

Make `std::make_from_tuple` SFINAE friendly

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1 Introduction

This paper introduce constraints for `std::make_from_tuple` to make it SFINAE friendly.

2 Motivation

[LWG3528] introduce constraints:

```
template<class T, class Tuple, size_t... I>
    requires is_constructible_v<T, decltype(get<I>(declval<Tuple>()))...>
constexpr T make-from-tuple-impl(Tuple&& t, index_sequence<I...>) { // exposition only
    return T(get<I>(std::forward<Tuple>(t))...);
}
```

When someone write SFINAE code like the following to check whether T can constructed from a tuple, they may hit hard errors like “no matching function for call to `make-from-tuple-impl`”.

```
template <class T, class Tuple, class = void>
inline constexpr bool has_make_from_tuple = false;

template <class T, class Tuple>
inline constexpr bool has_make_from_tuple<T, Tuple,
    T, Tuple,
    std::void_t<decltype(std::make_from_tuple<T>(std::declval<Tuple>()))>> =
    true;

struct A {
    int a;
};

static_assert(!has_make_from_tuple<int *, std::tuple<A *>>);
```

Even If the effects are *Equivalent* to calling a constrained function, the constraints has not apply to `std::make_from_tuple`.

This is somehow unclear when the constraints are not literally specified with *Constraints* in the standard wording (16.3.2.4 [structure.specifications]). At least *Equivalent* to doesn't propagate every substitution failure in immediate context. In the case of `make-from-tuple-impl`, the constraints were introduced via a *requires*-clause but not literal *Constraints*. Some implementors believed the *requires*-clause should be treated same as *Constraints*, but this is not explicitly stated.

3 Impact on the Standard

This proposal is a pure library improvement.

4 Implementation Experience

I've implemented this improvement in `libc++`, `microsoft/STL`, `libstdc++`.

5 Proposed Wording

Modify section 22.4.6 [tuple.apply] as indicated:

```
template<class T, tuple-like Tuple>
constexpr T make_from_tuple(Tuple&& t);
```

Mandates: If `tuple_size_v<remove_reference_t<Tuple>>` is 1, then `reference_constructs_from_temporary_v<T, decltype(get<0>(declval<Tuple>()))>` is false.

Let `I` be the pack `0, 1, ..., (tuple_size_v<remove_reference_t<Tuple>> - 1)`.

Constraints:

- `is_constructible_v<T, decltype(get<I>(declval<Tuple>()))...>` is true.
- If `tuple_size_v<remove_reference_t<Tuple>>` is 1, then `reference_constructs_from_temporary_v<T, decltype(get<0>(declval<Tuple>()))>` is false.

Effects: Given the exposition-only function template:

```
namespace std {
    template<class T, tuple-like Tuple, size_t... I>
        requires is_constructible_v<T, decltype(get<I>(declval<Tuple>()))...>
        constexpr T make-from-tuple-impl(Tuple&& t, index_sequence<I...>) { // exposition only
            return T(get<I>(std::forward<Tuple>(t))...);
        }
}
```

Equivalent to:

```
return make-from-tuple-impl<T>(
    std::forward<Tuple>(t),
    make_index_sequence<tuple_size_v<remove_reference_t<Tuple>>{}>());
```

[*Note:* Note 1: The type of `T` must be supplied as an explicit template parameter, as it cannot be deduced from the argument list. - end note — *end note*]

6 Acknowledgements

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7 References

[LWG3528] Tim Song. `make_from_tuple` can perform (the equivalent of) a C-style cast.
<https://wg21.link/lwg3528>