```
data TIO ⟨l_can, l_do⟩ a =
  TIO ( l : { l_do ⊑ l } → ({ l' : l ⊓ l_can ⊑ l' }, a) )
```

```
get :: Field ⟨l_f⟩ V → TIO ⟨l_f, ⊥⟩ a
get (Field l_f a) = TIO $ \W l sto →
  let l' = l ⊓ l_f in
  (W l' sto, sel sto a)
```

by def of ⊓

$$\frac{}{l \sqcap l_f \sqsubseteq l'}$$

```
set :: Field ⟨lf⟩ V → V → TIO ⟨T, lf⟩ ()
set (Field lf a) V = TIO $ \W l sto →
  if lf ⊆ l then
    (W l (upd sto a v) , ())
  else
    assert false "IFC EXCEPTION"
```

1 2

$$\frac{}{L \sqcap T \subseteq L}\ 2$$

← dead code as (1)

```
bind :: ∀ l2' ⊆ l1'. (0)
    TIO ⟨l1, l1'⟩ a
  → (a → TIO ⟨l2, l2'⟩ b)
  → (TIO ⟨l1 ⊓ l2, l1' ⊔ l2'⟩ b)

bind (TIO f1) k2 = TIO $ \l →
  let (l', v1) = f1 l        1
      TIO f2   = k2 v1
      (l'', v2) = f2 l'      2
  in
  (l'', v2)                  3
```

$l \longrightarrow l$

$l \longrightarrow l \sqcap l_1$

$l \longrightarrow l \sqcap l_1 \sqcap l_2$

$$\frac{l_1' \sqcup l_2' \subseteq l}{l_1' \subseteq l}\ (1)\ \text{pre}$$

$l_1' \sqcup l_2' \subseteq l$

$\therefore\ l_2' \subseteq l$

$\therefore\ l \sqcap l_2' = l_2'$ (*)

as $l_2' \subseteq l_1$ (0)

$l \sqcap l_1 \subseteq l'$ (1) post

$\therefore\ l \sqcap l_2' \subseteq l'$

by (*)

$$\frac{}{l_2' \subseteq l'}\ (2)\ \text{pre}$$

$$\frac{\begin{array}{ll} l \sqcap l_1 \subseteq l' & (f_1\ l) \\ l' \sqcap l_2 \subseteq l'' & (f_2\ l') \end{array}}{l \sqcap (l_1 \sqcap l_2) \subseteq l''}\ (3)$$