Code Amendment Proposal Application

Department of Consumer & Business Services
Building Codes Division
1535 Edgewater NW, Salem, Oregon
Mailing address: P.O. Box 14470, Salem, OR 97309-0404
Phone: 503-378-4133, Fax: 503-378-2322
Oregon.gov/bcd

Read the entire code amendment proposal application before completing this form. Please complete all parts before submitting your proposal and refer to the provided checklist.

APPLICANT INFORMATION

Name: Kevin Rose		Date: 8/26/22
Representing (if applicable): Northwest Energy Efficiency Alliance		Work phone: (503)688-5437
Mailing address: 700 NE Multnomah Street, Suite 1300		Cell phone:
City: Portland	State: OR	Zip: 97232
Email address: krose@neea.org		

PROPOSAL INFORMATION

Specialty code: ORSC

Code section(s): N1105.3

Briefly explain the subject of your proposal: requires projects that choose to locate ducts outside the thermal envelope to test said ductwork and meet a maximum leakage threshold

INSTRUCTIONS AND CHECKLIST

Fill in all the information above and submit this page, signed and dated, with the required supplementary information for Parts I, II, III, and IV described on page 2 of this application. This application may be submitted by mail to the mailing address above, or by email to BCD.PTSPtech@oregon.gov.

Summary checklist for the applicant:

- ☐ **Part I** Code amendment language is attached in the proper format.
- ☐ **Part II** Amendment proposal requirements for amending the code have been reviewed.
- ☐ **Part III** Amendment proposal criteria questions have been answered and are attached.
- ☐ **Part IV** If applicable, additional ORSC energy efficiency amendment proposal information is attached.

Note: One application is required for each code section you are proposing to amend. If this proposal requires changes in other sections of the code for alignment, include those changes as part of this application.

APPLICANT SIGNATURE

Signature:  Date: 8/26/22

PART I – CODE AMENDMENT LANGUAGE

N1105.3 Installation of ducts and air handling equipment. For new construction and *additions*, all new duct systems and air handling equipment and appliances shall be located fully within the building thermal envelope.

Exceptions:

1. Ventilation intake ductwork and exhaust ductwork.
2. Up to ~~5 percent of the length of an~~ 10 feet (2438 mm) of HVAC ~~system~~ ductwork shall be permitted to be located outside of the thermal envelope.
3. HVAC supply and return ductwork outside the thermal envelope and installed in accordance with either Section N1105.3.1, N1105.3.2 or N1105.3.3 shall select two measures from Table N1101.2(2). Duct leakage shall be measured in accordance with Section N1105.3.4 and shall be less than or equal to 3.0 cubic feet per minute (31.9L/min) per 100 square feet (9.29 m^2) of conditioned floor area by the duct system. ~~Ducts deeply buried in insulation in accordance all of the following: 3.1. Insulation shall be installed to fill gaps and voids between the duct and the ceiling, and a minimum of R-19 insulation shall be installed above the duct between the duct and unconditioned attic. 3.2. Insulation depth marker flags shall be installed on the ducts every 10 feet (3048 mm) or as approved by the building official.~~

N1105.3.4 Duct Leakage Testing. Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. **Rough-in test**: Total leakage shall be measured with a pressure differential of 0.1-inch w.g. (25 Pa) across the system including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. **Postconstruction test**: Total leakage shall be measured with a pressure differential of 0.1-inch w.g. (25 Pa) across the system including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.

PART II – CODE AMENDMENT PROPOSAL REQUIREMENTS

This proposal is enforceable by ORSC.

Part III – CODE AMENDMENT PROPOSAL CRITERIA

Proposal

Question	Response
1. Describe the concept and purpose of this proposal.	This proposal ensures that ducts that are not located 100% inside meet a minimum level of tightness by leveraging the duct testing language from 2021 ORRC and leakage limit from DOE ZERH.
2. What problem in the existing Oregon code or national model code is this proposal solving? How does this amendment address the issue? If you have evidence demonstrating the problem, submit that information.	The minimum target for the 2023 ORSC is DOE ZERH v6, and NEEA's analysis indicates that additional efficiency is needed beyond the 2023 ORSC draft to achieve this target (see the "2023 ORSC NEEA Proposals Support Document" appended). PNNL's 2020 Oregon Residential Energy Code Field Study found that duct leakage to outside (LTO) to be roughly 6 cfm25/100 sf of conditioned floor area (CFA) among the 68 home sample. Of the homes where ducts were not located 100% inside conditioned space, the highest recorded LTO was 15.6 cfm25/100 sf CFA (and one Oregon home with all ducts inside registered as high as 45 cfm25/100 sf CFA of total leakage). For comparison, DOE ZERH specifies that ducts located outside conditioned space must be tested to show an LTO of half of Oregon's average: 3.0 cfm25/100 sf of CFA. This proposal would directly align 2023 ORSC with DOE ZERH regarding HVAC distribution efficiency. In addition to saving energy in homes that choose the exception to locating 100% of ducts inside, improved duct tightness results in more comfortable homes. High leakage rates (especially to outside) mean air is not being delivered to rooms at the designed flow rates, which could cause rooms toward the end of duct runs to be cold in winter and hot in summer. Such temperature gradients could result in callbacks for builders and HVAC technicians, but further sealing the ducts post-construction will likely be difficult and expensive since the ducts will be deeply buried insulation (which is required for two of the three N1105.3 Exception 3 pathways). Testing and sealing these ducts while they are still easily accessible avoids this potential issue.
3. Has this been proposed at the national model code level? If so, explain when it was proposed, what happened, and why it was not adopted. Provide all associated national model code hearing information and background.	The IECC has required duct blaster testing nationwide since the 2009 version except for where ducts and air handlers are located entirely within the thermal envelope. Since the 2012 IECC, total duct leakage of no more than 4 cfm25/100 sf CFA has been required. In the 2021 IECC, the testing limit was maintained as options to bury ductwork entered the code. In fact, the testing exception for ducts 100% inside was dropped and a leakage limit was set. For the 2024 IECC, proposal REPI-86-21 As Amended introduced alternative leakage rate thresholds for homes 1,000 sq ft and smaller (this proposal was approved by the IECC-R Committee).

Implementation and fiscal impact

Question	Response
1. Explain how the proposed provisions would be enforced? Are additional inspections or permits required? Describe any necessary equipment, training, tests or special certifications.	The impact of this code proposal would depend upon what fraction of homes choose the exception to locating ducts 100% inside. If builders embrace locating ducts inside, this proposal could have minimal impact to enforcement. Alternatively, many builders that locate ducts outside may choose to avoid the one-time redesign costs to relocate ducts inside. In this case, significantly more duct testing would be needed than is currently done in Oregon. Implicit in more testing is a need to: (1) increase the amount of duct blaster equipment and the number of individuals capable of performing this test; and (2) ensure sufficient geographic distribution of this capacity to provide coverage for the entire state. For the workforce piece, a potential barrier to growth is the cost of certification. However, this proposal does not require the tester to be certified. This proposal also does not require the tester to be a third party, and the ability for self-testing can help reduce supply concerns (as well as reducing costs). For code enforcers, the only anticipated added effort would be checking project documentation that the test result does not exceed the threshold.
2. What is the fiscal impact of this proposal? Provide a cost benefit analysis and include the resources or methods you used to determine the fiscal impact.	For the fraction of 2,376 sq ft homes choosing not to locate 100% of ducts inside, annual energy savings and incremental construction costs are $30.96 and $1,184.13, respectively, after applying the 2023 ORSC assumptions and weighting factors (see Part IV); note that the zonal electric homes are excluded in calculating these statewide financial impacts. This yields a statewide simple payback of 38 years, which is within the useful life of the ductwork. A LCCA would provide a more appropriate lens for this measure given its long life; this analysis was not completed in time for submittal but could be developed later if needed.

Impacted stakeholders and other specialty codes

Question	Response
1. Was this proposal developed with people or organizations likely to be affected by it? Has it been reviewed or shared with people or organizations likely to be affected by it? If so, who, and if not, why not?	As mentioned above, the kernel of this proposed code change has been in the national code for over a decade. This topic was revisited at several meetings earlier this year by the wide range of stakeholders engaged by ICC's consensus process, and the 2024 IECC is on track to retain duct testing for ducts located outside the thermal envelope.
2. Does this proposal impact other specialty codes or statewide programs?	No.

Part IV – ORSC ENERGY EFFICIENCY CODE AMENDMENT PROPOSAL CRITERIA

1. **Modeled estimated energy savings**

2,376 sq ft		Gas Consumption (Therms/yr)		Electricity Consumption (kWh/yr)		Total Energy Use (MMBtu/yr)	
Prototype	**Weights**	**Baseline**	**Proposed**	**Baseline**	**Proposed**	**Baseline**	**Proposed**
4C, Gas, Crawl	23.9%	612.00	593.86	6,909.91	6,820.19	84.76	82.64
4C, Gas, Crawl, NO A/C	12.7%	612.06	593.92	5,256.27	5,219.62	79.12	77.18
4C, Electric, Crawl	3.8%	-	-	14,128.98	13,909.67	48.21	47.46
4C, Electric, Crawl, Zonal	3.8%	-	-	12,808.53	12,808.53	43.70	43.70
4C, Gas, SOG	8.2%	640.16	620.89	6,847.43	6,759.50	87.36	85.13
4C, Gas, SOG, NO A/C	4.3%	640.22	620.94	5,259.80	5,223.16	81.95	79.90
4C, Electric, SOG	1.3%	-	-	14,335.05	14,106.67	48.91	48.13
4C, Electric, SOG, Zonal	1.3%	-	-	12,975.56	12,975.56	44.27	44.27
5B, Gas, Crawl	16.5%	757.71	736.08	6,944.04	6,851.64	99.44	96.96
5B, Gas, Crawl, NO A/C	8.7%	757.76	736.13	5,315.52	5,271.45	93.89	91.58
5B, Electric, Crawl	2.6%	-	-	17,214.25	16,829.38	58.74	57.42
5B, Electric, Crawl, Zonal	2.6%	-	-	15,316.12	15,316.12	52.26	52.26
5B, Gas, SOG	5.6%	795.08	772.10	6,861.81	6,771.59	102.90	100.29
5B, Gas, SOG, NO A/C	3.0%	795.14	772.16	5,320.58	5,276.50	97.64	95.20
5B, Electric, SOG	0.9%	-	-	17,609.88	17,181.72	60.08	58.62
5B, Electric, SOG, Zonal	0.9%	-	-	15,629.98	15,629.98	53.33	53.33
Weighted Totals no zonal:		**616**	**598**	**7,192**	**7,099**	**86.14**	**84.02**
Weighted Totals w/ zonal:		**563**	**547**	**7,766**	**7,681**	**82.82**	**80.88**

For this proposal, NEEA adjusted the baseline to include a LTO of 6 cfm25/100 sf CFA of leakage to outside. The 2023 ORSC assumptions assumes ducts will be located 100% inside and sets the LTO to 0, which makes sense for those home designs if ignoring the 10 foot length allowed outside. However, it is

likely that a nontrivial fraction of homes will choose to locate ducts outisde, and the 2023 ORSC currently sets no maximum leakage level for ducts in this case. In the absence of a requiremen, NEEA chose the average value from the 2020 PNNL Field Study as our assumption for the baseline case.

Also note that this proposal was modeled against an adjusted baseline which set air leakage to 4 ACH50 (see appended Support Document). Since the 4 ACH50 assumption was maintained in the "as proposed" model, there should be a reasonably small variance when comparing to the 2023 ORSC assumption of 3.5 ACH50.

For the fraction of homes choosing the exception to 100% ducts inside, this proposal has statewide annual savings of 18 therms and 93 kWh (2.12 MMBtu total) for the 2,376 sq ft home. These figures were used in the cost-benefit analysis (see Part II).

Overall, this proposal has statewide annual savings of 16 therms and 85 kWh (1.94 MMBtu total) for the 2,376 sq ft home. **For computing total code progress compared to DOE ZERH, an assumption of 50% in the absence of better data yields 8 therms and 43 kWh (0.97 MMBtu total)**. For this calculation, the 4 electric zonal cases were assumed to maintain their energy use profile from NEEA's adjusted baseline for the purposes of calculating statewide energy savings.

2. **Increased construction costs**

Testing:

	2,376 sq ft	**1,200 sq ft**	**Source/Assumption**
c. Cost of labor	$70.85/hr	$70.85/hr	RS Means
d. Quantity of labor	4 hours	3 hours	TRC New Construction program judgement
e. Cost of materials	0	0	Duct blaster equipment is already owned or is a one-time expense that can be assumed negligible when apportioned across many homes
f. Quantity of materials	-	-	
g. Overhead costs	$92.20	$69.15	RS Means labor rate $47.80 was used to deduce $23.05 OP per labor hr
h. Profit			
i. Factors or conditions that would make an alteration, repair, change of use, or change of occupancy, or other code upgrade triggering event in an existing building more expensive to comply with	-	-	Only applies to new construction
Total Incremental Cost:	**$375.60**	**$281.70**	

Improving from 6.0 cfm25/100 sf CFA to 3.0 cfm25/100 sf CFA:

	2,376 sq ft	**1,200 sq ft**	**Source/Assumption**
c. Cost of labor	$70.85/hr	$70.85/hr	RS Means
d. Quantity of labor	6.75 hours	5.84 hours	RS Means (.013 lf/hr)
e. Cost of materials	$35	$35	Brushed latex mastic at $35/gallon
f. Quantity of materials	5	4	Calculated 519 and 449 lf, assumed 125 lf/gal mastic
g. Overhead costs	$155.52	$134.54	RS Means labor rate of $47.80 was used to deduce $23.05 OP per labor hr
h. Profit			
i. Factors or conditions that would make an alteration, repair, change of use, or change of occupancy, or other code upgrade triggering event in an existing building more expensive to comply with	-	-	Only applies to new construction
Total Incremental Cost:	**$808.53**	**$688.08**	

The total incremental costs are $1,184.13 for the 2,376 sf home and $969.78 for the 1,200 sf home.