-Block, framing with R-13 in 2 x 4 stud cavity, R-5 board insulation, open core, wood studs	4061.3	10,404	0	4,803	4,803
13BA-0fcw: Wall-Block, framing with R-11 in 2 x 4 stud cavity, filled core, wood studs	1019	3,766	0	1,855	1,855
Subtotals for structure:		18,225	0	16,456	16,456
People:	24		4,800	5,520	10,320
Equipment:			0	162	162
Lighting:	3670			12,515	12,515
Ductwork:		23,853	2,535	14,724	17,259
Infiltration: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Ventilation: Winter CFM: 400, Summer CFM: 400		18,085	6,496	9,904	16,400
System 1 001 Load Totals:		60,163	13,832	59,280	73,112

Check Figures

Supply CFM:	2,293	CFM Per Square ft.:	0.494
Square ft. of Room Area:	4,645	Square ft. Per Ton:	762
Volume (ft³) of Cond. Space:	50,268		

System Loads

Total Heating Required Including Ventilation Air:	60,163 Btuh	60.163	MBH
Total Sensible Gain:	59,280 Btuh	81	%
Total Latent Gain:	13,832 Btuh	19	%
Total Cooling Required Including Ventilation Air:	73,112 Btuh	6.09	Tons (Based On Sensible + Latent)

Take-aways

- Accurate load calculations require accurate data inputs – GIGO!
- Review for accuracy – learn to spot errors
- Think of HVAC from a performance perspective, not as a building component – everything else is essentially static
- Air flow is critical – begins with building design
- Design and install systems with an eye toward maximum performance
- At final, test or commission to ensure that performance is realized