REHAU®
Unlimited Polymer Solutions

OUTDOOR WOOD BOILER PIPE
INSTALLATION GUIDE

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⚠ This symbol and the signal words DANGER, WARNING or CAUTION alert you to personal injury hazards. If you don't avoid the hazardous situation:

- DANGER! Will result in death or serious injury
- WARNING! Could result in death or serious injury
- CAUTION! Can result in minor or moderate injury

The signal word NOTICE is used to help you avoid property damage.

We cannot warn of all hazards; you must also use your own good judgement.

For updates to this publication and the most current technical instructions, safety information and manufacturer's recommendations, visit **na.rehau.com/resourcecenter**

1. SCOPE

This technical information applies to the planning, installation and connection of REHAU outdoor wood boiler (OWB) insulated RAUPEX pipe in buried outdoor wood boiler energy transfer systems.

This guide gives direction to appropriately licensed installers who have a working knowledge of applicable federal, state, provincial and local regulations. Persons using this guide must have an understanding of the principles and practices for design and installation of buried insulated energy transfer piping systems and outdoor wood boilers. It is the responsibility of the designer and installer to check the prevailing local codes and to verify that the technical information presented in this guide is appropriate for a particular installation.

2. INSTALLATION OVERVIEW

Figure 1 highlights the most critical points in a REHAU OWB pipe installation:

1. Surround OWB pipe by at least 4 in. (10 cm) of sand (Chapter 6).
2. Protect OWB pipe from direct exposure to UV radiation (Chapter 5).
3. Lay OWB pipe below the frost line to prevent movement (Chapter 6).
4. Install proper wall penetration solution to avoid leakage (Chapter 9).
5. Anchor the connections that will receive the OWB fittings at each end (Chapter 8). Do not anchor the OWB outer casing, sleeve of EVERLOC fitting or nut of compression nut fitting.
6. Pressure test system before backfilling the trench. Perform the test using a glycol solution or air if there is any chance water could freeze in the system (Chapter 10).

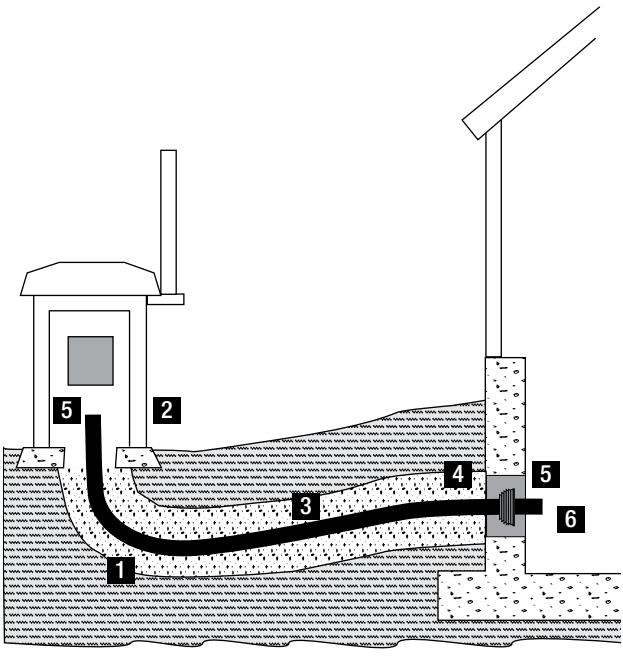


Fig 1: Outdoor wood boiler (OWB) pipe installation

3. UNDERSTANDING OUTDOOR WOOD BOILER (OWB) PIPE

Outdoor wood boiler (OWB) insulated RAUPEX pipe is specially designed for the efficient transfer of hot water from outdoor wood boilers to residential and light commercial buildings. A flexible alternative to rigid pipe, OWB pipe offers ease of installation combined with the long-term performance of REHAU's RAUPEX® O_2 Barrier PEXa pipe for hydronic heating applications.

3.1 OWB Pipe Composition

OWB pipe consists of two carrier pipes surrounded by a solid layer of polyurethane foam insulation and protected by a polyethylene casing. The two-pipe configuration combines supply and return pipes, streamlining installation. One of the RAUPEX pipes is marked with a black line to differentiate supply from return.

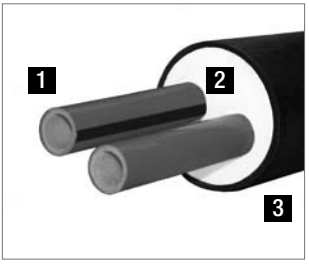


Fig. 2: OWB pipe composition

1 **Carrier pipes** – transfer hot water through RAUPEX O_2 Barrier PEXa supply and return lines

2 **Polyurethane foam** – insulates carrier pipes

3 **Polyethylene casing** – protects insulation and carrier pipes

OWB pipes are available with 1 in. and 1 1/4 in. carrier pipes and are coiled for shipment.

Table 1: OWB Pipe Sizes

Description	Casing Outer Diameter		Weight	
	in.	mm	lb/ft	kg/m
(2) 1" OWB Insulated RAUPEX Pipe	4 3/8	111	1.18	1.76
(2) 1 1/4" OWB Insulated RAUPEX Pipe	4 3/8	111	1.37	2.04

3.2 RAUPEX Carrier Pipe

RAUPEX® crosslinked polyethylene (PEXa) pipe is manufactured using REHAU's high-pressure peroxide extrusion method that typically yields the highest, most consistent level of crosslinking. Pioneered by REHAU in 1968, PEXa technology enhances flexibility and thermal memory, providing ease of handling and kink repair while supporting the use of REHAU EVERLOC® compression-sleeve fittings.

Fig. 3: RAUPEX carrier pipes

3.2.1 Oxygen Diffusion Barrier

The carrier pipes in REHAU OWB pipe are RAUPEX O_2 Barrier, produced with an oxygen diffusion barrier that limits oxygen permeation through the pipe wall in accordance with DIN 4726. This pipe is suitable for many types of hydronic heating systems including systems with ferrous (iron or steel) components. Polymer pipes that do not have an O_2 barrier can allow oxygen to pass through the pipe wall and dissolve in the heating water which may corrode any iron or steel components such as pipes, valves, pumps and the boiler.

3.2.2 Pressure Ratings

In accordance with the Plastic Pipe Institute's PPI TR-3 policy, RAUPEX pipe has continuous use ratings at the following pressures and temperatures:

- 160 psi @ 73.4°F (23°C)
- 100 psi @ 180°F (82°C)
- 80 psi @ 200°F (93°C)

These pressure/temperature ratings are based on an extrapolated time-to-failure prediction as defined in ASTM D2837 *Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials*.

NOTICE: Installer must verify the system has the necessary hydronic controls (e.g., air eliminators, temperature limit controls) to ensure the pressure/temperature in the OWB pipe is not exceeded. Excess water pressure/temperature and/or steam pockets can lead to pipe failure.

3.2.3 Ultraviolent (UV) Resistance

All polymer pipes must be protected from UV exposure before, during and after installation. RAUPEX O_2 Barrier pipe has a maximum UV exposure limit of 30 days accumulated. Failure to follow recommendations for maximum UV exposure can result in premature pipe failure and will negate any warranty provided by REHAU.

NOTICE: Excessive UV exposure may cause RAUPEX carrier pipes to fail, resulting in property damage and loss of water pressure.

3.2.4 Freeze Break Resistance

RAUPEX carrier pipe will expand as water freezes in the pipe, as long as the pipe has room to expand. When the water thaws, the pipe returns to its original shape. If portions of the pipe are encased in a solid mass such as concrete, hard-packed soil or rigid insulation, then expansion of the pipe evenly along its length may be prevented and the pipe may break if frozen.

NOTICE: Frozen pipes can burst. Installer must take precautions to ensure that pipes do not freeze.

3.2.5 Chemical Compatibility

RAUPEX pipe is compatible with common glycols, typically ethylene or propylene, used in hydronic piping systems as well as common corrosion inhibitors.

NOTICE: Do not allow RAUPEX pipe to come in contact with petroleum products and other chemicals such as solvents and glues. These substances may cause the pipe to fail, resulting in property damage and loss of water pressure.

RAUPEX pipe is resistant to a wide range of chemicals. However, while some chemicals may not harm RAUPEX, chemical concentration, temperature, pressure and other parameters can influence the lifetime of a pipe. If you have questions regarding chemical compatibility, contact your REHAU regional sales office.

3.2.6 Dimensions

RAUPEX carrier pipes are SDR9 copper tube sizes (CTS) manufactured in accordance with ASTM F876 and CSA B137.5. In addition, wall thickness is determined by the standard dimensional ratio (SDR), which equates to the outside diameter being approximately nine times the wall thickness.

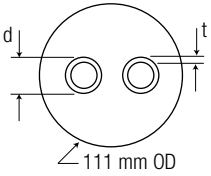


Table 2: RAUPEX Carrier Pipe Sizes

Description	SDR	d (avg)		t (min)		Volume	
		in.	mm	in.	mm	gal/ft	L/m
(2) 1" OWB Insulated RAUPEX Pipe	9	1.125	28.6	0.125	3.2	0.031	0.39
(2) 1 1/4" OWB Insulated RAUPEX Pipe	9	1.375	34.9	0.153	3.9	0.047	0.58

3.3 Polyurethane Foam

The insulation of the OWB pipes is made of rigid closed-cell polyurethane (PUR) foam using a pentane blowing agent. The PUR foam is free from CFCs and HCFCs.

Thermal conductivity: < 0.2 Btu·in/h·ft²·ºF (0.03 W/m·ºC)

3.4 Polyethylene Casing

The outer casing of the OWB pipe is manufactured with flexible low-density polyethylene (LDPE) which has excellent strength, puncture and cut resistance, water resistance and thermal insulation properties.

Color: Carbon black > 2.5%
Thermal conductivity: 3.0 Btu·in/h·ft^2·ºF (0.43 W/m·ºC)
Density: 59 lb/ft^3 (950 kg/m^3)

3.5 OWB Pipe Accessories

REHAU offers a variety of accessories for OWB pipe installations including compression nut and EVERLOC compression-sleeve fittings, wall penetration rings, end caps, coupling insulation kits and repair tape. See the REHAU *Sustainable Building Technology Product Catalog* for a complete list.

3.6 Warranty

The REHAU *PEXa Limited Warranty* is currently available online at na.rehau.com/warranties

When installation is carried out in accordance with the requirements outlined in the warranty, REHAU offers:

– 1-year limited warranty on the outer casing and insulation
– 25-year limited warranty on the RAUPEX carrier pipe

System designers and installers should review a copy of the warranty prior to installation.

4. DESIGNING OWB PIPE SYSTEMS

4.1 Pressure Loss

The pressure loss from the OWB pipe is one factor used in sizing the system's circulator pump.

Pressure Loss Calculation

Use the following calculation to find the pressure loss of your OWB pipe.

1. Refer to Head Loss Tables in the Appendix. Find the table for the size of carrier pipe and the type of fluid you are using.

2. Find the intersection of the row for the flow rate of the fluid and the column of the fluid temperature. The number at this intersection is the feet of head loss per 100 ft of carrier pipe.

Example, given:
150 ft of (2) 1" OWB pipe
20% polypropylene glycol fluid
5 gpm flow rate
140°F average fluid temperature

The head loss value in the table is: 3.28

3. Calculate the length of carrier pipe in your system in hundreds of feet.

150 ft of (2) 1" OWB pipe = 300 ft of 1 in. carrier pipe

4. Multiply the head loss value by the feet of carrier pipe in the system.

3.28 x 300/100 = 9.8 ft of head loss

4.2 Heat Loss for Buried Pipes

OWB pipe is ideally suited to reduce heat loss into the ground under normal operating conditions. Use the following equation along with the values in Tables 3 and 4 to find the heat loss of your system.

REHAU uses three typical native soil types for purposes of heat loss calculations. Even though the OWB pipe will be surrounded by sand, use the native soil properties for heat loss calculations.

Table 3: Thermal Conductivity of Typical Native Soil Types

Native Soil Type	Description	Thermal Conductivity	
		Btu·in/h·ft²·ºF	W/m·ºC
dry	well to excessively drained, course-textured particles	1	0.1
medium	well drained with moderately fine or medium-textured particles, or poorly drained with moderately course textured soil	8	1.2
moist	poor to very poorly drained, fine-textured soils or peats	15	2.2

Heat Loss Calculation

Use the following calculation to solve for heat loss (Q_{OWB}):

$$Q_{OWB} = \frac{L \times \left[\frac{T_{supply} + T_{return}}{2} - T_{soil}^{1} \right]}{R_{OWB}}$$

Q_{OWB} – heat loss (Btu/h)
L – length of the OWB pipe being used
T_{supply} – temperature of your supply water
T_{return} – temperature of your return water
T_{soil}^{1} – temperature of soil
R_{OWB} – total thermal resistance of buried OWB pipe

[1]Native soil temperatures vary month to month. Use the lowest native soil temperature for calculating heat loss. If the native soil temperature is not known, consult with the supplier of the outdoor wood boiler or your REHAU regional representative for assistance.

Example, given:
150 ft of (2) 1" OWB pipe
39 in. buried depth to center of OWB pipe
160ºF supply hot water temperature
120ºF return hot water temperature
50ºF lowest soil temperature
Medium native soil type

Solution:
R_{OWB} = 10.2 (per Table 4)
Q_{OWB} = 150 x [(160 + 120)/2 - 50] / 10.2
Q_{OWB} = 1,323 Btu/h

Table 4: Total Thermal Resistance of OWB Pipe (Rowb)

Total Thermal Resistance Rowb (h·ft·°F/Btu)							
Carrier Pipe Size		(2) 1"			(2) 1 1/4"		
Native Soil Type		dry	medium	moist	dry	medium	moist
Depth of Bury to OWB Pipe Centerline	19 in. (48 cm)	14.6	10.1	9.8	12.6	8.0	7.7
	27 in. (69 cm)	15.4	10.2	9.8	13.3	8.1	7.8
	39 in. (99 cm)	16.0	10.2	9.9	13.9	8.2	7.8
	51 in. (130 cm)	16.5	10.3	9.9	14.5	8.2	7.8
	63 in. (160 cm)	16.9	10.4	9.9	14.9	8.3	7.9
	75 in. (190 cm)	17.2	10.4	9.9	15.2	8.3	7.9
	87 in. (221 cm)	17.5	10.4	10.0	15.5	8.4	7.9
	99 in. (251 cm)	17.8	10.5	10.0	15.7	8.4	7.9
	105 in. (266 cm)	17.9	10.5	10.0	15.8	8.4	7.9

Values assume average native soil property conditions classified in Table 3

4.3 Above-Ground Placement of Pipe

When OWB pipe is installed in a non-buried application, the installation must account for the natural tendency of the pipe to expand due to temperature changes and must protect the pipe from direct exposure to UV radiation.

NOTICE: Conceal all above-ground installations of OWB pipe from UV radiation (sunlight).

Non-buried applications must be properly supported. Check local codes for maximum distances between support devices. If none are specified, horizontal and vertical runs should be supported every 3 ft (91 cm).

Heat loss calculations need to be adjusted for non-buried sections using guidelines provided in ASHRAE S11 *Pipes in Air.*

5. HANDLING OWB PIPE

Improper handling and storage can damage OWB pipes, accessories and fittings, reducing the system's thermal performance and durability.

Handling OWB pipe coils can also be dangerous because they weigh between 150 to 1,500 lbs (68 to 680 kg).

⚠ **WARNING!** To reduce the risk of serious injury, use caution, appropriate equipment and techniques when handling OWB pipe coils.

5.1 Transportation and Handling Pipe

- Use at least two people and appropriate equipment when handling OWB coils.
- Make sure forklift tines are covered with a soft material (e.g., plastic or cardboard tubes) and support the entire coil width.
- Use transport straps of at least 2 in. (5 cm) in width when lifting coils with a backhoe; do not use ropes or chains.
- Transport coils lying completely flat on a clean, smooth surface.
- Secure coils during transport to prevent movement.
- Avoid all impact blows, gouging or abrasions to coils. If pipe is damaged, refer to Section 8.3 for instructions on repairing the pipe.
- Do not drag the lower part of the coil across the ground or loading area.
- Lower (do not drop) coils to the ground.

5.2 Storing Pipe

- Store pipe coils horizontally on wooden pallets that support the entire coil width.
- Do not store pipe coils upright because they might fall.
- Brace and chock coils to prevent rolling or tipping if coils must be stored upright.
- Do not store pipe coils on top of sharp objects that could penetrate the outer casing.
- Protect the pipe from direct sunlight for prolonged periods of external storage or in areas with intense solar radiation (e.g., seashore or at altitudes over 5,000 ft [1.5 km]).
- When covering pipe with tarps, provide good ventilation to prevent heat build-up.
- Do not remove protective end caps until you are ready to make pipe connections. Reuse and reinstall protective end caps when storing unused pipe.
- Avoid contact with petroleum products and other chemicals such as solvents and glues.

6. PREPARING THE TRENCH

OWB pipe is suitable for depths ranging from a minimum pipe cover of 2 ft (61 cm) to a maximum buried depth of 8.5 ft (2.6 m).

6.1 Planning the Pipe Installation

NOTICE: Check frost line location with local codes and check utility locations with utility companies before you begin digging your trench.

1. Mark the intended route for the OWB pipe. Check with the utility companies to ensure the path is clear.
2. Make sure the system design has the pipe placed below the frost line to prevent movement. Verify the location with local building codes before proceeding.

6.2 Excavating the Trench

⚠ **WARNING!** To reduce the risk of injury to installation personnel, make sure all trenches are properly shored in accordance with federal, state, provincial and local regulations (including OSHA 2226 Excavations).

1. Excavate trench according to the system design and in compliance with all applicable codes and regulations.
2. Use the dimensions in Fig. 4 as a guide for sizing your trench.
3. Fill the bottom of the trench with 4 in. (10 cm) hand-packed sand before laying the OWB pipe. A minimum of 4 in. (10 cm) of sand should surround the pipe to protect the pipe from sharp objects and ensure the thermal performance of the system.

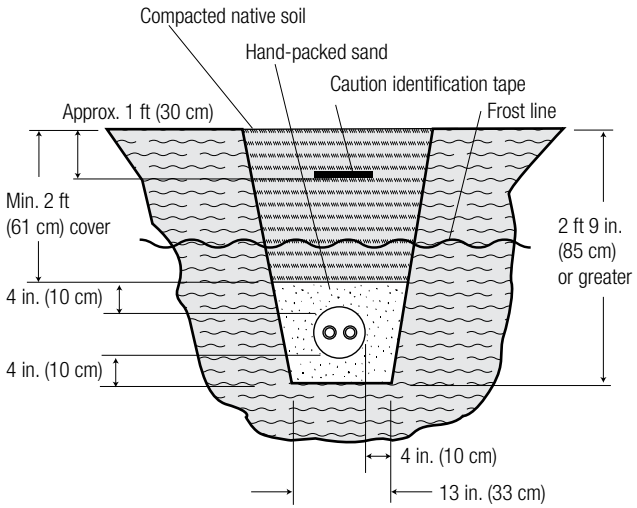


Fig. 4: OWB pipe trench design

7. PLACING OWB PIPE

⚠ Follow the transportation and handling recommendations in Chapter 5 to minimize the risk of personal injury.

Check pipes and accessories for any transportation and storage damage before placing them in the trench. Do not install damaged pipes and pipeline components.

7.1 Uncoiling OWB Pipe

⚠ **WARNING**! To reduce the risk of serious injury, use caution, appropriate equipment and techniques when handling OWB pipe coils.
- Use two people and appropriate equipment to make sure the coil does not fall over.
- Pipe ends can spring out when straps are cut. Stand clear when opening coils.
- Do not cut all the straps at once. The coil can twist and kink or become unstable and fall over.

1. Hold the OWB pipe coil in an upright position.
2. Cut the straps one layer at a time, starting with the outermost straps.
3. Unwind the coil one layer at a time, making sure the uncoiled pipe does not twist and kink.

7.2 Bending OWB Pipe

The high flexibility of OWB pipe allows you to bypass obstacles and make changes of direction in trenches without the need for connections.
- Achieve the minimum bending radii of 3 ft (0.9 m) down to 50ºF (10ºC).
- Warm pipe coils for a few hours in a heated building or tent to maintain this flexibility before doing installations in near-freezing temperatures.

8. MAKING CONNECTIONS

REHAU offers two fittings options for making OWB pipe connections – compression nut fittings and EVERLOC compression-sleeve fittings.

Anchor the connections that will receive the OWB fittings at each end. Do not anchor the OWB outer casing, sleeve of EVERLOC fitting or nut of compression nut fitting.

8.1 Compression Nut Fittings

RAUPEX carrier pipes can be connected to threaded fittings or copper adapter fittings that can be threaded or soldered on to copper pipes. REHAU offers 1 in. compression nut fittings for use with OWB pipe. For 1 1/4 in. connections, contact your local plumbing supplier

Fig.5: Compression nut fittings

CAUTION! Wear safety glasses and gloves when making joints to reduce the risk of personal injury.

NOTICE: Do not damage the carrier pipe or its oxygen diffusion barrier when making joints. Cuts and scratches to the carrier pipe can reduce its pressure rating and oxygen resistance.

1. Cut OWB pipe with a fine-toothed saw.

CAUTION! OWB pipe can spring back when cut. Secure both sections of pipe when cutting to minimize the risk of personal injury.

NOTICE: Reinstall protective end caps if storing unused pipes (see Section 5.2).

2. Mark the outer casing 9 in. (23 cm) from the end where the carrier pipe is to be exposed.

Note: If the end of the pipe is not cut square, add an extra 1/4 to 1/2 in. (5 to 10 mm) so the carrier pipe can be trimmed in Step 5.

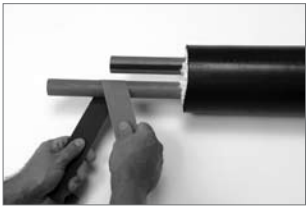
3. Cut the casing all the way around with a saw or pipe cutter, making sure not to damage the carrier pipes. Peel the casing off.

4. Remove the foam with a blunt tool.

NOTICE: Do not use a sharp tool that can damage the pipe or its oxygen diffusion barrier.

5. Cut one carrier pipe 1/4 to 1/2 in. (5 to 10 mm) to square the end. Cut the other carrier pipe 4 in. (10 cm) shorter to offset the compression nut fittings for easier installation.

NOTICE: A clean, square cut of the RAUPEX carrier pipes is required for a proper fitting connection. The REHAU Ratchet Cutter provides a clean, square and accurate cut. Do not cut RAUPEX carrier pipe with a saw blade, as the rough edges will interfere with fitting connections.



6. Use sandpaper to remove the remaining foam from the carrier pipe. Be careful not to damage the pipe or its oxygen diffusion barrier.

7. Slide the wall penetration ring onto the OWB pipe (see Section 9.2).

8. Slide the compression nut over the pipe with threads facing the pipe end. Slide the compression ring over the pipe.

Note: Perform any required soldering of fittings before beginning Step 8.

9. Thread one compression nut and ring onto the fitting to hand tight, then tighten an additional 1/4 to 1/2 turn.

10. Repeat Step 8 and 9 for the second fitting.

Once hot water is circulating through the system, check for leaking. Re-tighten the fittings, if required.

NOTICE: Do not overtighten. Overtight joints will leak.

8.2 EVERLOC Compression-Sleeve Fittings and Tools

RAUPEX carrier pipes can also be connected using the REHAU EVERLOC brass compression-sleeve fitting. This ASTM F2080 fitting system is designed for use exclusively with RAUPEX pipe and should be assembled only with REHAU EVERLOC fitting tools.

Fig. 6: EVERLOC fitting

The basic process of making an EVERLOC connection is first to expand the carrier pipe with the expander tool using the appropriately sized head, and then to compress the fitting together using the compression tool.

A complete step-by-step guide to making connections with REHAU EVERLOC fittings can be found in the REHAU *Radiant Heating System Installation Guide* available online.

Refer to Section 8.1, steps 1 through 7 for the steps required to prepare the OWB pipe for making the EVERLOC connection.

8.3 Repairing OWB Pipe

Damage to the outer casing of OWB pipe can be repaired using waterproof, synthetic rubber adhesive tape.

NOTICE: Do not apply tape to the RAUPEX carrier pipes. Adhesives can damage the pipe or the oxygen barrier.

Fig. 7: Repair tape

To repair damage to foam insulation:

1. Fill any void in the polyurethane foam with canned spray polyurethane foam.
2. Wrap the outer casing with REHAU Repair Tape.

To repair damage to carrier pipes:

1. Cut out the damaged section of carrier pipe.
2. Connect the two sections of OWB pipe with an EVERLOC fitting and a REHAU universal coupling insulation kit. These kits are molded from rigid polyethylene with staggered ends that can be cut for use with various pipe diameters. Kits include two heat shrink sleeves for sealing around the OWB pipe.

Fig. 8: Universal coupling insulation kit

9. PENETRATING THE BUILDING WALL

9.1 Positioning the Pipe

If the OWB pipeline runs parallel to the building, the entry bend radius into the building must be no less than 3 ft (0.9 m) at 50°F (10°C). To complete the connections inside the building, the pipes must project 10 in. (25 cm) or more into the building.

9.2 Installing the Wall Penetration Ring

There are two options when penetrating through an exterior below-grade wall – bored hole or wall breakthrough. Both methods require installing a wall penetration ring and filling around the ring with concrete.

Note: It may be necessary to contact an architect or engineer before boring through walls, floors or ceilings.

Fig. 9: Wall penetration ring

REHAU supplies a Neoprene wall penetration ring that fits tightly over the OWB pipe casing and helps to prevent water from penetrating into the building.

REHAU recommends the following wall penetration steps:

1. Make a bored hole or wall breakthrough with a minimum diameter of 10 1/2 in. (27 cm). This provides a 3 in. (7 cm) clearance between the OWB pipe and the sides of the hole.
2. Apply sealant in and around the hole to seal any hairline cracks that arise during wall breakthrough.
3. Position the wall penetration ring with the large end facing inward and the small tapered end facing toward the exterior side of the building wall.
4. Insert the pipe with the wall penetration ring into the bored hole or wall breakthrough at least 3 in. (7 cm) from the outside wall surface.
5. Fill the hole with concrete.

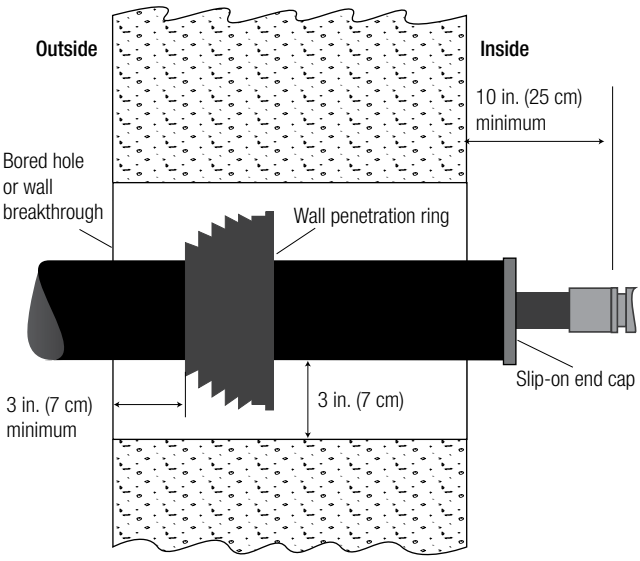


Fig. 10: OWB pipe penetrating building wall, side view

9.3 Covering Exposed Pipe Ends

REHAU recommends the use of a slip-on end cap to close off the casing after the OWB pipe penetrates the building wall. In most cases, the OWB pipe can be routed through the building penetration first and stripped afterwards. However, if the slip-on end cap will be located within the building wall, the outer casing and foam insulation should be stripped back before the pipe is laid in the trench and routed through the building wall.

Fig. 11: Slip-on end cap

Slip-on end caps improve the cosmetic appearance on the ends of OWB pipes inside a building or chamber. They are not watertight and are not certified for burial underground.

To install push-on end caps:
1. Expose carrier pipe in accordance with Section 8
2. Slide on end cap
3. Complete the connection

10. TESTING THE SYSTEM

Before backfilling the trench, pressure test the OWB pipe and connections. The pressure test can be carried out immediately after completing the connections.

10.1 Flushing

1. Verify that the supply and return pipes are correctly connected. The black line on one of the carrier pipes can help you distinguish supply from return.
2. Flush all pipe sections with water or a water/glycol mixture to remove any dirt or debris that may have entered the pipeline during installation.

10.2 Pressure Testing

Perform a pressure test on the system to make sure the OWB pipe and connections are leak-free. When performing the pressure test, ambient air temperature will affect the gauge pressure, so perform all pressure tests at a constant temperature. Test pressures should not exceed 150 psi (10 bar).

Note: If there is a chance that the water could freeze, fill the system with a water/glycol mixture or perform an air test.

REHAU recommends the following pressure test procedure for pipe and fittings:
1. Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure, or 100 psi (6.9 bar), for 30 minutes.
2. As the piping expands, restore pressure, first at 10 minutes and again at 20 minutes into the test.
3. At the end of the 30-minute preliminary test, pressure must not fall by more than 5 psi (0.3 bar) from the maximum, and there must be no leakage.
4. Perform the main pressure test immediately. The main pressure test must last at least 2 hours. The test pressure must be restored and must not fall more than 3 psi (0.2 bar) after 2 hours. There must be no leakage.

Record the following test data and provide it to the building owner:
- Installation/project details including pipe length (interval markings on the pipe can help you calculate total length)
- Test pressure
- Time the pipeline was under pressure
- Test date
- Confirmation that the pressure test has been performed properly

11. BACKFILLING THE TRENCH

Cover the installation of OWB pipe with backfill as soon as possible to help protect the pipe from flooding, shifting, UV exposure, vandalism or damage due to temperature extremes. Refer to the trench diagram in Section 6.2.

1. Surround the pipe with a minimum of 4 in. (10 cm) of sand.

Note: Native soil can be used for the remaining fill, as long as there are no large, frozen or sharp objects such as rocks or debris greater than 1 1/2 in. (4 cm) in diameter.

2. Add 2 in. (5 cm) of the fill material by hand for a total height of at least 6 in. (15 cm) above the OWB pipe.
3. Continue filling and compacting the trench using a mechanical device to 12 in. (30 cm) below the surface, taking care not to disturb the pipe.
4. Install Caution Identification Tape to improve pipeline identification during future excavation work.
5. Complete the backfilling and compacting to the surface level.

Table 5: RAUPEX Pipes With 100% Water

Flow Rate GPM	Flow Velocity ft/sec		ft head loss per 100 ft RAUPEX pipe 60°F (16°C)		100°F (38°C)		140°F (60°C)	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
0.2	0.11	0.07	0.01	<.01	0.01	<.01	0.01	<.01
0.3	0.16	0.11	0.03	0.01	0.02	<.01	0.02	<.01
0.4	0.21	0.14	0.04	0.02	0.04	0.01	0.03	0.01
0.5	0.27	0.18	0.06	0.02	0.06	0.02	0.05	0.02
0.6	0.32	0.21	0.09	0.03	0.08	0.03	0.07	0.03
0.7	0.37	0.25	0.11	0.04	0.10	0.04	0.09	0.04
0.8	0.43	0.29	0.15	0.06	0.13	0.05	0.12	0.05
0.9	0.48	0.32	0.18	0.07	0.16	0.06	0.15	0.06
1	0.53	0.36	0.22	0.08	0.19	0.07	0.18	0.07
1.1	0.59	0.39	0.26	0.10	0.23	0.09	0.21	0.08
1.2	0.64	0.43	0.30	0.12	0.27	0.10	0.25	0.09
1.3	0.69	0.46	0.35	0.13	0.31	0.12	0.29	0.11
1.4	0.75	0.50	0.40	0.15	0.35	0.14	0.33	0.12
1.5	0.80	0.54	0.45	0.17	0.40	0.15	0.37	0.14
1.6	0.85	0.57	0.50	0.19	0.45	0.17	0.41	0.16
1.7	0.91	0.61	0.56	0.21	0.50	0.19	0.46	0.18
1.8	0.96	0.64	0.62	0.24	0.55	0.21	0.51	0.20
1.9	1.01	0.68	0.68	0.26	0.61	0.23	0.56	0.22
2	1.07	0.71	0.75	0.29	0.67	0.26	0.62	0.24
2.5	1.33	0.89	1.12	0.43	1.00	0.38	0.92	0.35
3	1.60	1.07	1.55	0.59	1.38	0.53	1.28	0.49
4	2.13	1.43	2.59	0.99	2.31	0.89	2.14	0.82
5	2.67	1.79	3.86	1.48	3.45	1.32	3.20	1.22
6	3.20	2.14	5.35	2.05	4.79	1.83	4.44	1.70
7	3.73	2.50	7.06	2.70	6.32	2.42	5.86	2.24
8	4.27	2.86	8.97	3.43	8.04	3.08	7.45	2.85
9	4.80	3.22	11.1	4.24	9.94	3.80	9.21	3.52
10	5.34	3.57	13.4	5.13	12.0	4.60	11.1	4.26
11	5.87	3.93	15.9	6.08	14.3	5.45	13.2	5.05
12	6.40	4.29	18.6	7.11	16.7	6.38	15.5	5.91
13	6.94	4.65	21.5	8.21	19.3	7.37	17.9	6.83
14	7.47	5.00	24.5	9.38	22.0	8.42	20.4	7.81
15	8.00	5.36	27.8	10.6	25.0	9.54	23.2	8.84
16	8.54	5.72	31.2	11.9	28.0	10.7	26.0	9.94
17	9.07	6.08	34.8	13.3	31.3	12.0	29.0	11.1
18	9.60	6.43	38.6	14.7	34.7	13.3	32.2	12.3
19	10.1	6.79	42.5	16.3	38.2	14.6	35.5	13.6
20	10.7	7.15	46.6	17.8	41.9	16.0	39.0	14.9
22		7.86		21.2		19.0		17.7
24		8.58		24.8		22.3		20.7
26		9.29		28.6		25.7		23.9
28		10.0		32.7		29.4		27.3
30		10.7		37.0		33.3		31.0

Table 6: RAUPEX Pipes With 80% Water / 20% Polypropylene Glycol

Flow Rate GPM	Flow Velocity ft/sec		ft head loss per 100 ft RAUPEX pipe 60°F (16°C)		100°F (38°C)		140°F (60°C)	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
0.2	0.11	0.07	0.01	<.01	0.01	<.01	0.01	<.01
0.3	0.16	0.11	0.03	0.01	0.02	<.01	0.02	<.01
0.4	0.21	0.14	0.04	0.02	0.04	0.01	0.04	0.01
0.5	0.27	0.18	0.07	0.02	0.06	0.02	0.05	0.02
0.6	0.32	0.21	0.09	0.03	0.08	0.03	0.07	0.03
0.7	0.37	0.25	0.12	0.05	0.11	0.04	0.10	0.04
0.8	0.43	0.29	0.15	0.06	0.13	0.05	0.12	0.05
0.9	0.48	0.32	0.19	0.07	0.16	0.06	0.15	0.06
1	0.53	0.36	0.22	0.09	0.20	0.08	0.18	0.07
1.1	0.59	0.39	0.27	0.10	0.24	0.09	0.22	0.08
1.2	0.64	0.43	0.31	0.12	0.28	0.11	0.25	0.10
1.3	0.69	0.46	0.36	0.14	0.32	0.12	0.29	0.11
1.4	0.75	0.50	0.41	0.16	0.36	0.14	0.33	0.13
1.5	0.80	0.54	0.46	0.18	0.41	0.16	0.38	0.14
1.6	0.85	0.57	0.52	0.20	0.46	0.18	0.42	0.16
1.7	0.91	0.61	0.58	0.22	0.51	0.20	0.47	0.18
1.8	0.96	0.64	0.64	0.25	0.57	0.22	0.52	0.20
1.9	1.01	0.68	0.70	0.27	0.63	0.24	0.58	0.22
2	1.07	0.71	0.77	0.30	0.69	0.26	0.63	0.24
2.5	1.33	0.89	1.15	0.44	1.02	0.39	0.94	0.36
3	1.60	1.07	1.59	0.61	1.42	0.54	1.31	0.50
4	2.13	1.43	2.67	1.02	2.38	0.91	2.20	0.84
5	2.67	1.79	3.98	1.52	3.55	1.36	3.28	1.25
6	3.20	2.14	5.52	2.11	4.92	1.88	4.55	1.74
7	3.73	2.50	7.27	2.78	6.50	2.49	6.01	2.30
8	4.27	2.86	9.24	3.54	8.26	3.16	7.64	2.92
9	4.80	3.22	11.4	4.37	10.2	3.91	9.45	3.61
10	5.34	3.57	13.8	5.28	12.3	4.72	11.4	4.37
11	5.87	3.93	16.4	6.27	14.7	5.60	13.6	5.18
12	6.40	4.29	19.2	7.33	17.1	6.55	15.9	6.06
13	6.94	4.65	22.1	8.46	19.8	7.57	18.3	7.01
14	7.47	5.00	25.3	9.67	22.6	8.65	21.0	8.01
15	8.00	5.36	28.6	10.9	25.6	9.80	23.7	9.07
16	8.54	5.72	32.1	12.3	28.8	11.0	26.7	10.2
17	9.07	6.08	35.9	13.7	32.1	12.3	29.8	11.4
18	9.60	6.43	39.7	15.2	35.6	13.6	33.0	12.6
19	10.1	6.79	43.8	16.7	39.3	15.0	36.4	13.9
20	10.7	7.15	48.1	18.4	43.1	16.5	40.0	15.3
22		7.86		21.8		19.6		18.1
24		8.58		25.5		22.9		21.2
26		9.29		29.5		26.4		24.5
28		10.0		33.7		30.2		28.0
30		10.7		38.2		34.2		31.8

Table 7: RAUPEX Pipes With 70% Water / 30% Polypropylene Glycol

Flow Rate GPM	Flow Velocity ft/sec		ft head loss per 100 ft RAUPEX pipe 60°F (16°C)		100°F (38°C)		140°F (60°C)	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
0.2	0.107	0.071	0.013	<.01	0.011	<.01	0.010	<.01
0.3	0.160	0.107	0.027	0.010	0.023	<.01	0.022	<.01
0.4	0.213	0.143	0.044	0.017	0.039	0.015	0.036	0.014
0.5	0.267	0.179	0.066	0.025	0.058	0.022	0.054	0.021
0.6	0.32	0.21	0.09	0.03	0.08	0.03	0.07	0.03
0.7	0.37	0.25	0.12	0.05	0.11	0.04	0.10	0.04
0.8	0.43	0.29	0.15	0.06	0.13	0.05	0.12	0.05
0.9	0.48	0.32	0.19	0.07	0.17	0.06	0.15	0.06
1	0.53	0.36	0.23	0.09	0.20	0.08	0.18	0.07
1.1	0.59	0.39	0.27	0.10	0.24	0.09	0.22	0.08
1.2	0.64	0.43	0.31	0.12	0.28	0.11	0.26	0.10
1.3	0.69	0.46	0.36	0.14	0.32	0.12	0.30	0.11
1.4	0.75	0.50	0.41	0.16	0.37	0.14	0.34	0.13
1.5	0.80	0.54	0.47	0.18	0.41	0.16	0.38	0.15
1.6	0.85	0.57	0.52	0.20	0.47	0.18	0.43	0.16
1.7	0.91	0.61	0.58	0.22	0.52	0.20	0.48	0.18
1.8	0.96	0.64	0.65	0.25	0.57	0.22	0.53	0.20
1.9	1.01	0.68	0.71	0.27	0.63	0.24	0.58	0.22
2	1.07	0.71	0.78	0.30	0.69	0.27	0.64	0.24
2.5	1.33	0.89	1.16	0.45	1.04	0.40	0.95	0.37
3	1.60	1.07	1.61	0.62	1.44	0.55	1.32	0.51
4	2.13	1.43	2.70	1.03	2.40	0.92	2.22	0.85
5	2.67	1.79	4.03	1.54	3.59	1.37	3.31	1.27
6	3.20	2.14	5.58	2.14	4.98	1.91	4.60	1.76
7	3.73	2.50	7.36	2.82	6.57	2.51	6.07	2.32
8	4.27	2.86	9.36	3.58	8.36	3.20	7.72	2.95
9	4.80	3.22	11.6	4.43	10.3	3.95	9.54	3.65
10	5.34	3.57	14.0	5.35	12.5	4.77	11.5	4.41
11	5.87	3.93	16.6	6.35	14.8	5.67	13.7	5.24
12	6.40	4.29	19.4	7.42	17.3	6.63	16.0	6.13
13	6.94	4.65	22.4	8.57	20.0	7.66	18.5	7.08
14	7.47	5.00	25.6	9.79	22.9	8.75	21.2	8.09
15	8.00	5.36	29.0	11.1	25.9	9.91	24.0	9.16
16	8.54	5.72	32.5	12.4	29.1	11.1	27.0	10.3
17	9.07	6.08	36.3	13.9	32.5	12.4	30.1	11.5
18	9.60	6.43	40.2	15.4	36.0	13.8	33.4	12.7
19	10.1	6.79	44.4	17.0	39.7	15.2	36.8	14.0
20	10.7	7.15	48.6	18.6	43.6	16.7	40.4	15.4
22		7.86		22.1		19.8		18.3
24		8.58		25.8		23.1		21.4
26		9.29		29.8		26.7		24.8
28		10.0		34.1		30.6		28.3
30		10.7		38.6		34.6		32.1

Table 8: RAUPEX Pipes With 60% Water / 40% Polypropylene Glycol

Flow Rate GPM	Flow Velocity ft/sec		ft head loss per 100 ft RAUPEX pipe 60ºF (16ºC)		100ºF (38ºC)		140ºF (60ºC)	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
0.2	0.11	0.07	0.01	<.01	0.01	<.01	0.01	<.01
0.3	0.16	0.11	0.03	0.01	0.02	<.01	0.02	<.01
0.4	0.21	0.14	0.04	0.02	0.04	0.02	0.04	0.01
0.5	0.27	0.18	0.07	0.03	0.06	0.02	0.05	0.02
0.6	0.32	0.21	0.09	0.04	0.08	0.03	0.07	0.03
0.7	0.37	0.25	0.12	0.05	0.11	0.04	0.10	0.04
0.8	0.43	0.29	0.15	0.06	0.14	0.05	0.13	0.05
0.9	0.48	0.32	0.19	0.07	0.17	0.06	0.15	0.06
1	0.53	0.36	0.23	0.09	0.20	0.08	0.19	0.07
1.1	0.59	0.39	0.27	0.10	0.24	0.09	0.22	0.08
1.2	0.64	0.43	0.32	0.12	0.28	0.11	0.26	0.10
1.3	0.69	0.46	0.37	0.14	0.32	0.12	0.30	0.11
1.4	0.75	0.50	0.42	0.16	0.37	0.14	0.34	0.13
1.5	0.80	0.54	0.47	0.18	0.42	0.16	0.39	0.15
1.6	0.85	0.57	0.53	0.20	0.47	0.18	0.43	0.17
1.7	0.91	0.61	0.59	0.23	0.52	0.20	0.48	0.18
1.8	0.96	0.64	0.65	0.25	0.58	0.22	0.53	0.20
1.9	1.01	0.68	0.72	0.28	0.64	0.25	0.59	0.23
2	1.07	0.71	0.79	0.30	0.70	0.27	0.64	0.25
2.5	1.33	0.89	1.18	0.45	1.05	0.40	0.96	0.37
3	1.60	1.07	1.63	0.62	1.45	0.56	1.33	0.51
4	2.13	1.43	2.73	1.05	2.43	0.93	2.24	0.86
5	2.67	1.79	4.07	1.56	3.62	1.39	3.34	1.28
6	3.20	2.14	5.64	2.16	5.03	1.92	4.64	1.77
7	3.73	2.50	7.44	2.85	6.63	2.54	6.12	2.34
8	4.27	2.86	9.46	3.62	8.44	3.23	7.79	2.98
9	4.80	3.22	11.7	4.47	10.4	3.99	9.63	3.68
10	5.34	3.57	14.1	5.40	12.6	4.82	11.6	4.45
11	5.87	3.93	16.8	6.41	15.0	5.72	13.8	5.28
12	6.40	4.29	19.6	7.50	17.5	6.69	16.2	6.18
13	6.94	4.65	22.6	8.66	20.2	7.73	18.7	7.14
14	7.47	5.00	25.9	9.89	23.1	8.84	21.4	8.16
15	8.00	5.36	29.3	11.2	26.2	10.0	24.2	9.24
16	8.54	5.72	32.9	12.6	29.4	11.2	27.2	10.4
17	9.07	6.08	36.7	14.0	32.8	12.5	30.3	11.6
18	9.60	6.43	40.7	15.6	36.4	13.9	33.7	12.8
19	10.1	6.79	44.8	17.1	40.1	15.3	37.1	14.2
20	10.7	7.15	49.2	18.8	44.0	16.8	40.7	15.5
22		7.86		22.3		20.0		18.5
24		8.58		26.1		23.4		21.6
26		9.29		30.2		27.0		25.0
28		10.0		34.5		30.9		28.6
30		10.7		39.0		35.0		32.4

Table 9: RAUPEX Pipes With 50% Water / 50% Polypropylene Glycol

Flow Rate GPM	Flow Velocity ft/sec		ft head loss per 100 ft RAUPEX pipe 60ºF (16ºC)		100ºF (38ºC)		140ºF (60ºC)	
	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"	1"	1 1/4"
0.2	0.11	0.07	0.01	<.01	0.01	<.01	0.01	<.01
0.3	0.16	0.11	0.03	0.01	0.02	<.01	0.02	<.01
0.4	0.21	0.14	0.05	0.02	0.04	0.02	0.04	0.01
0.5	0.27	0.18	0.07	0.03	0.06	0.02	0.05	0.02
0.6	0.32	0.21	0.09	0.04	0.08	0.03	0.08	0.03
0.7	0.37	0.25	0.12	0.05	0.11	0.04	0.10	0.04
0.8	0.43	0.29	0.16	0.06	0.14	0.05	0.13	0.05
0.9	0.48	0.32	0.19	0.07	0.17	0.06	0.16	0.06
1	0.53	0.36	0.23	0.09	0.20	0.08	0.19	0.07
1.1	0.59	0.39	0.27	0.11	0.24	0.09	0.22	0.09
1.2	0.64	0.43	0.32	0.12	0.28	0.11	0.26	0.10
1.3	0.69	0.46	0.37	0.14	0.33	0.13	0.30	0.12
1.4	0.75	0.50	0.42	0.16	0.37	0.14	0.34	0.13
1.5	0.80	0.54	0.48	0.18	0.42	0.16	0.39	0.15
1.6	0.85	0.57	0.53	0.21	0.47	0.18	0.44	0.17
1.7	0.91	0.61	0.60	0.23	0.53	0.20	0.49	0.19
1.8	0.96	0.64	0.66	0.25	0.59	0.22	0.54	0.21
1.9	1.01	0.68	0.73	0.28	0.64	0.25	0.59	0.23
2	1.07	0.71	0.80	0.31	0.71	0.27	0.65	0.25
2.5	1.33	0.89	1.19	0.46	1.05	0.40	0.97	0.37
3	1.60	1.07	1.65	0.63	1.46	0.56	1.34	0.51
4	2.13	1.43	2.75	1.06	2.45	0.94	2.25	0.86
5	2.67	1.79	4.11	1.57	3.65	1.40	3.37	1.29
6	3.20	2.14	5.70	2.18	5.07	1.94	4.67	1.79
7	3.73	2.50	7.51	2.88	6.69	2.56	6.17	2.36
8	4.27	2.86	9.55	3.65	8.50	3.25	7.84	3.00
9	4.80	3.22	11.8	4.51	10.5	4.02	9.70	3.71
10	5.34	3.57	14.3	5.46	12.7	4.86	11.7	4.48
11	5.87	3.93	16.9	6.47	15.1	5.77	13.9	5.32
12	6.40	4.29	19.8	7.57	17.7	6.75	16.3	6.23
13	6.94	4.65	22.8	8.74	20.4	7.79	18.8	7.19
14	7.47	5.00	26.1	9.99	23.3	8.91	21.5	8.22
15	8.00	5.36	29.6	11.3	26.4	10.1	24.4	9.31
16	8.54	5.72	33.2	12.7	29.7	11.3	27.4	10.5
17	9.07	6.08	37.0	14.2	33.1	12.6	30.6	11.7
18	9.60	6.43	41.0	15.7	36.7	14.0	33.9	12.9
19	10.1	6.79	45.2	17.3	40.4	15.4	37.4	14.3
20	10.7	7.15	49.6	19.0	44.4	16.9	41.0	15.7
22		7.86		22.5		20.1		18.6
24		8.58		26.4		23.6		21.8
26		9.29		30.4		27.2		25.2
28		10.0		34.8		31.1		28.8
30		10.7		39.4		35.3		32.6

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