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## **Red Hat Enterprise Linux Release 9.2 Manual Pages on 'EVP RAND STATE ERROR.3oss1' command**

**`$ man EVP RAND STATE ERROR.3oss1`**

EVP RAND(3oss1)            OpenSSL            EVP RAND(3oss1)

### NAME

EVP RAND, EVP RAND\_fetch, EVP RAND\_free, EVP RAND\_up\_ref, EVP RAND\_CTX, EVP RAND\_CTX\_new, EVP RAND\_CTX\_free, EVP RAND\_instantiate, EVP RAND\_uninstantiate, EVP RAND\_generate, EVP RAND\_reseed, EVP RAND\_nonce, EVP RAND\_enable\_locking, EVP RAND\_verify\_zeroization, EVP RAND\_get\_strength, EVP RAND\_get\_state, EVP RAND\_get0\_provider, EVP RAND\_CTX\_get0\_rand, EVP RAND\_is\_a, EVP RAND\_get0\_name, EVP RAND\_names\_do\_all, EVP RAND\_get0\_description, EVP RAND\_CTX\_get\_params, EVP RAND\_CTX\_set\_params, EVP RAND\_do\_all\_provided, EVP RAND\_get\_params, EVP RAND\_gettable\_ctx\_params, EVP RAND\_settable\_ctx\_params, EVP RAND\_CTX\_gettable\_params, EVP RAND\_CTX\_settable\_params, EVP RAND\_gettable\_params, EVP RAND\_STATE\_UNINITIALISED, EVP RAND\_STATE\_READY, EVP RAND\_STATE\_ERROR - EVP RAND routines

### SYNOPSIS

```
#include <openssl/evp.h>

typedef struct evp_rand_st EVP RAND;

typedef struct evp_rand_ctx_st EVP RAND_CTX;

EVP RAND *EVP RAND_fetch(OSSL_LIB_CTX *libctx, const char *algorithm,
                        const char *properties);

int EVP RAND_up_ref(EVP RAND *rand);

void EVP RAND_free(EVP RAND *rand);
```

```

EVP RAND_CTX *EVP RAND_CTX_new(EVP RAND *rand, EVP RAND_CTX *parent);
void EVP RAND_CTX_free(EVP RAND_CTX *ctx);
EVP RAND *EVP RAND_CTX_get0_rand(EVP RAND_CTX *ctx);
int EVP RAND_get_params(EVP RAND *rand, OSSL_PARAM params[]);
int EVP RAND_CTX_get_params(EVP RAND_CTX *ctx, OSSL_PARAM params[]);
int EVP RAND_CTX_set_params(EVP RAND_CTX *ctx, const OSSL_PARAM params[]);
const OSSL_PARAM *EVP RAND_gettable_params(const EVP RAND *rand);
const OSSL_PARAM *EVP RAND_gettable_ctx_params(const EVP RAND *rand);
const OSSL_PARAM *EVP RAND_settable_ctx_params(const EVP RAND *rand);
const OSSL_PARAM *EVP RAND_CTX_gettable_params(EVP RAND_CTX *ctx);
const OSSL_PARAM *EVP RAND_CTX_settable_params(EVP RAND_CTX *ctx);
const char *EVP RAND_get0_name(const EVP RAND *rand);
const char *EVP RAND_get0_description(const EVP RAND *rand);
int EVP RAND_is_a(const EVP RAND *rand, const char *name);
const OSSL_PROVIDER *EVP RAND_get0_provider(const EVP RAND *rand);
void EVP RAND_do_all_provided(OSSL_LIB_CTX *libctx,
    void (*fn)(EVP RAND *rand, void *arg),
    void *arg);
int EVP RAND_names_do_all(const EVP RAND *rand,
    void (*fn)(const char *name, void *data),
    void *data);
int EVP RAND_instantiate(EVP RAND_CTX *ctx, unsigned int strength,
    int prediction_resistance,
    const unsigned char *pstr, size_t pstr_len,
    const OSSL_PARAM params[]);
int EVP RAND_uninstantiate(EVP RAND_CTX *ctx);
int EVP RAND_generate(EVP RAND_CTX *ctx, unsigned char *out, size_t outlen,
    unsigned int strength, int prediction_resistance,
    const unsigned char *addin, size_t addin_len);
int EVP RAND_reseed(EVP RAND_CTX *ctx, int prediction_resistance,
    const unsigned char *ent, size_t ent_len,
    const unsigned char *addin, size_t addin_len);
int EVP RAND_nonce(EVP RAND_CTX *ctx, unsigned char *out, size_t outlen);

```

```

int EVP RAND_enable_locking(EVP RAND_CTX *ctx);
int EVP RAND_verify_zeroization(EVP RAND_CTX *ctx);
unsigned int EVP RAND_get_strength(EVP RAND_CTX *ctx);
int EVP RAND_get_state(EVP RAND_CTX *ctx);
#define EVP RAND_STATE_UNINITIALISED 0
#define EVP RAND_STATE_READY 1
#define EVP RAND_STATE_ERROR 2

```

## DESCRIPTION

The EVP RAND routines are a high-level interface to random number generators both deterministic and not. If you just want to generate random bytes then you don't need to use these functions: just call RAND\_bytes() or RAND\_priv\_bytes(). If you want to do more, these calls should be used instead of the older RAND and RAND\_DRBG functions. After creating a EVP RAND\_CTX for the required algorithm using EVP RAND\_CTX\_new(), inputs to the algorithm are supplied either by passing them as part of the EVP RAND\_instantiate() call or using calls to EVP RAND\_CTX\_set\_params() before calling EVP RAND\_instantiate(). Finally, call EVP RAND\_generate() to produce cryptographically secure random bytes.

## Types

EVP RAND is a type that holds the implementation of a RAND.

EVP RAND\_CTX is a context type that holds the algorithm inputs.

EVP RAND\_CTX structures are reference counted.

## Algorithm implementation fetching

EVP RAND\_fetch() fetches an implementation of a RAND algorithm, given a library context libctx and a set of properties. See "ALGORITHM FETCHING" in crypto(7) for further information.

The returned value must eventually be freed with EVP RAND\_free(3).

EVP RAND\_up\_ref() increments the reference count of an already fetched RAND.

EVP RAND\_free() frees a fetched algorithm. NULL is a valid parameter, for which this function is a no-op.

## Context manipulation functions

EVP RAND\_CTX\_new() creates a new context for the RAND implementation rand. If not NULL, parent specifies the seed source for this implementation. Not all random number generators need to have a seed source specified. If a parent is required, a NULL parent will utilise the operating system entropy sources. It is recommended to minimise the number of random number generators that rely on the operating system for their randomness because this is often scarce.

EVP RAND\_CTX\_free() frees up the context ctx. If ctx is NULL, nothing is done.

EVP RAND\_CTX\_get0\_rand() returns the EVP RAND associated with the context ctx.

### Random Number Generator Functions

EVP RAND\_instantiate() processes any parameters in params and then instantiates the RAND ctx with a minimum security strength of <strength> and personalisation string pstr of length <pstr\_len>. If prediction\_resistance is specified, fresh entropy from a live source will be sought. This call operates as per NIST SP 800-90A and SP 800-90C.

EVP RAND\_uninstantiate() uninstantiates the RAND ctx as per NIST SP 800-90A and SP 800-90C. Subsequent to this call, the RAND cannot be used to generate bytes. It can only be freed or instantiated again.

EVP RAND\_generate() produces random bytes from the RAND ctx with the additional input addin of length addin\_len. The bytes produced will meet the security strength. If prediction\_resistance is specified, fresh entropy from a live source will be sought. This call operates as per NIST SP 800-90A and SP 800-90C.

EVP RAND\_reseed() reseeds the RAND with new entropy. Entropy ent of length ent\_len bytes can be supplied as can additional input addin of length addin\_len bytes. In the FIPS provider, both are treated as additional input as per NIST SP-800-90Ar1, Sections 9.1 and 9.2.

Additional seed material is also drawn from the RAND's parent or the operating system. If prediction\_resistance is specified, fresh entropy from a live source will be sought. This call operates as per NIST SP

800-90A and SP 800-90C.

`EVP RAND nonce()` creates a nonce in out of maximum length outlen bytes from the RAND ctx. The function returns the length of the generated nonce. If out is NULL, the length is still returned but no generation takes place. This allows a caller to dynamically allocate a buffer of the appropriate size.

`EVP RAND enable locking()` enables locking for the RAND ctx and all of its parents. After this ctx will operate in a thread safe manner, albeit more slowly. This function is not itself thread safe if called with the same ctx from multiple threads. Typically locking should be enabled before a ctx is shared across multiple threads.

`EVP RAND get params()` retrieves details about the implementation rand. The set of parameters given with params determine exactly what parameters should be retrieved. Note that a parameter that is unknown in the underlying context is simply ignored.

`EVP RAND_CTX get params()` retrieves chosen parameters, given the context ctx and its underlying context. The set of parameters given with params determine exactly what parameters should be retrieved. Note that a parameter that is unknown in the underlying context is simply ignored.

`EVP RAND_CTX set params()` passes chosen parameters to the underlying context, given a context ctx. The set of parameters given with params determine exactly what parameters are passed down. Note that a parameter that is unknown in the underlying context is simply ignored. Also, what happens when a needed parameter isn't passed down is defined by the implementation.

`EVP RAND gettable params()` returns an `OSSL_PARAM` array that describes the retrievable and settable parameters. `EVP RAND gettable params()` returns parameters that can be used with `EVP RAND get params()`. See `OSSL_PARAM(3)` for the use of `OSSL_PARAM` as a parameter descriptor. `EVP RAND gettable ctx params()` and `EVP RAND_CTX gettable params()` return constant `OSSL_PARAM` arrays that describe the retrievable parameters that can be used with `EVP RAND_CTX get params()`.

`EVP RAND_gettable_ctx_params()` returns the parameters that can be retrieved from the algorithm, whereas `EVP RAND_CTX_gettable_params()` returns the parameters that can be retrieved in the context's current state. See `OSSL_PARAM(3)` for the use of `OSSL_PARAM` as a parameter descriptor.

`EVP RAND_settable_ctx_params()` and `EVP RAND_CTX_settable_params()` return constant `OSSL_PARAM` arrays that describe the settable parameters that can be used with `EVP RAND_CTX_set_params()`.

`EVP RAND_settable_ctx_params()` returns the parameters that can be retrieved from the algorithm, whereas `EVP RAND_CTX_settable_params()` returns the parameters that can be retrieved in the context's current state. See `OSSL_PARAM(3)` for the use of `OSSL_PARAM` as a parameter descriptor.

#### Information functions

`EVP RAND_get_strength()` returns the security strength of the RAND ctx.

`EVP RAND_get_state()` returns the current state of the RAND ctx. States defined by the OpenSSL RNGs are:

? `EVP RAND_STATE_UNINITIALISED`: this RNG is currently uninitialised.

The instantiate call will change this to the ready state.

? `EVP RAND_STATE_READY`: this RNG is currently ready to generate output.

? `EVP RAND_STATE_ERROR`: this RNG is in an error state.

`EVP RAND_is_a()` returns 1 if rand is an implementation of an algorithm that's identifiable with name, otherwise 0.

`EVP RAND_get0_provider()` returns the provider that holds the implementation of the given rand.

`EVP RAND_do_all_provided()` traverses all RAND implemented by all activated providers in the given library context libctx, and for each of the implementations, calls the given function fn with the implementation method and the given arg as argument.

`EVP RAND_get0_name()` returns the canonical name of rand.

`EVP RAND_names_do_all()` traverses all names for rand, and calls fn with each name and data.

EVP RAND\_get0\_description() returns a description of the rand, meant for display and human consumption. The description is at the discretion of the rand implementation.

EVP RAND\_verify\_zeroization() confirms if the internal DRBG state is currently zeroed. This is used by the FIPS provider to support the mandatory self tests.

## PARAMETERS

The standard parameter names are:

"state" (OSSL RAND\_PARAM\_STATE) <integer>

Returns the state of the random number generator.

"strength" (OSSL RAND\_PARAM\_STRENGTH) <unsigned integer>

Returns the bit strength of the random number generator.

For rands that are also deterministic random bit generators (DRBGs), these additional parameters are recognised. Not all parameters are relevant to, or are understood by all DRBG rands:

"reseed\_requests" (OSSL\_DRBG\_PARAM\_RESEED\_REQUESTS) <unsigned integer>

Reads or set the number of generate requests before reseeding the associated RAND ctx.

"reseed\_time\_interval" (OSSL\_DRBG\_PARAM\_RESEED\_TIME\_INTERVAL) <integer>

Reads or set the number of elapsed seconds before reseeding the associated RAND ctx.

"max\_request" (OSSL\_DRBG\_PARAM\_RESEED\_REQUESTS) <unsigned integer>

Specifies the maximum number of bytes that can be generated in a single call to OSSL\_FUNC\_rand\_generate.

"min\_entropylen" (OSSL\_DRBG\_PARAM\_MIN\_ENTROPYLEN) <unsigned integer>

"max\_entropylen" (OSSL\_DRBG\_PARAM\_MAX\_ENTROPYLEN) <unsigned integer>

Specify the minimum and maximum number of bytes of random material that can be used to seed the DRBG.

"min\_noncelen" (OSSL\_DRBG\_PARAM\_MIN\_NONCELEN) <unsigned integer>

"max\_noncelen" (OSSL\_DRBG\_PARAM\_MAX\_NONCELEN) <unsigned integer>

Specify the minimum and maximum number of bytes of nonce that can be used to seed the DRBG.

"max\_perslen" (OSSL\_DRBG\_PARAM\_MAX\_PERSLEN) <unsigned integer>

"max\_adinlen" (OSSL\_DRBG\_PARAM\_MAX\_ADINLEN) <unsigned integer>

Specify the minimum and maximum number of bytes of personalisation string that can be used with the DRBG.

"reseed\_counter" (OSSL\_DRBG\_PARAM\_RESEED\_COUNTER) <unsigned integer>

Specifies the number of times the DRBG has been seeded or reseeded.

"properties" (OSSL\_RAND\_PARAM\_PROPERTIES) <UTF8 string>

"mac" (OSSL\_RAND\_PARAM\_MAC) <UTF8 string>

"digest" (OSSL\_RAND\_PARAM\_DIGEST) <UTF8 string>

"cipher" (OSSL\_RAND\_PARAM\_CIPHER) <UTF8 string>

For RAND implementations that use an underlying computation MAC, digest or cipher, these parameters set what the algorithm should be.

The value is always the name of the intended algorithm, or the properties in the case of OSSL\_RAND\_PARAM\_PROPERTIES.

## NOTES

An EVP\_RAND\_CTX needs to have locking enabled if it acts as the parent of more than one child and the children can be accessed concurrently.

This must be done by explicitly calling EVP\_RAND\_enable\_locking().

The RAND life-cycle is described in life\_cycle-rand(7). In the future, the transitions described there will be enforced. When this is done, it will not be considered a breaking change to the API.

## RETURN VALUES

EVP\_RAND\_fetch() returns a pointer to a newly fetched EVP\_RAND, or NULL if allocation failed.

EVP\_RAND\_get0\_provider() returns a pointer to the provider for the RAND, or NULL on error.

EVP\_RAND\_CTX\_get0\_rand() returns a pointer to the EVP\_RAND associated with the context.

EVP\_RAND\_get0\_name() returns the name of the random number generation algorithm.

EVP\_RAND\_up\_ref() returns 1 on success, 0 on error.

EVP\_RAND\_names\_do\_all() returns 1 if the callback was called for all names. A return value of 0 means that the callback was not called for

any names.

`EVP RAND_CTX_new()` returns either the newly allocated `EVP RAND_CTX` structure or `NULL` if an error occurred.

`EVP RAND_CTX_free()` does not return a value.

`EVP RAND_nonce()` returns the length of the nonce.

`EVP RAND_get_strength()` returns the strength of the random number generator in bits.

`EVP RAND_gettable_params()`, `EVP RAND_gettable_ctx_params()` and

`EVP RAND_settable_ctx_params()` return an array of `OSSL_PARAMS`.

`EVP RAND_verify_zeroization()` returns 1 if the internal DRBG state is currently zeroed, and 0 if not.

The remaining functions return 1 for success and 0 or a negative value for failure.

#### SEE ALSO

`RAND_bytes(3)`, `EVP RAND-CTR-DRBG(7)`, `EVP RAND-HASH-DRBG(7)`,  
`EVP RAND-HMAC-DRBG(7)`, `EVP RAND-TEST-RAND(7)`, `provider-rand(7)`,  
`life_cycle-rand(7)`

#### HISTORY

This functionality was added to OpenSSL 3.0.

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