# Assertion-Control Objects (P3400R4)

## P4275R0 (for EWG)

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  - Each dimension of behavior is called a **facet**

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- *"mylib::pointers"*group is a user-defined literal operator from <contracts>

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  - `opt` will generally default to checked
  - `audit` will require explicit opt-in

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- It changes the semantic to *observe* when an enforcing semantic would have been chosen

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```
void f(int *begin, int *end)
  pre<audit | review>( std::is_sorted(begin,end) );
    // Slow check is on in only some builds
    // and is observed in those builds.
```

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- `terminating` is not a keyword — it resolves to a **`constexpr`** variable from `<contracts>`

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- Same guarantee as existing hardened preconditions
- Implementation can base behavior on its own configuration macros or intrinsics

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- With this label, behavior is the same as with no assertion-control object

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```
namespace std::contracts::labels {
struct review_t {
  using assertion_control_object = review_t;

  constexpr evaluation_semantic
  compute_semantic(evaluation_semantic in) const {
    if (is_terminating(in))
      return evaluation_semantic::observe;
    return in;
  }
};
constexpr review_t review{};
}
```

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```
namespace std::contracts::labels {
template <evaluation_semantic... allowed>
struct allowed_semantics_t {
  using assertion_control_object
                        = allowed_semantics_t<allowed...>;
  static constexpr evaluation_semantic_set
    allowed_semantics = {allowed...};
};
constexpr allowed_semantics_t<
    evaluation_semantic::quick_enforce,
    evaluation_semantic::enforce> terminating;
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- **Reuse Name Lookup**: `contract_control(` *expression* `)`
  - same name lookup, outside assertion-control expressions

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  - `query` — identify labels (and extract information) from the violation handler

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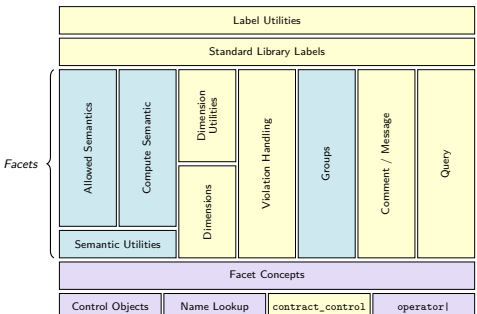


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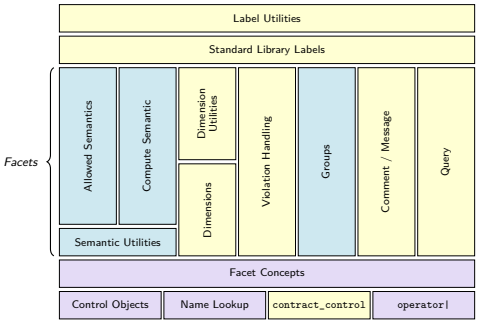


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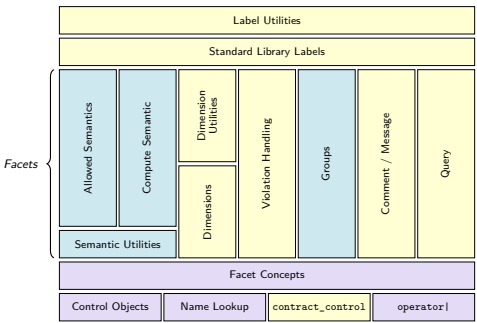


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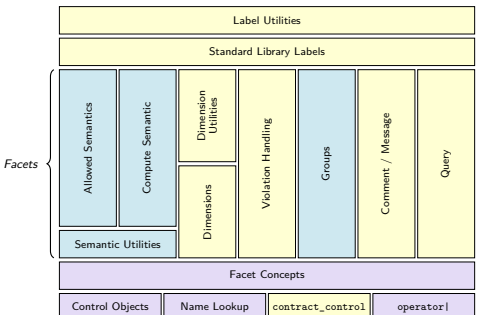


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- Needed for C++29 — Priority facets

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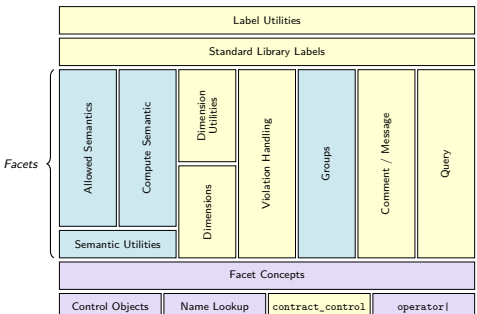


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- Framework — Central language feature
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- Additional enhancements — Further facets and standardizing expected uses

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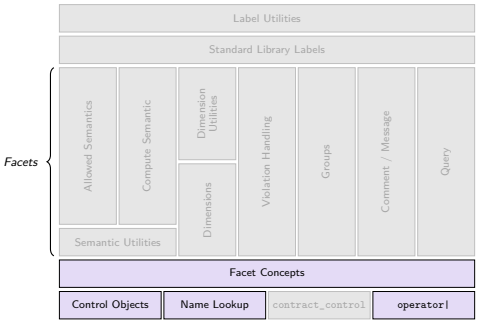


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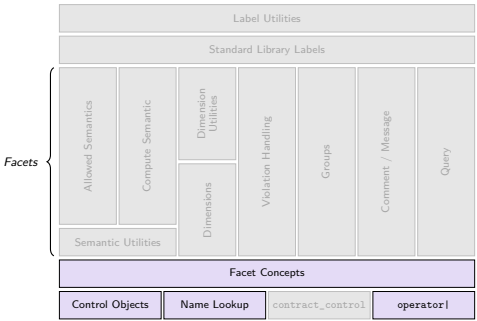


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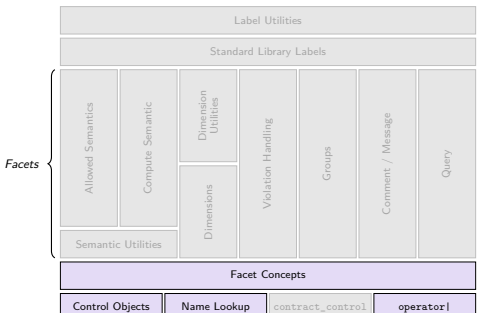


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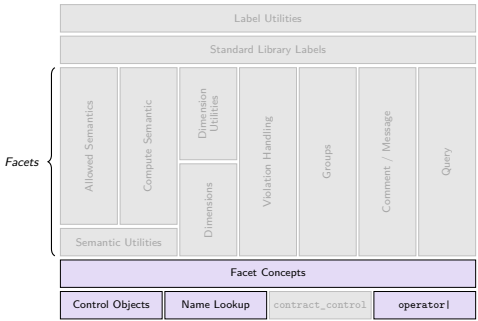


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- Short names for common labels through name lookup
- Combining labels with `operator|`

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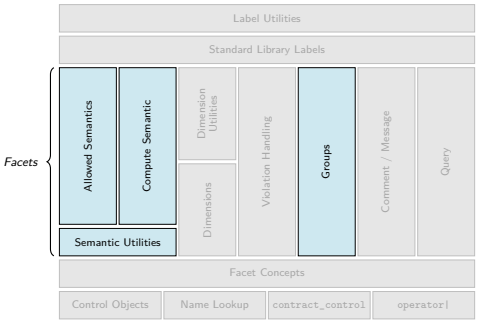


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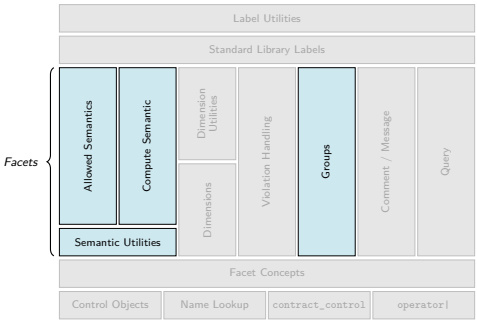


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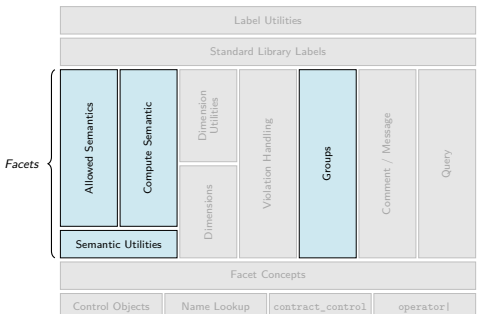


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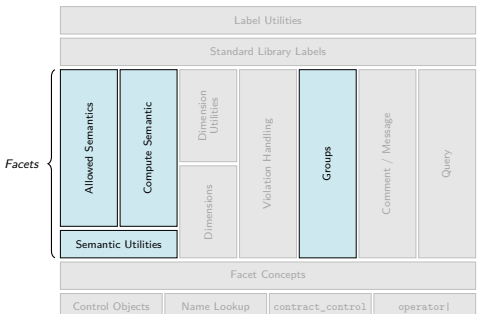


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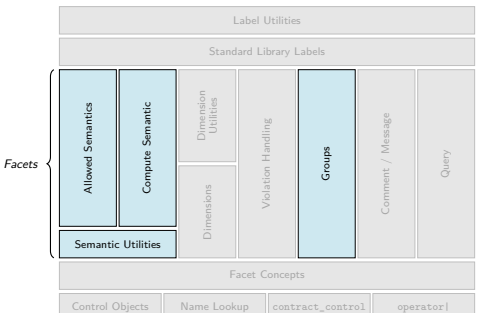


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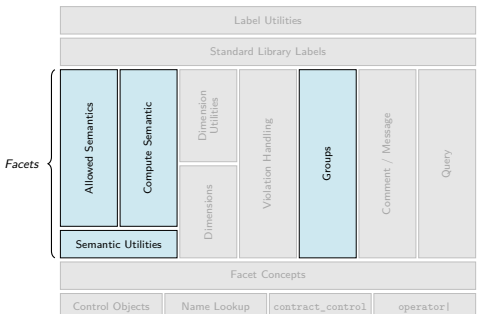


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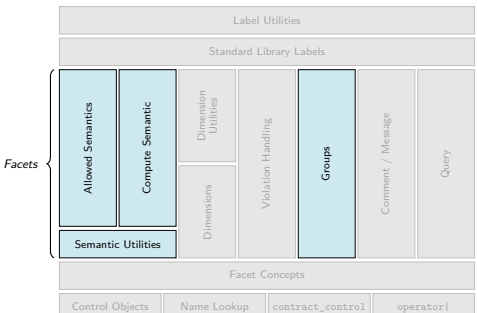


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- Most commonly cited missing features of C++26 Contracts

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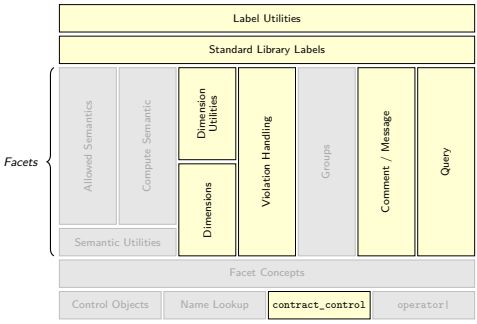


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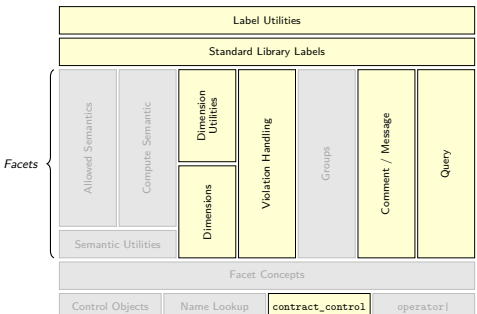


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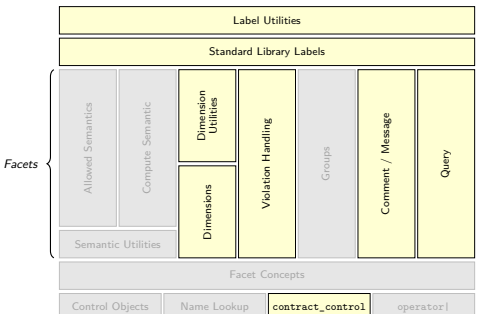


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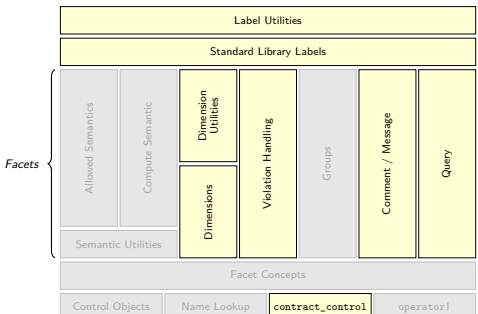


**Additional Enhancements**

- Many orthogonal features building on the framework
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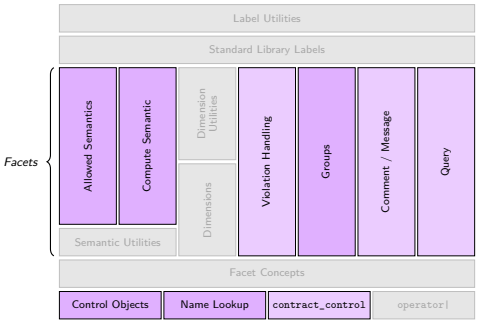
- Incremental adoption in any order is feasible

# Core-Language Features




**EWG (Core Language)**[a]

[a] Mauve selected as official EWG color by Erich Keane

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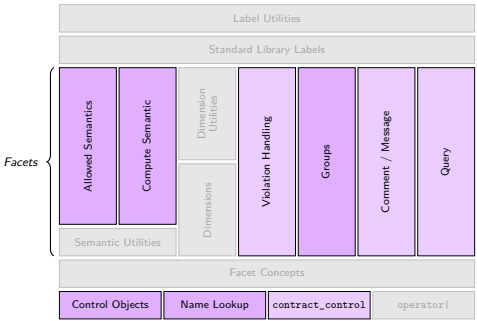


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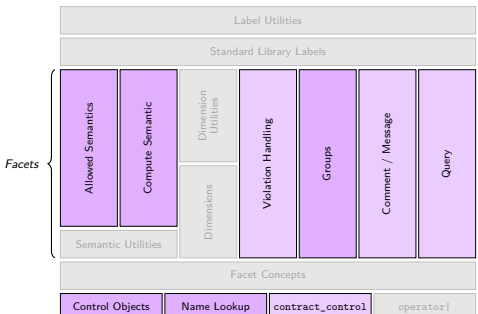


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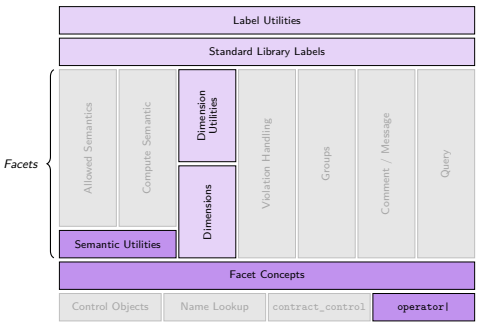


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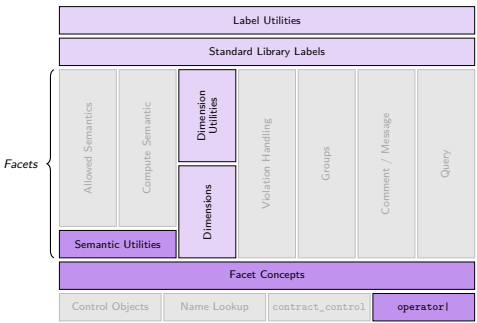


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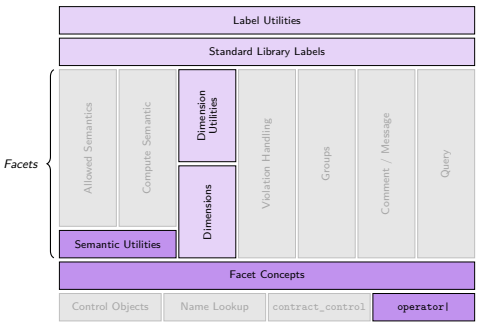


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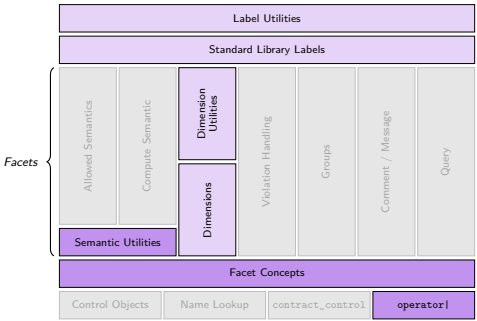


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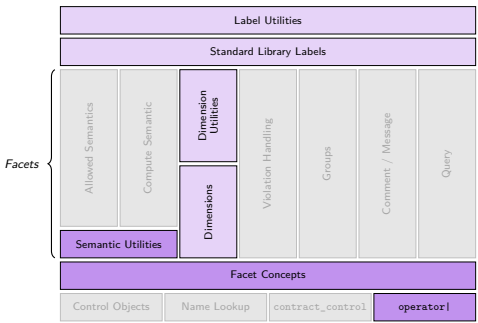


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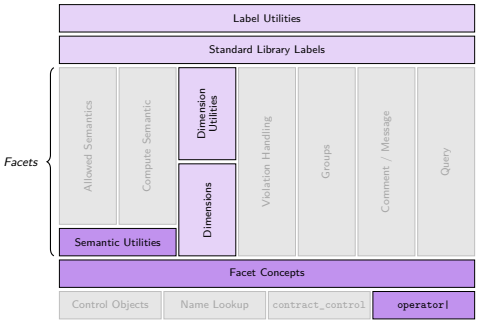


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```
void g(int *p)
  pre(p != nullptr);  // equivalent to pre<empty_label>(...)
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pre<opt | audit>(...)  // Error: overlapping dimensions
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template <typename T>
concept allowed_semantics_label =
  assertion_control_object<T> &&
  requires (const T t) {
    requires std::is_const_v<decltype(T::allowed_semantics)>;
    evaluation_semantic_set({t.allowed_semantics});
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- The `semantic_computation_label` concept:

```
template <typename T>
concept semantic_computation_label =
  assertion_control_object<T> &&
  requires(const T t, evaluation_semantic s) {
    evaluation_semantic(t.compute_semantic(s));
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```
constexpr evaluation_semantic
compute_semantic(evaluation_semantic in) const {
#if _LIBCPP_ASSERTION_SEMANTIC == ...
  return evaluation_semantic::quick_enforce;
#else
  return in;
#endif
}
```

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- Entirely implemented in the Standard Library (constraints on `operator|`)

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- Combined labels: sorted, unique union of group names
- Implementations document how groups interact with command-line configuration

# Groups

- The `identification_label` concept lets a label list, by name, the groups it belongs to:

```
template <typename T>
concept identification_label =
  assertion_control_object<T> &&
  requires (const T t) {
    { t.group_names } -> std::ranges::range;
    { *(std::ranges::begin(t.group_names)) }
        -> std::convertible_to<std::string_view>;
  };
```

- Combined labels: sorted, unique union of group names
- Implementations document how groups interact with command-line configuration
- Static-analysis tools can use groups to selectively analyze assertions

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```
{ group="important" semantic="quick-enforce" }
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```

- Applied to assertions:

```
auto important = "important"group;
auto testing_only = "testing_only"group;

void f(...)
  pre<important>    (...)  // quick-enforce
  pre<testing_only> (...)  // ignore
  pre               (...); // enforce
```

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- The `local_violation_label` concept:

```
template <typename T>
concept local_violation_label =
  assertion_control_object<T> &&
  requires(std::remove_const_t<T> t,
           const contract_violation& v) {
    t.handle_contract_violation(v);
  };
```

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- Combined labels: handlers invoked right to left
- Example — rethrow `bad_alloc`:

```
struct rethrow_bad_alloc_t {
  using assertion_control_object = rethrow_bad_alloc_t;

  std::integral_constant<violation_handled,
                         violation_handled::not_handled>
  handle_contract_violation(
                       const contract_violation& v) {
    if (v.detection_mode()
                == detection_mode::evaluation_exception) {
      try { throw; }
      catch (const std::bad_alloc&) { throw; }
      catch (...) {}
```

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- Combined labels: functions chained left to right
- Can leverage `define_static_string` (P3491R3) for dynamic compile-time strings

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```
template <typename T>
concept queryable_label =
  assertion_control_object<T> &&
  requires (const T t, const void *key,
            std::size_t index) {
    { t.query(key,index) } -> std::same_as<void*>;
  };
```

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- Example: an `owner_label` carrying name and address:

```
if (auto* name = violation.query_control_object(
                     &owner_label::name_key)) {
  // send notification to owner
}
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- Makes label names available unqualified in assertion-control expressions
- Does *not* pollute the enclosing namespace
- Users can also use `contract_control(expr)` to get the same lookup outside assertions

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- **Concept variable templates**:
  - `is_assertion_control_object<obj>`, etc.

# Conclusion

Please discuss.