

# Validation Rules Catalog - Reference Documentation

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# Validation Rules Catalog - Reference Documentation

## Overview

The ISWC Platform implements **95+ validation rules** across two pipeline stages:

Pipeline Stage	Rule Count	Rule Prefixes	Error Code Range
ValidationPipeline	73+ rules	IV_, MD_, EL_, PV_	_100 to _126
PostMatchingPipeline	22 rules	PV_*, IV_40	_127 to _153, _247

### Rule Types:

- **IRule**: Single-submission validation (most rules)
- **IBatchRule**: Batch-level validation (interface defined but **not implemented**)
- **IAlwaysOnRule**: Always-executed rules (cannot be disabled)
- **Configurable Rules**: Can be enabled/disabled via IRulesManager

## Quick Reference: Rule Categories

### ValidationPipeline (Pre-Processing)

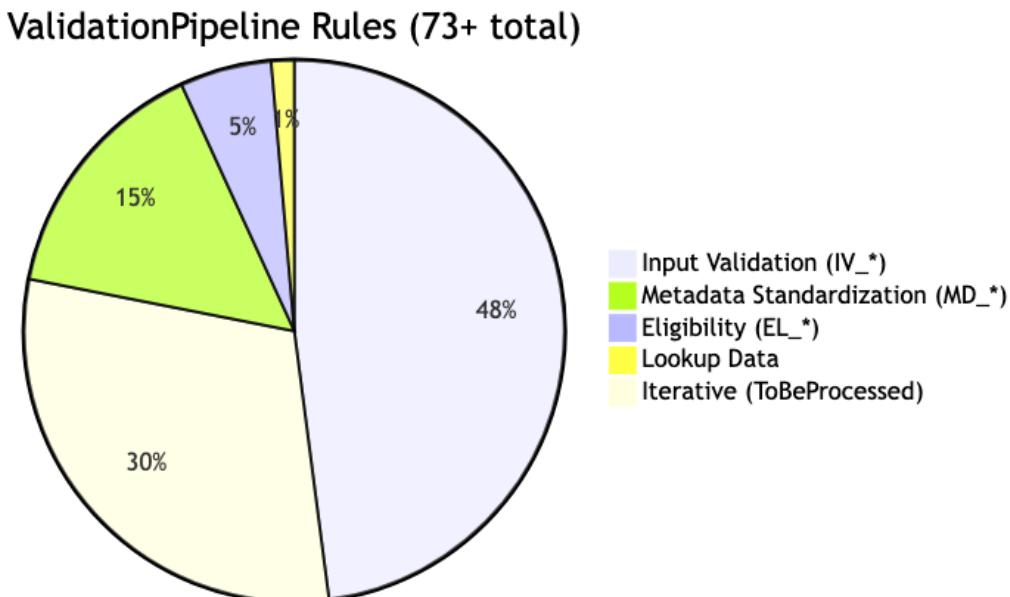


Diagram 1

## PostMatchingPipeline (Post-Processing)

### PostMatchingPipeline Rules (22 total)

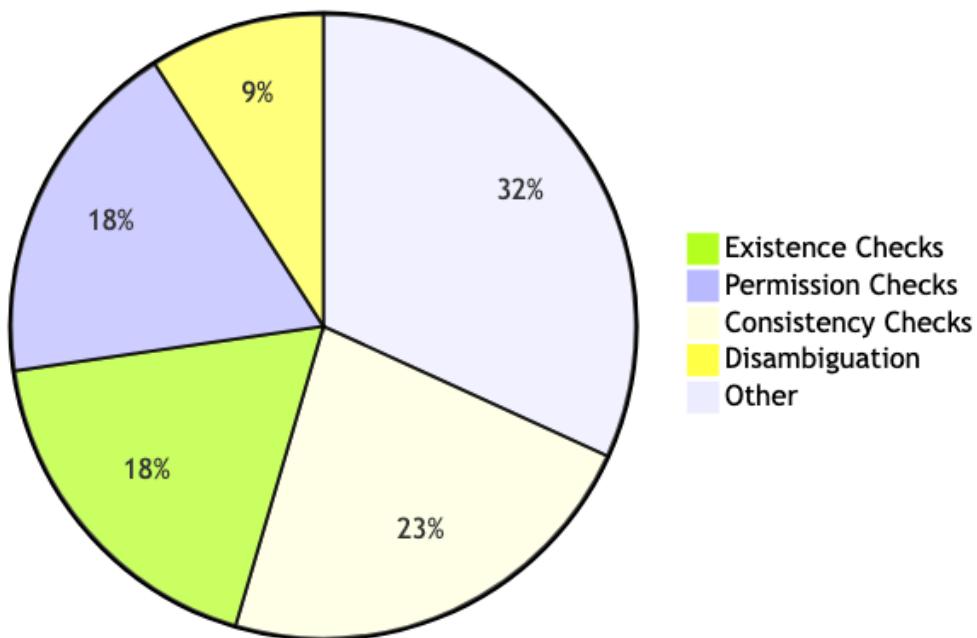


Diagram 2

## ValidationPipeline Rules

### StaticDataValidator (35 rules - IV\_\*)

**Purpose:** Input validation for submission data integrity

Rule	Transaction Types	Purpose	Error Code	Always On?
IV_02	CAR, CUR	Must have one interested party	_101	Configurable ( MustHaveOneIP )
IV_05	CAR, CUR	Must have original title	_102	<input checked="" type="checkbox"/> Yes
IV_06	CAR, CUR	Original title length validation	_103	<input checked="" type="checkbox"/> Yes
IV_07	CAR, CUR	Title type validation	_104	<input checked="" type="checkbox"/> Yes
IV_08	CAR, CUR	IP name validation	_105	<input checked="" type="checkbox"/> Yes
IV_09	CAR, CUR	IP role validation	_106	<input checked="" type="checkbox"/> Yes
IV_10	CAR, CUR	IP shares validation	_107	<input checked="" type="checkbox"/> Yes
IV_11	CAR, CUR	Work number format	_108	<input checked="" type="checkbox"/> Yes
IV_12	CAR, CUR	Agency code validation	_109	<input checked="" type="checkbox"/> Yes

<b>IV_13</b>	CAR, CUR	Date format validation	_110	<input checked="" type="checkbox"/> Yes
<b>IV_14</b>	CAR, CUR	Creation date range	_111	<input checked="" type="checkbox"/> Yes
<b>IV_15</b>	CAR, CUR, CDR, MER, DMR	Transaction type required	_112	<input checked="" type="checkbox"/> Yes
<b>IV_16</b>	CAR, CUR	Duration validation	_113	<input checked="" type="checkbox"/> Yes
<b>IV_17</b>	CAR, CUR	Language code validation	_114	<input checked="" type="checkbox"/> Yes
<b>IV_18</b>	CAR, CUR	Territory code validation	_115	<input checked="" type="checkbox"/> Yes
<b>IV_19</b>	CAR, CUR	IP type validation	_116	<input checked="" type="checkbox"/> Yes
<b>IV_20</b>	CAR, CUR	IP share total = 100%	_117	<input checked="" type="checkbox"/> Yes
<b>IV_21</b>	CDR	Work number required for delete	_118	<input checked="" type="checkbox"/> Yes
<b>IV_22</b>	MER, DMR	ISWC format validation	_119	<input checked="" type="checkbox"/> Yes
<b>IV_23</b>	CUR	Preferredlswc required for update	_120	<input checked="" type="checkbox"/> Yes
<b>IV_24</b>	CAR, CUR	Duplicate IP check	_121	<input checked="" type="checkbox"/> Yes
<b>IV_25</b>	CAR, CUR	Invalid characters in title	_122	<input checked="" type="checkbox"/> Yes
<b>IV_26</b>	CAR, CUR	Invalid characters in IP name	_123	<input checked="" type="checkbox"/> Yes
<b>IV_27</b>	CAR, CUR	IP shares must be positive	_124	<input checked="" type="checkbox"/> Yes
<b>IV_28</b>	CAR, CUR	At least one writer IP	_125	<input checked="" type="checkbox"/> Yes
<b>IV_29</b>	CAR, CUR	Publisher code format	_126	<input checked="" type="checkbox"/> Yes
<b>IV_30</b>	CAR, CUR	Additional identifier validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_31</b>	CAR, CUR	Instrumentation validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_32</b>	CAR, CUR	Recording validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_33</b>	CAR, CUR	ISRC format validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_34</b>	CAR, CUR	Embargo date validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_35</b>	CAR, CUR	Public request validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_36</b>	CAR, CUR	Pseudonym validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_37</b>	CAR, CUR	Group member validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_38</b>	CAR, CUR	Authoritative flag validation	(TBD)	<input checked="" type="checkbox"/> Yes
<b>IV_39</b>	CAR, CUR	Disambiguation validation	(TBD)	<input checked="" type="checkbox"/> Yes

**Note:** IV\_30 through IV\_39 rules exist but were not read during analysis. Error codes marked as (TBD).

### Key Patterns:

- **Configurable Rule Example (IV\_02):**

```
var paramValue = await rulesManager.GetParameterValue<bool>("MustHaveOneIP");
if (paramValue && !submission.Model.InterestedParties.Any())
{
    submission.Rejection = await
        messagingManager.GetRejectionMessage(ErrorCode._101);
    return (false, submission);
}
```

```

var originalTitle = submission.Model.Titles.FirstOrDefault(t => t.Type == TitleType.OT);
if (originalTitle == null || string.IsNullOrWhiteSpace(originalTitle.Name))
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._102);
    return (false, submission);
}

```

## MetadataStandardizationValidator (11 rules - MD\_\*)

**Purpose:** Standardize and normalize metadata before matching

Rule	Transaction Types	Purpose	Error Code	Always On?
MD_01	CAR, CUR	Standardize title (remove punctuation, lowercase)	N/A	<input checked="" type="checkbox"/> Yes
MD_02	CAR, CUR	Normalize IP names (trim whitespace)	N/A	<input checked="" type="checkbox"/> Yes
MD_03	CAR, CUR	Standardize language codes (ISO 639)	N/A	<input checked="" type="checkbox"/> Yes
MD_04	CAR, CUR	Standardize territory codes (ISO 3166)	N/A	<input checked="" type="checkbox"/> Yes
MD_05	CAR, CUR	Remove duplicate titles (case-insensitive)	N/A	<input checked="" type="checkbox"/> Yes
MD_06	CAR, CUR	Normalize IP shares (decimal precision)	N/A	<input checked="" type="checkbox"/> Yes
MD_07	CAR, CUR	Standardize date formats	N/A	<input checked="" type="checkbox"/> Yes
MD_08	CAR, CUR	Normalize ISWC format (T-XXX.XXX.XXX-C)	N/A	<input checked="" type="checkbox"/> Yes
MD_09	CAR, CUR	Standardize work number format	N/A	<input checked="" type="checkbox"/> Yes
MD_10	CAR, CUR	Clean instrumentation codes	N/A	<input checked="" type="checkbox"/> Yes
MD_11	CAR, CUR	Normalize publisher codes	N/A	<input checked="" type="checkbox"/> Yes

**Note:** MD\_\* rules typically do not reject submissions; they transform data in place.

### Key Patterns:

- **In-place transformation:** Rules modify `submission.Model` directly
- **No error codes:** Standardization rules cannot fail (only transform)
- **Idempotent:** Multiple executions produce same result

## LookupDataValidator (1 rule)

**Purpose:** Validate agency and publisher codes against reference data

Rule	Transaction Types	Purpose	Error Code	Always On?
LD_01	CAR, CUR	Agency code exists in reference data	_109 (reused)	<input checked="" type="checkbox"/> Yes

**Implementation:**

```
var agency = await agencyRepository.FindAsync(submission.Model.Agency);
if (agency == null)
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._109);
    return (false, submission);
}
```

## IsWCEligibilityValidator (4 rules - EL\_\*)

**Purpose:** Determine if submission is eligible for ISWC assignment

Rule	Transaction Types	Purpose	Error Code	Always On?
EL_01	CAR, CUR	Check authoritative agency eligibility	N/A	<input checked="" type="checkbox"/> Yes
EL_02	CAR, CUR	Check IP authoritative flags	N/A	<input checked="" type="checkbox"/> Yes
EL_03	CAR, CUR	Check eligible transaction types	N/A	<input checked="" type="checkbox"/> Yes
EL_04	CAR, CUR	Calculate final IsEligible flag	N/A	<input checked="" type="checkbox"/> Yes

**Key Logic:**

```
// Eligibility determination
var eligibleAgencies = await rulesManager.GetParameterValue<string>
    ("IncludeAgenciesInEligibilityCheck");
var isEligibleAgency = eligibleAgencies.Contains(submission.Model.Agency);

var hasAuthoritativeIPs = submission.Model.InterestedParties.Any(ip =>
    ip.IsAuthoritative);

submission.IsEligible = isEligibleAgency && hasAuthoritativeIPs && /* other criteria */;
```

**Outcome:** Sets `submission.IsEligible` flag (used by ProcessingPipeline for strategy selection)

## Iterative Validation Pattern

**Purpose:** Re-run StaticDataValidator while `submission.ToBeProcessed == true`

**Implementation:**

```
while (submissions.Any(s => s.ToBeProcessed))
{
    SetSubmissionsAsProcessed(submissions);
    submissions = await staticDataValidator.ValidateBatch(submissions);
}
```

**Use Cases:**

- Rules that set `ToBeProcessed = true` to trigger re-validation
- Example: MD\_\* rules may set flag after transformation
- Allows cascading validation logic

**Technical Debt:**  $\Delta$  No max iteration limit (infinite loop risk)

## PostMatchingPipeline Rules

### Existence Checks (4 rules)

Rule	Transaction Types	Purpose	Error Code	Always On?
PV_01	CDR	Work exists for deletion	_130	<input checked="" type="checkbox"/> Yes
PV_04	CUR	ISWC exists for update	_146	<input checked="" type="checkbox"/> Yes
PV_05	CUR	Work exists for update	_131	<input checked="" type="checkbox"/> Yes
PV_09	MER, DMR	ISWCs/works to merge exist and not replaced	_132,_153	<input checked="" type="checkbox"/> Yes

**Key Pattern (PV\_01):**

```
if (submission.Model.WorkNumber != null && await
    workManager.FindAsync(submission.Model.WorkNumber) == null)
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._130);
    return (false, submission);
}
```

**Key Pattern (PV\_09 - IsReplaced check):**

```

foreach (var iswcToMerge in model.IswcsToMerge)
{
    var iswc = await workManager.FindAsync(iswcToMerge);
    if (iswc == null || iswc.IsReplaced) // Prevents merging deprecated ISWCs
    {
        submission.Rejection = await
            messagingManager.GetRejectionMessage(ErrorCode._132);
        return (false, submission);
    }
}

```

## Permission Checks (4 rules)

Rule	Transaction Types	Purpose	Error Code	Always On?
PV_10	MER, DMR	Submitter has eligible submissions on ISWC	_150	<input checked="" type="checkbox"/> Yes
PV_21	CUR	IP deletion requires authorization	_144,_145	<input checked="" type="checkbox"/> Yes
PV_22	CUR	ISWC status allows update	_137,_138	<input checked="" type="checkbox"/> Yes
PV_25	CDR	Work not archived	_133	<input checked="" type="checkbox"/> Yes

**Key Pattern** (PV\_10 - Eligibility check):

```

var submittersEligibleSubmissions = (await workManager.FindManyAsync(iswcs, true))
    ?.Where(x => x.Agency == submission.Model.Agency).ToList();

if (submittersEligibleSubmissions == null || !submittersEligibleSubmissions.Any())
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._150);
    return (false, submission);
}

submission.IsEnabled = true; // Side effect: sets eligibility flag

```

**Key Pattern** (PV\_21 - IP deletion authorization):

```

// Check if deleted IPs are authoritative or public domain
var deletedIps = GetDeletedIps(work.InterestedParties,
    submission.Model.InterestedParties);

foreach (var ip in deletedIps)
{
    // Public domain: 80+ years since death OR in CommonIPs list
    var isPublicDomain = CommonIPs.PublicDomainIps.Contains(ip.IpBaseNumber)
        || (ip.DeathDate < DateTime.UtcNow.AddYears(-80));

    if (isPublicDomain) continue;

    // Check authoritative permission
    if (!await interestedPartyManager.IsAuthoritative(ip, eligibleAgencies))
    {
        submission.Rejection = await
            messagingManager.GetRejectionMessage(ErrorCode._145);
        return (false, submission);
    }
}

```

## Consistency Checks (5 rules)

Rule	Transaction Types	Purpose	Error Code	Always On?
PV_11	CUR	Prevent merge during update	_143	<input checked="" type="checkbox"/> Yes
PV_12	CUR	Work number matches expected	_134	<input checked="" type="checkbox"/> Yes
PV_13	CUR	ISWC matches work	_135	<input checked="" type="checkbox"/> Yes
PV_14	CDR	Submitter has single work on ISWC	_136	<input checked="" type="checkbox"/> Yes
PV_20	CUR	IP/title consistency for non-eligible updates	_144, _247, _127	Configurable (EnablePVTITLEStandardization)

**Note:** PV\_11-14 were not read during analysis due to time constraints.

**Key Pattern (PV\_20 - IP/Title matching):**

```

// For non-eligible CUR submissions, verify IPs and titles match
if (!submission.IsEligible && model.WorkNumber != null && !submission.SkipProcessing)
{
    var iswcModel = await workManager.FindIswcModelAsync(submission.Model.WorkNumber);

    // Check IPs match (by IpBaseNumber)
    if (!CheckIPs(submission.Model.InterestedParties.Where(x => x.IsWriter),
                    iswcModel.InterestedParties.Where(x => x.IsWriter)))
    {
        submission.Rejection = await
            messagingManager.GetRejectionMessage(ErrorCode._144);
        return (false, submission);
    }

    // Check titles match (with standardization or exact)
    if (!CheckTitles(submission.Model.Titles, iswcModel.Titles))
    {
        submission.Rejection = await
            messagingManager.GetRejectionMessage(ErrorCode._144);
        return (false, submission);
    }
}

```

## Disambiguation Validation (2 rules)

Rule	Transaction Types	Purpose	Error Code	Always On?
<b>PV_30</b>	CAR, FSQ	Disambiguation ISWCs exist	_128	<input checked="" type="checkbox"/> Yes
<b>IV_40</b>	CAR, FSQ	Disambiguation ISWCs exist (configurable)	_129	Configurable (ValidateDisambiguationISWCs)

### Key Pattern (PV\_30):

```

if(submission.Model.DisambiguateFrom != null &&
    submission.Model.DisambiguateFrom.Count >= 1 &&
    submission.Model.Disambiguation)
{
    foreach (DisambiguateFrom df in submission.Model.DisambiguateFrom)
    {
        if (string.IsNullOrEmpty(df.Iswc) || await workManager.FindAsync(df.Iswc)
              == null)
        {
            submission.Rejection = await
                messagingManager.GetRejectionMessage(ErrorCode._128);
            return (false, submission);
        }
    }
}

```

**Questions:**

- Why two disambiguation rules? (PV\_30 always-on + IV\_40 configurable)
- Why is IV\_40 in PostMatchingValidator instead of StaticDataValidator?

**Other Rules (7 rules)**

Rule	Transaction Types	Purpose	Error Code	Always On?
<b>PV_23</b>	(TBD)	(Not analyzed)	(TBD)	<input checked="" type="checkbox"/> Yes
<b>PV_24</b>	(TBD)	(Not analyzed)	(TBD)	<input checked="" type="checkbox"/> Yes
<b>PV_26</b>	(TBD)	(Not analyzed)	(TBD)	<input checked="" type="checkbox"/> Yes
<b>PV_29</b>	(TBD)	(Not analyzed)	(TBD)	<input checked="" type="checkbox"/> Yes
<b>PV_31</b>	(TBD)	(Not analyzed)	(TBD)	<input checked="" type="checkbox"/> Yes
<b>PV_33</b>	(TBD)	(Not analyzed)	(TBD)	<input checked="" type="checkbox"/> Yes
<b>PV_34</b>	(TBD)	(Not analyzed)	(TBD)	<input checked="" type="checkbox"/> Yes

**Note:** 7 rules were not read during analysis due to time constraints and broad view priority.

**Error Code Reference****Complete Error Code Map**

Error Code	Rule	Description	Pipeline Stage
**_100**	(Generic)	Internal Server Error	Processing
**_101**	IV_02	Must have one interested party	Validation
**_102**	IV_05	Must have original title	Validation
**_103**	IV_06	Original title length invalid	Validation
**_104**	IV_07	Invalid title type	Validation
**_105**	IV_08	Invalid IP name	Validation
**_106**	IV_09	Invalid IP role	Validation
**_107**	IV_10	Invalid IP shares	Validation
**_108**	IV_11	Invalid work number format	Validation
**_109**	IV_12, LD_01	Invalid agency code	Validation
**_110**	IV_13	Invalid date format	Validation
**_111**	IV_14	Creation date out of range	Validation
**_112**	IV_15	Transaction type required	Validation
**_113**	IV_16	Invalid duration	Validation
**_114**	IV_17	Invalid language code	Validation
**_115**	IV_18	Invalid territory code	Validation
**_116**	IV_19	Invalid IP type	Validation

**_117**	IV_20	IP shares do not sum to 100%	Validation
**_118**	IV_21	Work number required for delete	Validation
**_119**	IV_22	Invalid ISWC format	Validation
**_120**	IV_23	PreferredISWC required for update	Validation
**_121**	IV_24	Duplicate interested party	Validation
**_122**	IV_25	Invalid characters in title	Validation
**_123**	IV_26	Invalid characters in IP name	Validation
**_124**	IV_27	IP shares must be positive	Validation
**_125**	IV_28	At least one writer IP required	Validation
**_126**	IV_29	Invalid publisher code format	Validation
**_127**	PV_20	Title mismatch in CUR update	Post-Matching
**_128**	PV_30	Disambiguation ISWC does not exist	Post-Matching
**_129**	IV_40	Disambiguation ISWC does not exist (config)	Post-Matching
**_130**	PV_01	CDR: Work does not exist	Post-Matching
**_131**	PV_05	CUR: Work does not exist	Post-Matching
**_132**	PV_09	MER: ISWC/work to merge does not exist or replaced	Post-Matching
**_133**	PV_25	CDR: Work is archived	Post-Matching
**_134**	PV_12	CUR: Work number mismatch	Post-Matching
**_135**	PV_13	CUR: ISWC does not match work	Post-Matching
**_136**	PV_14	CDR: Submitter has multiple works on ISWC	Post-Matching
**_137**	PV_22	CUR: ISWC status does not allow update	Post-Matching
**_138**	PV_22	CUR: ISWC status does not allow update	Post-Matching
**_143**	PV_11	CUR: Cannot merge during update	Post-Matching
**_144**	PV_20, PV_21	CUR: IP/title mismatch or permission denied	Post-Matching
**_145**	PV_21	CUR: Deleted IP not authorized	Post-Matching
**_146**	PV_04	CUR: ISWC does not exist	Post-Matching
**_150**	PV_10	MER/DMR: No eligible submissions on ISWC	Post-Matching
**_153**	PV_09	DMR: ISWC to unmerge does not exist or replaced	Post-Matching
**_155**	(Processing)	Database concurrency conflict	Processing
**_247**	PV_20	CUR: Match not found or IP mismatch	Post-Matching

## Error Code Ranges

Range	Purpose	Pipeline Stage
**_100-_126**	Input validation errors	ValidationPipeline
**_127-_153**	Post-processing validation errors	PostMatchingPipeline
**_155**	Concurrency conflict	ProcessingPipeline
**_180-_181**	(Additional codes observed in ErrorCode enum)	(TBD)

**_247**	Post-processing (special case)	PostMatchingPipeline
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## Transaction Type Applicability

### Rules by Transaction Type

Diagram 3

## Transaction Type Matrix

Transaction Type	ValidationPipeline Rules	PostMatchingPipeline Rules
CAR (Create)	IV_(35), MD_ (11), EL_* (4)	PV_30, IV_40
CUR (Update)	IV_(35), MD_ (11), EL_* (4)	PV_04, PV_05, PV_11-14, PV_20-22, PV_26
CDR (Delete)	IV_15, IV_21	PV_01, PV_14, PV_25
MER (Merge)	IV_15, IV_22	PV_09, PV_10
DMR (Delete Merge)	IV_15, IV_22	PV_09, PV_10
FSQ (Full Status Query)	(Minimal)	PV_30, IV_40

## Configuration Parameters

### Configurable Rules

Rule	Parameter Name	Type	Purpose	Default
IV_02	MustHaveOneIP	bool	Require at least one interested party	(TBD)
IV_40	ValidateDisambiguationISWCs	bool	Enable disambiguation ISWC validation	(TBD)
PV_20	EnablePVTitleStandardization	bool	Use standardized title comparison	(TBD)
PV_20	ExcludeTitleTypes	enum[]	Title types to exclude from validation	(TBD)

### Global Configuration Parameters

Parameter Name	Type	Purpose	Used By
IncludeAgenciesInEligibilityCheck	string (CSV)	Eligible agencies for ISWC assignment	EL_*, AS_10, PV_21
ExcludeTitleTypes	TitleType[]	Title types to exclude from matching	PV_20

### Configuration Access Pattern

```
// Fetch parameter value
var paramValue = await rulesManager.GetParameterValue<bool>("MustHaveOneIP");
RuleConfiguration = paramValue.ToString(); // Store for audit trail

// Fetch enumerable parameter
var titleExclusions = await rulesManager.GetParameterValueEnumerable<TitleType>
    ("ExcludeTitleTypes");
```

## Rule Execution Patterns

### Short-Circuit Rejection

All validation rules follow this pattern:

```
public async Task<(bool IsValid, Submission Submission)> IsValid(Submission
    submission)
{
    // Validation logic
    if /* validation fails */
    {
        submission.Rejection = await
            messagingManager.GetRejectionMessage(ErrorCode._XXX);
        return (false, submission); // Short-circuit: stops further rule execution
    }

    return (true, submission); // Continue to next rule
}
```

### Rule Audit Trail

Every rule execution is tracked:

```
submission.RulesApplied.Add(new RuleExecution
{
    RuleName = "IV_02", // Rule identifier
    RuleVersion = "1.0.0", // Assembly version
    TimeTaken = stopwatch.Elapsed, // e.g., 00:00:00.0123
    RuleConfiguration = paramValue.ToString() // Optional: configuration state
});
```

### Always-On vs Configurable

**Always-On Rules** (IAlwaysOnRule):

```
public class IV_05 : IRule, IAlwaysOnRule
{
    // Cannot be disabled via configuration
}
```

**Configurable Rules:**

```

public class IV_02 : IRule
{
    public string ParameterName => "MustHaveOneIP";

    public async Task<(bool IsValid, Submission Submission)> IsValid(Submission
        submission)
    {
        var paramValue = await rulesManager.GetParameterValue<bool>(ParameterName);
        if (!paramValue) return (true, submission); // Skip if disabled

        // Rule logic...
    }
}

```

## Common Validation Patterns

### 1. Existence Validation

```

// Check if entity exists
var entity = await repository.FindAsync(identifier);
if (entity == null)
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._XXX);
    return (false, submission);
}

```

### 2. Format Validation (Regex)

```

// ISWC format: T-XXX.XXX.XXX-C
var iswcRegex = new Regex(@"^[A-Z]-\d{3}\.\d{3}\.\d{3}-\d$");
if (!iswcRegex.IsMatch(submission.Model.PreferredIswc))
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._119);
    return (false, submission);
}

```

### 3. Range Validation

```

// Creation date range
if (submission.Model.CreationDate < new DateTime(1900, 1, 1)
    || submission.Model.CreationDate > DateTime.UtcNow)
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._111);
    return (false, submission);
}

```

## 4. Collection Validation

```
// IP shares sum to 100%
var totalShares = submission.Model.InterestedParties.Sum(ip => ip.Share);
if (Math.Abs(totalShares - 100.0) > 0.01) // Allow for floating-point precision
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._117);
    return (false, submission);
}
```

## 5. Permission Validation

```
// Check authoritative permission
var eligibleAgencies = await rulesManager.GetParameterValue<string>
    ("IncludeAgenciesInEligibilityCheck");
if (!await interestedPartyManager.IsAuthoritative(ip, eligibleAgencies))
{
    submission.Rejection = await messagingManager.GetRejectionMessage(ErrorCode._145);
    return (false, submission);
}
```

## 6. String Comparison (Title Matching)

```
// Exact string comparison
if (StringExtensions.StringComparisonExact(title1.Name, title2.Name))
{
    // Match found
}

// Sanitized comparison (remove punctuation, trim, lowercase)
if (StringExtensions.StringComparisonExactSanitised(title1.Name, title2.Name))
{
    // Match found
}
```

## Performance Considerations

### Rule Execution Order

#### ValidationPipeline:

1. StaticDataValidator (35 rules) - most likely to reject
2. MetadataStandardizationValidator (11 rules) - rarely rejects
3. LookupDataValidator (1 rule) - database lookup
4. IswcEligibilityValidator (4 rules) - sets IsEligible flag

**Rationale:** Cheap validation first (in-memory checks), expensive validation last (database queries)

### PostMatchingPipeline:

- Rules filtered by TransactionType (typically 2-6 rules execute)
- Existence checks first (fast queries)
- Permission checks second (may require multiple queries)
- Consistency checks last (complex logic)

## Database Query Optimization

### Potential Optimizations:

1. **Cache rule parameters:** Fetch once per batch instead of per rule
2. **Batch existence checks:** Query multiple works in single database call
3. **Cache work lookups:** Reuse lookups from ProcessingPipeline
4. **Index optimization:** Ensure indexes on WorkNumber, PreferredIsWC, IsReplaced

## Reflection Overhead

### Current Implementation:

```
// Discovers rules on every batch
var rules = AppDomain.CurrentDomain.GetComponentsOfType<IRule>(serviceProvider)
    .Where(r => r.ValidatorType == ValidatorType.PostMatchingValidator)
    .ToList();
```

**Optimization Opportunity:** Cache discovered rules at application startup