

# Pipelines Reference

**Ed Tomlinson**

**Jeff Hennick**

**Rene Jansen**

Version 3.07-BETA of July 25, 2018

**THE REXX LANGUAGE ASSOCIATION**  
**NetRexx Programming Series**  
**ISBN 978-90-819090-3-7**

## Publication Data

©Copyright The Rexx Language Association, 2011- 2018

All original material in this publication is published under the Creative Commons - Share Alike 3.0 License as stated at <http://creativecommons.org/licenses/by-nc-sa/3.0/us/legalcode>.

The responsible publisher of this edition is identified as *IBizz IT Services and Consultancy*, Amsteldijk 14, 1074 HR Amsterdam, a registered company governed by the laws of the Kingdom of The Netherlands.

This edition is registered under ISBN 978-90-819090-3-7

ISBN 978-90-819090-3-7





---

# Contents

<b>The NetREXX Programming Series</b>	<b>i</b>
<b>Typographical conventions</b>	<b>iii</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 The Pipeline Concept</b>	<b>3</b>
2.1 What is a pipeline?	3
2.2 Stage	3
2.3 Device Driver	4
2.4 Building the pipeline	4
<b>3 Device Drivers</b>	<b>7</b>
<b>4 Filters</b>	<b>9</b>
<b>5 Record Selection</b>	<b>11</b>
<b>6 NetREXX Pipelines Implementation</b>	<b>13</b>
6.1 Installation and verification	13
<b>7 Differences with respect to the CMS Pipelines version</b>	<b>15</b>
<b>8 Developing stages in NetREXX</b>	<b>17</b>
<b>9 Deadlocks</b>	<b>21</b>
<b>10 The Pipe Compiler</b>	<b>23</b>
<b>11 Stages</b>	<b>25</b>
11.1 abbrev	25
11.2 append	26
11.3 between	26
11.4 buffer	27
11.5 casei	27

11.6	change	27
11.7	chop	27
11.8	command	28
11.9	compare	28
11.10	console	29
11.11	copy	29
11.12	count	29
11.13	dam	30
11.14	deal	30
11.15	deblock	30
11.16	dict	30
11.17	dicta	31
11.18	dictr	31
11.19	dictw	31
11.20	disk	31
11.21	diska	31
11.22	diskr	31
11.23	diskslow	32
11.24	diskw	32
11.25	drop	32
11.26	dup	32
11.27	elastic	32
11.28	fanin	33
11.29	faninany	33
11.30	fanout	33
11.31	fblock	33
11.32	file	33
11.33	filea	34
11.34	filer	34
11.35	fileslow	34
11.36	filew	34
11.37	find	34
11.38	frlabel	35
11.39	frtarget	35
11.40	gate	35
11.41	gen	35
11.42	getfiles	36

11.43	getovers	36
11.44	getstems	36
11.45	hash	36
11.46	hasa	37
11.47	hashr	37
11.48	hashw	37
11.49	hole	37
11.50	insert	37
11.51	inside	38
11.52	join	38
11.53	joincont	38
11.54	juxtapose	39
11.55	literal	39
11.56	locate	39
11.57	lookup	40
11.58	nfind	41
11.59	nlocate	41
11.60	noeofback	41
11.61	nop	42
11.62	not	42
11.63	notinside	42
11.64	outside	42
11.65	over	42
11.66	overlay	43
11.67	pad	43
11.68	pick	43
11.69	prefix	44
11.70	ptimer	44
11.71	qsort	44
11.72	random	44
11.73	reverse	44
11.74	serialize	45
11.75	sort	45
11.76	sortClass	45
11.77	sortRexx	45
11.78	specs	46
11.79	split	46

11.80 sqlselect	46
11.81 stem	46
11.82 stema	46
11.83 stemr	47
11.84 stemw	47
11.85 strfind	47
11.86 strfrlabel	47
11.87 strliteral	48
11.88 strnfind	48
11.89 strtolabel	48
11.90 take	49
11.91 task	49
11.92 tcpclient	49
11.93 tcpdata	49
11.94 tcplisten	50
11.95 timestamp	50
11.96 tokenize	51
11.97 tolabel	51
11.98 totarget	51
11.99 unique	52
11.100var	52
11.101vector	52
11.102vectora	52
11.103vectorr	53
11.104vectorw	53
11.105watchp	53
11.106xconsole	53
11.107xlate	53
11.108zone	54
<b>12 Appendix A</b>	<b>55</b>
<b>List of Figures</b>	<b>63</b>
<b>List of Tables</b>	<b>63</b>
<b>Index</b>	<b>69</b>

---

# The NetREXX Programming Series

This book is part of a library, the *NetREXX Programming Series*, documenting the NetREXX programming language and its use and applications. This section lists the other publications in this series, and their roles. These books can be ordered in convenient hardcopy and electronic formats from the REXX Language Association.

---

<b>Quick Start Guide</b>	This guide is meant for an audience that has done some programming and wants to start quickly. It starts with a quick tour of the language, and a section on installing the NetREXX translator and how to run it. It also contains help for troubleshooting if anything in the installation does not work as designed, and states current limits and restrictions of the open source reference implementation.
<b>Programming Guide</b>	The Programming Guide is the one manual that at the same time teaches programming, shows lots of examples as they occur in the real world, and explains about the internals of the translator and how to interface with it.
<b>Language Reference</b>	Referred to as the NRL, this is the formal definition for the language, documenting its syntax and semantics, and prescribing minimal functionality for language implementors. It is the definitive answer to any question on the language, and as such, is subject to approval of the NetREXX Architecture Review Board on any release of the language (including its NRL).
<b>Pipelines Reference</b>	The Data Flow oriented companion to NetREXX, with its CMS Pipes compatible syntax, is documented in this manual. It discusses installing and running Pipes for NetREXX, and has ample examples of defining your own stages in NetREXX.

---





---

# Typographical conventions

In general, the following conventions have been observed in the NetRexx publications:

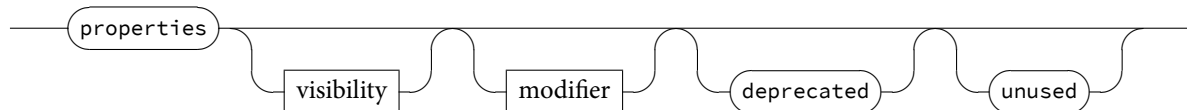
- Body text is in this font
- Examples of language statements are in a **bold** type
- Variables or strings as mentioned in source code, or things that appear on the console, are in a typewriter type
- Items that are introduced, or emphasized, are in an *italic* type
- Included program fragments are listed in this fashion:

Listing 1: Example Listing

```
1 -- salute the reader
2 say 'hello reader'
```

- Syntax diagrams take the form of so-called *Railroad Diagrams* to convey structure, mandatory and optional items

*Properties*





# Introduction

A Pipeline, or Hartmann Pipeline<sup>1</sup>, is a concept that extends and improves pipes as they are known from Unix and other operating systems. The name pipe indicates an interprocess communication mechanism, as well as the programming paradigm it has introduced. Compared to Unix pipes, Hartmann Pipelines offer multiple input- and output streams, more complex pipe topologies, and a lot more.

Pipelines were first implemented on VM/CMS, one of IBM's mainframe operating systems. This version was later ported to TSO to run under MVS and has been part of several product configurations. Pipelines are widely used by VM users, in a symbiotic relationship with REXX, the interpreted language that also has its origins on this platform.

Pipes for NetRexx is the implementation of Pipelines for the Java Virtual machine.<sup>2</sup> It is written in NetRexx and pipes and stages can be defined using this language. The resulting code can run on every platform that has a JVM (Java Virtual Machine) installed. This portable version of Pipelines was started by Ed Tomlinson in 1997 under the name of *njPipes*, when NetRexx was still very new, and was open sourced in 2011, soon after the NetRexx translator itself. The included stages have always been open source. It was integrated into the NetRexx translator in 2014 and first released with version 3.04.

---

<sup>1</sup>[http://en.wikipedia.org/wiki/Hartmann\\_pipeline](http://en.wikipedia.org/wiki/Hartmann_pipeline)

<sup>2</sup>And indeed, it can also be used from programs written in the Java Language.



## The Pipeline Concept

### 2.1 What is a pipeline?

The *pipeline* terminology is a metaphor derived from plumbing. Fitting two or more pipe segments together yield a pipeline. Water flows in one direction through the pipeline.

There is a source, which could be a well or a water tower; water is pumped through the pipe into the first segment, then through the other segments until it reaches a tap, and most of it will end up in the sink. A pipeline can be increased in length with more segments of pipe, and this illustrates the modular concept of the pipeline.

When we discuss pipelines in relation to computing we have the same basic structure, but instead of water that passes through the pipeline, data is passed through a series of programs (*stages*) that act as filters.

Data must come from some place and go to some place. Analogous to the well or the water tower there are *device drivers* that act as a source of the data, where the tap or the *sink* represents the place the data is going to, for example to some output device as your terminal window or a file on disk, or a network destination.

Just as water, data in a pipeline flows in one direction, by convention from the left to the right.

### 2.2 Stage

A program that runs in a pipeline is called a *stage*. A program can run in more than one place in a pipeline - these occurrences function independent of each other.

The pipeline specification is processed by the *pipeline compiler*, and it must be contained in a character string; on the commandline, it needs to be between quotes, while when contained in a file, it needs to be between the delimiters of a NetREXX string. An exclamation mark (!) is used as *stage separator*, while the solid vertical bar | can be used as an option when specifying the local option for the pipe, after the pipe name.

When looking at two adjacent segments in a pipeline, we call the left stage the *producer* and the stage on the right the *consumer*, with the *stage separator* as the connector.

## 2.3 Device Driver

A *device driver* reads from a device (for instance a file, the command prompt, a machine console or a network connection) or writes to a device; in some cases it can both read and write. An example of a device drivers are `diskr` for diskread and `diskw` for diskwrite; these read and write data from and to files.

A pipeline can take data from one input device and write it to a different device. Within the pipeline, data can be modified in almost any way imaginable by the programmer.

The simplest process for the pipeline is to read data from the input side and copy it unmodified to the output side. Figure X shows the currently supported input- and output devices. The pipeline compiler connects these programs; it uses one program for each device and connects them together.

The inherent characteristic of the pipeline is that any program can be connected to any other program because each obtains data and sends data through a device independent standard interface.

The pipeline usually processes one record (or line) at a time. The pipeline reads a record for the input, processes it and sends it to the output. It continues until the input source is drained.

## 2.4 Building the pipeline

Until now everything was just theory, but now we are going to show how to compile and run a pipeline. The executable script `pipe` is included in the NetREXX distribution to specify a pipeline and to compile NetREXX source that contains pipelines. Pipelines can be specified on the command line or in a file, but will always be compiled to a `.class` file for execution in the JVM. In this case, we have the following pipe definition in a file called `firstsample.njp`. We tell the pipe compiler that the pipe is called `hello`.

### Listing 2.1: Hello World

```
1 pipe (hello) literal hello world ! console
```

This specifies a pipeline consisting of a source stage `literal` that puts a string (“hello world”) into the pipeline, and a `console` sink, that puts the string on the screen.

We compile this pipe with the command:

```
pipe firstsample
```

The pipe compiler will echo the source of the pipe to the screen - or issue messages when something was mistyped. The name of the classfile is the name of the pipe, here specified between parentheses. Options also go there.

We call execute the pipe by typing:

```
java hello
```

Its output is:

```
1 dlrow olleh
```

Now we have shown the obligatory example, we can make it more interesting by adding a reverse stage in between:

#### Listing 2.2: Hello World 2

```
1 pipe (hello) literal hello world ! reverse ! console
```

When this is executed, it dutifully types

```
1 dlrow olleh
```

If we replace the string after `literal` with `arg()`, we then can start the hello pipeline with a an argument to reverse:

#### Listing 2.3: Hello World3

```
1 pipe "(hello) literal arg() ! reverse ! console"
```

and we run it with:

```
java hello a man a plan a canal panama
```

and it will respond:

```
amanap lanac a nalp a nam a
```

which goes to show that without ignoring space no palindrome is very convincing - which we can remedy with a change to the pipeline: use the `change` stage to take out the spaces:

#### Listing 2.4: Hello World4

```
1 pipe "(hello) literal arg() ! change /" "/" ! console"
```





## Device Drivers

A device driver reads from a device (for instance a file on disk, on the network, or from the shell) or writes to a device; in some cases it can both read from and write to the device. An example of a device driver is `disk` which reads and writes files. You can use it on the left-hand side of the pipeline as an input device and on the right-hand side of the pipeline as an output device.

A pipeline can take data from one input device and write it to another device. Within the pipeline, data can be modified in many ways. The simplest process for the pipeline is to copy data from a device on the input side to a device on the output side.

Using any input driver with any output driver, Pipelines for NetRexx moves data directly from the input device to the output device. The pipeline implementation uses one program for each device and connects them together. The inherent characteristic of the pipeline is that any program can be connected to any other one because each obtains data and sends data through a device independent standard interface.

The pipeline usually processes one record (or line) at a time. The pipeline reads a record from the input, processes it and sends it to the output. It continues until all records from the input have been processed.



## Filters



## **Record Selection**



---

## NetRexx Pipelines Implementation

NetREXX Pipelines enables us to follow the usage model of CMS Pipelines closely; in fact, the documentation for the mainframe product can be used for most stages.

### 6.1 Installation and verification

To run NetREXX Pipelines a running NetREXX installation is needed. To write your own pipes or stages you need compilers for both Java and NetRexx. The core classes for pipes and stages are in the archive NetREXXF.jar. This file may be used on the -cp option or added to your CLASSPATH, as indicated in the *NetRexx Quickstart Guide*.

To test the installation, we can run a pipeline from the command line. Running a pipeline from the command line To run a pipeline from the commandline, type:

#### Listing 6.1: Count Words

```
1 pipe (test) 'literal arg() ! dup 999 ! count words ! console'
```

The first time you use the pipe command in a new directory it will create a default pipes.cnf file for you. When the pipe command is not on your path, you can also use:

#### Listing 6.2: Test Dup

```
1 java org.netrexx.njpipes.pipes.compiler (test) 'literal arg() ! dup 999 ! count words  
! console'
```

You should see a message that the pipe compiler is processing your pipe and soon after that messages from the NetRexx compiler as it processes the pipe. To run the pipe type:

```
java test some words
```

The pipe should then output:

```
2000
```





## **Differences with respect to the CMS Pipelines version**



## Developing stages in NetRexx

Writing your own pipes or stage is simple. Take a look at the source of the supplied stages in the stages directory. Here are some more examples. The first shows how to use a pipe in a NetRexx program: – examples/testpipe.njp – to compile use: pipe testpipe.njp – or: java njp testpipe.njp – to execute use: java testpipe some text

```

1  class testpipe
2
3      method testpipe(avar=Rexx)
4
5          F = Rexx 'abase'
6          T = Rexx 1
7
8          F[0]=5
9          F[1]=222
10         F[2]=3333
11         F[3]=1111
12         F[4]=55
13         F[5]=444
14
15         pipe (apipe stall 1000 )
16             stem F ! sort ! prefix literal {avar} ! console ! stem T
17
18         loop i=1 to T[0]
19             say 'T['i']='T[i]
20         end
21
22     method main(a=String[]) static
23
24         testpipe(Rexx(a))

```

A couple things can be inferred from this example. First its simple to pass rexx variables to pipes using STEM. Also look at the phrase avar. It passes the Rexx variable's value to the stage at runtime. In CMS the pipe would be quoted and you would unquote sections to get a similiar effect. Another thing to note is that the pipe extraction program is fairly smart. It detects when pipes takes several lines. As long as there are stages, or the current line ends with a stagesep or stageend character, or the next line starts with a stagesep or stageend character. It gets added to the pipe. The arg(), arg(rexx) or arg(null) methods get the arguments passed to a stage or pipe. To get the complete rexx string of an argument use arg(). To get the nth word of a rexx argument use arg(n). When using pipes in netrexx or java code you can use arg('name') to get the named argument. If the class of the arguement is not rexx use arg(null) to get the object. In .njp files you can use avar phrase actually just shorthand for arg('avar'). The following example shows what has to be done in a stage to access the rexx variables passed by VAR, STEM and OVER. The real over stage is a bit more complete.

```

1  -- over.nrx
2  class over extends stage final
3
4      method run() public
5          a = getRexx(arg())
6          loop i over a

```

```

7      output(a[i])
8      catch StageError
9      rc = rc()
10     end
11
12     exit(rc*(rc<>12))

```

The getRexx method is passed the name of a string by the pipe. In the previous example it would be passed A and would return an Object pointer to A in testpipe. If you wish to replace a stream this can be done using connectors. For example look at the following fragment:

```

-- examples\calltest.njp
pipe (callt1) literal test ! calltest {} ! console

1  import org.netrexx.njpipes.pipes.
2
3  class calltest extends stage final
4
5  method run() public
6
7      do
8          a = arg()
9
10         callpipe (cp1) gen {a} ! *out0:
11
12         loop forever
13             line = peekto()
14             output(line)
15             readto()
16         end
17
18     catch StageError
19     rc = rc()
20     end
21
22     exit(rc*(rc<>12))

```

Running the callt1 pipe with an argument of 10 would pass the 10 to calltest via `arg()`. Then cp1's gen stage would be passed 'a' which is set to 10. Since gen generate numbers in sequence, the console stage of callt1 would get the numbers from 1 to 10. Now cp1 ends and calltest's output stream is restored and calltest unblocks and reads the the literal's data 'test' and passes it to console.

The use of `only` works when compiling from .njp files. It will not work from the command line. The njpipes compiler recognizes connectors as labels with the following forms:

```

*in:
*inN:
*out:
*outN

```

When N is a whole number, the connector connects input or output stream N of the stage with the connector. When the label `*in` or `*out`, the connector connects the stages's current input or output stream with the connector. This is used instead of `*`: due to the way the compiler/preprocessor works. If you do not want the stage to wait for the called pipe to complete you can use `addpipe`. Here is an example.

```

1  -- similar to examples\addtest.njp
2
3  a = 100

```

```

4  b = 'some text for literal'
5
6  addpipe (linktest) literal {b} ! dup {a} ! *in0:
7
8  loop forever
9      line = REXX readto()
10 catch StageError
11 end

```

readto() will get 'some text for literal' one hundred times.

A quick aside. When writing stages remember that njPipes moves objects through pipes. Use 'value = peekto()' instead of 'value = rexx peekto()' when ever possible. Some of the supplied stages pass objects with classes other than rexx and forcing rexx will cause class-CastExceptions. If a stage needs a rexx object try using the rexx stage modifier to attempt to convert the object. Feel free to expand this stage, but please send me the updated version.

Serious stage writers will probably want to take a good look at the methods defined in the NetREXX source package `org.netrexx.process.njpipes.stages`. There you will find various methods for parsing ranges. You will also find the stub for the stageExit compiler exit. It can be used to produce 'on the fly' code at compile time. You can also use it to change the topology of the unprocessed part of the pipe. The major use is to allow implementations of stages like prefix, append or zone. Its also used to produce better performing stages, for an example see specs. The compiler also queries the rexxArg() and stageArg() methods. If your stage expects objects of class REXX as arguments rexxArg() should return the number of variables expected. If your stage expects a stage for an argument, stageArg() should return the word position of the stage.

To get a good idea of what can be done with pipes look at the tasktest pipe in the examples directory. It, using code from Melinda Varins 'Cramming for the Journeyman Plumber Exam' paper, implements the shell of a multitasking server - using about eight stages. The file `examples/tcptask.njp` contains an example of this technique being used.



## Deadlocks

---

Pipes for NetRexx and Java detects deadlocks and outputs information to allow you to fix the problem. Consider the following session:

```
java njp (deadlock) literal test ! a: fanin ! console ! a:
Pipes for NetRexx and Java version 0.33
Copyright (c) E. J. Tomlinson , 1998. All rights reserved.
Building pipe deadlock
NetRexx portable processor, version 1.140
Copyright (c) IBM Corporation, 1998. All rights reserved.
Program deadlock.nrx
Compilation of 'deadlock.nrx' successful

njpipes/examples]java -nojit deadlock
test
Deadlocked in deadlock

Dumping deadlock Monitored by deadlock

Flag units digit:  1=wait out, 2=wait in, 4=wait any, 8=wait commit
                  : 10=pending autocommit, 20=pending sever

literal_1
Running rc=0 commit=-1 Flag=201
-> out 0 fanin_2 1 test

fanin_2
Running rc=0 commit=-1 Flag=101
-> in  0 literal\_1 1 test
    in  1 console\_3 0 test
-> out 0 console\_3 1 test

console_3
Running rc=0 commit=-1 Flag=101
-> in  0 fanin\_2 1 test
-> out 0 fanin\_2 0 test

Dumped Pipe deadlock Flag 40F rc=16
```



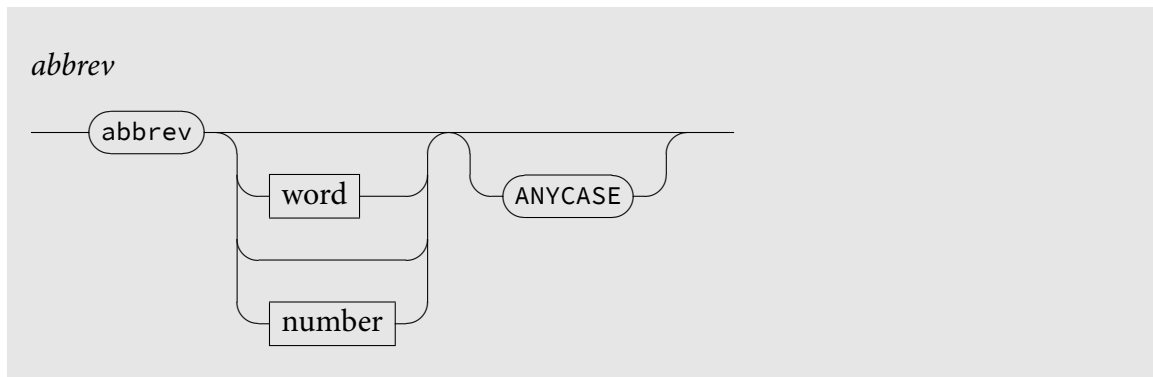
We can see that there are three stages Running. None have any return codes set. The Flags tell us that all the stages are waiting for an output to complete. The '->' show which stream is selected. From this we can see console\_3 is trying to output to fanin\_2. Unfortunately fanin\_2 is waiting for output on stream 0 to complete, it cannot read the data waiting on in stream 1. Hence the stall. When a stream has data being output, there is a boolean flag following the name of the stage the stream is connected to. This tracks the peek state of the object. For an output stream, true means the following stage has peeked at the value. With input streams, the current stage has seen the value when its true. When a stage is multithreaded, like elastic, you can get flags of 3 or 5. This means that threads are waiting on output and read, or output and any. When using multithreaded stages, only one thread should use output unless it is serialized using protected or synchronized blocks. When a stage has a pending sever or autocommit flag bits are set too.

## The Pipe Compiler



## Stages

### 11.1 abbrev



**Type:** Selection Stage

**Syntax Description:** A word, a number and a keyword are optional.

The word specifies the characters to compare against the beginning of input records. The default is a null word. The number specifies the minimum count of characters that must be present to select the record. The default is zero, which means that any abbreviation down to a null record or a leading blank will be selected. Specify ANYCASE to make the comparison case insensitive.

**Operation:** *abbrev* compares the leading columns of each record against the specified word until a blank or the end of the record is met. The record is passed to the primary output stream if a minimum abbreviation of the specified word is present. Otherwise, the record is discarded (or passed to the secondary output stream if the secondary output stream is connected).

**Example:**

Listing 11.1: abbrev example

```
1 pipe (abbrev1) literal st str string strings ! split ! abbrev string 3 ! console
```

```
1 str
2 string
```

## 11.2 append

*append*



**Type:** Control

**Syntax Description:** The argument string is normally a single stage, but any pipeline specification that can be suffixed by a connector (`|*:`) is acceptable.

**Operation:** All records on the primary input stream are copied to the primary output stream. Then the string is issued as a subroutine pipeline with CALLPIPE, using the default stage separator (`|`), double quotes as the escape character (`"`), and the backward slash as the end character. The beginning of the pipeline is unconnected. The end of the pipeline is connected to append's primary output stream. (Do not write an explicit connector.)

**Example:**

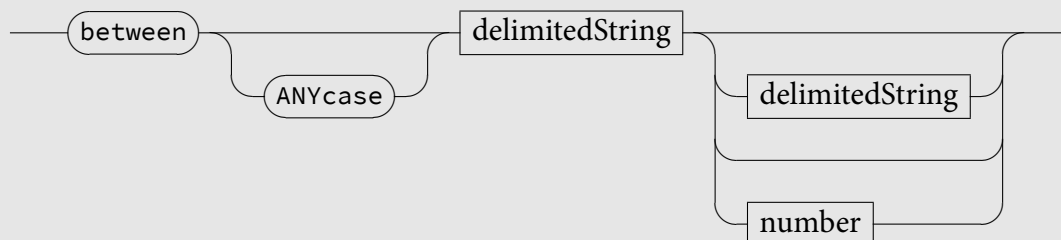
Listing 11.2: append example

```
1 pipe (appendtest) literal c d e ! append literal a b ! split ! console
```

```
1 c
2 d
3 e
4 a
5 b
```

## 11.3 between

*between*



**Type:** Selection Stage

**Syntax Description:**

**Operation:** *between*

## 11.4 buffer

```
/** buffer
```

```
>>--BUFFER--+-----+-----+-----><
              +-number--+-----+--+
                  +-delimitedString--+
```

## 11.5 casei

## 11.6 change

```
/** change
```

```
>>--CHANGE--+-----+-----+----->
              +-ANYcase-+  +-inputRange-----+
                      |    <-----+    |
                      +--(----range+---)-+

>--++ changeString +-----+-----+-----><
      +-delimitedString--delimitedString-+ +-numorstar-+

changeString:
+-delimeter--string--delimeter--string--delimeter-----+
```

## 11.7 chop

```
/** chop
```

```
              +-80-----+
>>--+-CHOP-----+-----+-----><
      +-TRUNCate-+  +-number-+
```

```

>>--CHOP--+-----+-----+-----+-----+-----+-----+----->
      +-ANYCase--+ |           +-BEFORE--+ | +-NOT--+
              +-+-----+-----+-----+-----+
                +-snumber--+ +-AFTER--+

>--+ target +-----+-----+-----+-----+-----+-----+-----><

target:
+--+xrange-----+-----+-----+-----+-----+-----+-----+
  +--+STRing+---delimitedString--+
    +-ANYof--+

```

## 11.8 command

## 11.9 compare

```
/** compare
```

```

>>--COMPARE--+-----+-----+-----+-----+-----+-----+-----><
      +-TRINARY--+ (1)           +-PAD SPACE--+
      +-BINARY--+ (2)           | +-PAD-Xorc--+
      |                               |
      | <-----+-----+-----+ |
      +---ANY DString-----+---+ (4) (5)
      +---EQUAL DString-----+ (4)
      +---LESS DString-----+ (3) (4)
      +---MORE DString-----+ (3) (4)
      +---NOTEQUAL DString--+ (4)

```

(1) -1 = Primary is shorter/less, 0 = equal, 1 = Secondary is shorter/less

(2) 0 = equal, 1 = not equal

(3) Primary is LESS/shorter (or MORE/longer) than secondary

(4) DStrings can use any of the following escapes (or the lowercase) for the unequal situation:

```

    \C (count) for the record number,
    \B (byte) for column number
    \P (primary) for the primary stream record

```

- \S (secondary) for the secondary stream record
- \L (Least) for then stream number that is shortest, -1 if equal
- \M (Most) for the stream number that is longest, -1 if equal

(5) Equal or not, this DString precedes any of the others.

## 11.10 console

```
/** console
```

CMS Only

```
>>--+-CONSOLE-+-----+-----+-----+-----+-----+-----><  
      +-TERMINAL-+   +-EOF--delimitedString-+       +-DIRECT-----+  
                  +-NOEOF-----+                +-ASYNchronously-+  
                                           +-DARK-----+
```

**11.11 copy**

```
/** copy
```

copy from input stream to output without delaying the stream. See [elastic](#) for a more generic way to do this.

## 11.12 count

```
/** count
```

```

<-----+
>>--COUNT--++-CHARACTERs--++-----><
      +-WORDS-----+
      +-LINES-----+
      +-MINline----+
      +-MAXline----+

```



## 11.13 dam

```
/** dam
```

Do not pass any objects thru secondary streams until an object appears on the primary input stream. The primary output stream must not be connected.

## 11.14 deal

```
/** DEAL
```

```

    +-STOP--ALLEOF-----+
>>--DEAL--+------+-----><
    +-STOP--+-ALLEOF--+------+
    |          +-ANYEOF--          |
    |          +-number--          |
    +-SECONDARY--+------+-----+
    |          +-RELEASE--          |
    +-KEY--inputRange--+------+-----+
    |          +-STRIP--          |
    +-STREAMid--inputRange--+------+--+
                                +-STRIP--+
```

Since java dispatches the stage threads. Deal may not see a sever immediately, as the severing thread can get multitasked. This can make options like 'ANYEOF' work in unexpected ways.

## 11.15 deblock

## 11.16 dict

```
/** dict
```

Call dictr at the start of a pipe segment

### **11.17 dicta**

### **11.18 dictr**

### **11.19 dictw**

### **11.20 disk**

**/\*\* disk**

Call diskr at the start of a pipe segment

### **11.21 diska**

**/\*\* diska**

Appends records on its input stream to the end of the supplied file, the file is created if its does not exist.

### **11.22 diskr**

```
/** drop
```

	+--FIRST--+	+--1-----+	
>>--DROP-	+-----+--+	+-----+--+	+-----+--+
	+--LAST---+	+--number-+	+--BYTES--+
		+--*-----+	

```
/** dup
```

```
/** elastic
```

read objects from the primary input stream as soon as they arrive without delaying the stream. Output when requested. Note elastic always accepts new objects - even if its output is blocked pending a write.

## 11.28 fanin

```
/** fanin

>>--FANIN--+-----+-----><
          | <-----+ |
          +---stream-+++
```

## 11.29 faninany

## 11.30 fanout

```
/** fanout

          +-STOP--ALLEOF-----+
>>--FANOUT--+-----+-----><
          +-STOP--+--ANYEOF-++
          +-number-+
```

## 11.31 fblock

```
/** fblock

>>--FBLOCK--number--+-----+-----><
                  +-xorc-+
```

## 11.32 file

```
/** file

Call diskr at the start of a pipe segment
```

### 11.33 filea

```
/** filea
    Synonym of diska
```

## 11.34 filer

```
/** filer
    Synonym of diskr
```

### 11.35 fileslow

```
/** fileslow

    Call use diskslow for writing
```

**11.36 flew**

```
/** filew
    Synonym of diskw
```

**11.37 find**

```
/** find
```

```
>>--+-FIND--+-----+-----+-----><
```

```
|      +-string-+          |
```

```
+--STRFIND--+-----+---delimitedString-+
```

+ - ANY case - +

### 11.38 frlabel

```
/** frlabel
```

```
>>--+-FRLABEL--+-----+-----+-----+-----+-----+-----+-----+
      |          +-string-+                                     |
+-STRFRLABEL--+-----+---delimitedString-+
                +-ANYcase-+
```

Purpose: read records searching for a string starting in column 1. copy thereafter (including the record containing the label) to stream 2. copy all preceding records to stream 1 (if it exists).

a null argument causes stream 0 to be shorted to output (0).

Contributed by Chuck Moore.

### 11.39 frtarget

### 11.40 gate

```
/** Gate
```

pass objects thru secondary streams until an object appears on the primary stream. If the strict option is specified, verify that there is not a object waiting on stream 0 before passing the selected stream's object.

### 11.41 gen

## 11.42 getfiles

```
/** getfiles
```

Expects a stream of fileids. Output the contents of the files on stream 0, if stream 1 is connected, it copies the fileids there. Fileids will be copied even if there is a problem with the file (ie rc=2).

rc = 2 - When a fileid does not exist

## 11.43 getovers

```
/** getovers
```

Input stream 0 should contain rexx objects. The getovers stage will output will output the index and contents of the stem on stream 0. If output stream 1 is connected, the root is placed there. Any severed streams will cause then stage to exit. Passing a non rexx object will cause the stage to exit with return code 13

## 11.44 getstems

```
/** getstems
```

Input stream 0 should contain rexx objects containing stems. The getstems stage will output the contents of the stem on stream 0. If output stream 1 is connected, the root is placed there. Any severed streams will cause then stage to exit. Passing a non rexx stem object will cause the stage to exit with return code 13

## 11.45 hash

```
/** hash
```

Call hashr at the start of a pipe segment

## 11.46 hasha

```
/** hasha  
  
    Synonym of dicta
```

## 11.47 hashr

```
/** hashr  
  
    Synonym of dictr
```

## 11.48 hashw

## 11.49 hole

## 11.50 insert

```
/** insert  
  
insert a string into a record. Will be much more effecient than specs espically  
if the input is a Byte[]  
  
                                +-BEFORE-+  
>>--INSERT--delimitedString--+------+----->>  
                                +-AFTER---+
```



## 11.51 inside

```
/** inside

>>--INSIDE---+-----+--delimitedString--+-number-----+-----><
              +-ANYcase-+                +-delimitedString-+

FRLABLE Contributed by Chuck Moore.
```

## 11.52 join

```
/** join

+-1-----+
>>--JOIN--+-+-----+--+-----+--+-----+-----><
          +-number-----+ +-delimitedString-+ +-number-+
          +-*-----+
          +-KEYLENgth--number-+
```

## 11.53 joincont

```
/** joincont

+-TRAILING-----+
>>--JOINCONT--+-+-----+--+-----+--+-----+----->
              +-ANYCase-+ +-NOT-+ +-RANGE--inputRange-+ +-ANYof-+
              +-LEADING-----+

>--delimitedString--+-+-----+--+-----+-----><
                    +-KEEP-+ +-delimitedString-+
```

## 11.54 juxtapose

```
/** Juxtapose

prefix a record from the secondary input stream with those from records
from the primary input stream.

pipe (findtext end ? runaway 60000 debug 0 )

    command cmd /C dir /B 2 !                -- get the directory
a: not getfiles !                            -- flip streams 0/1
b: juxtapose !                               -- prefix with the file name
    specs word1 1-20 word2-* next !          -- format the output
    console ?                                -- display it
a: !
    locate /1/ !                             -- send lines to juxta to display
b:
```

## 11.55 literal

```
/** literal

                                +--object-name--+
>>--+-LITERAL-----+-----+-----+-----+-----+-----+-----><
    |               +-string-+                               |
    |               +-PREFACE-+                               |
    +-STRLITERAL---+-----+-----+-----+-----+-----+-----+
                                +-APPEND--+ +-delimitedString-+
```

## 11.56 locate

```
/** locate

>>--LOCATE-----+-----+-----+-----+-----+-----+----->
                +-ANYcase-+ +-inputRanges-+ +-ANYof-+

>--+-----+-----+-----+-----+-----+-----+-----><
```

```
+--delimitedString--+
```

## 11.57 lookup

```
/** lookup
```

```
in stream 0 are detail records
in stream 1 are master records
in stream 2 adds to masters
in stream 3 delete from masters
```

```
out stream 0 are matched records
out stream 1 are unmatched detail records
out stream 2 are unmatched or counted master records
out stream 3 deleted masters
out stream 4 duplicate masters
out stream 5 unmatched master deletes
```

lookup does not consider an unconnected output stream an error. It does propagate EOFs from output streams.

To increase performance reorder the 'when type=' in method out so the type you use is first in the list and recompile the stage.

```
>>--LOOKUP--+-+-----+--+-----+--+-----+--+-----+-->
              +-COUNT--+ +-ANYCASE--+ +-AUTOADD--+ +-BEFORE--+

>>+-+-----+--+-----+--+-----+--+-----+--+-----+----->
    +-KEYONLY--+ +-SETCOUNT--+ +-INCREMENT--+ +-TRACKCOUNT--+

>>-----+-----+-----+-----+-----+-----+----->
                                   +-inputRange--+-----+
                                   +-inputRange--+

>--+-+-----+--+-----+--+-----+--+-----+--+-----+-----><
    +-DETAIL MASTER-----+
    +-DETAIL ALLMASTER PAIRWISE--+
    +-DETAIL ALLMASTER-----+
    +-DETAIL-----+
    +-MASTER DETAIL-----+
    +-MASTER-----+
```

```

+-ALLMASTER DETAIL PAIRWISE-+
+-ALLMASTER DETAIL-----+
+-ALLMASTER-----+

```

### 11.58 nfind

```
/** nfind
```

>>--+NFIND--+-----+-----+

| +-string-+ |

+STRNFIND--+-----+--delimitedString-+

+-ANYcase-

```
/** nfind
```

```
>>--+-NFIND--+-----+-----+-----+
```

```
|           +-string-+               |
```

```
+--STRNFIN--+-+-----+---delimitedString-+
```

```
              +-ANYcase-
```

## 11.59 nlocate

```
/** nlocate
```

```
>>--NLOCATE--+-----+--+-----+--+-----+
```

```
          +-ANYcase-+  +-inputRanges-+  +-ANYof-+
```

```
>--+-----+-----+
```

```
      +-delimitedString-+
```

```
/** nlocate

>>--NLOCATE--+-+-----+-----+-----+-----+
               +-ANYcase-+  +-inputRanges-+  +-ANYof-+

>+-+-----+-----+-----+-----+
   +-delimitedString-+
```

## 11.60 noeofback

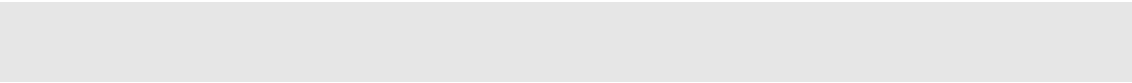
```
/** noEofBack
```

do not proprogate eof back thru this stage.

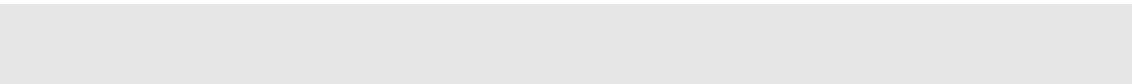
```
/** noEofBack
```

do not proprogate eof back thru this stage.

## 11.61 nop



## 11.62 not



## 11.63 notinside

```
/** notinside

>>--BETWEEN----+--+-----+--delimitedString--+-number-----+-----><
    +-INSIDE-----+  +-ANYcase-+                               +-delimitedString-+
    +-NOTINSIDE---+
    +-OUTSIDE-----+

FRLABLE Contributed by Chuck Moore.
```

## 11.64 outside

```
/** outside

>>--OUTSIDE--+-+-----+--delimitedString--+-number-----+-----><
                +-ANYcase-+                               +-delimitedString-+

FRLABLE Contributed by Chuck Moore.
```

## 11.65 over

```
/** over
```

Extract all the indexes of a rexx variable.

## 11.66 overlay

```
/** OVERLAY
```

+--BLANK--+

>>--OVERlay--+-----+-----><

+--xorc--+

### 11.67 pad

```
/** pad
```

```
pad a rexx record
```

**11.68** pick

```

/** pick
>>--PICK--+-+-----+--+-----+--+-----+--+-----+--+=====+--+-----+
          +-ANYcase-+  +-PAD xorc-+  +-inputRanges-+  +-^==--+  +-inputRan
                                     +-<<--+  +-delimite
                                     +-<<==+
                                     +->>--+
                                     +->>==+

```

The performance of Pick can be enhanced by reordering the compares in the comp method to put your compare first.

## 11.69 prefix

```
/** prefix
```

Blocks its primary input and excutes stage supplied as an arguement. The output from this stage are put to the primary output stream. When its compete the primary input is shorted.

## 11.70 ptimer

## 11.71 qsort

```
/** sort
```

This sort routine is very basic. It uses sortRexx class, which implements the sortClass interface. To sort objects of classes other than Rexx requires that you implement another sortClass with a name begining with 'sort'.

I implemented this class using an Java array for the objects to be sorted as opposed to a Rexx stem. Using an array is about 50% faster. I choose a quick/Bose Norman sort since I had the code, in Rexx, for it from a time before I had pipes on CMS!

## 11.72 random

## 11.73 reverse

## 11.74 serialize

## 11.75 sort

```
/** sort
```

This sort routine is very basic. It uses sortRexx class, which implements the sortClass interface. To sort objects of classes other than Rexx requires that you implement another sortClass with a name beginning with 'sort'.

I implemented this class using an Java array for the objects to be sorted as opposed to a Rexx stem. Using an array is about 50% faster. I choose a quick/Bose Norman sort since I had the code, in Rexx, for it from a time before I had pipes on CMS!

## 11.76 sortClass

```
/**
```

This is an interface class to allow a generic sort routine to handle objects of different type. Currently it is implemented by sortRexx, which will sort rexx objects.

## 11.77 sortRexx

```
/**
```

An implementation for sortClass for rexx objects. Part of the logic to generate sortClass stages is in sort's stageExit.



## 11.78 specs

## 11.79 split

```
/** split

>>--SPLIT--+-+-----+-----+-----+-----+----->
          +-ANYCase-+  +-MINimum--number-+

          +-AT-----+          +-BLANK-----+
>--+-+-----+-----+-----+-----+-----><
    +-+-----+---+-BEFORE-++  +-NOT-+  +-+ target +-+-----+
    +-snumber-+  +-AFTER--+          +-number-+

target:
+-+--xrange-----+-----+-----+-----+-----+
  +-+--STRing+---delimitedString-+
    +-ANYof--+
```

## 11.80 sqlselect

## 11.81 stem

```
/** stem

    Call stemr at the start of a pipe segment
```

## 11.82 stema

```
/** stema

Append to an existing stem, exits if the arguement is not a stem.
```

### 11.83 stemr

### 11.84 stemw

### 11.85 strfind

```
/** strfind
    +-FIND---+-----+-----+
    |      +-string-+      |
    >>--+-STRFIND--+-delimitedString-+-----><
                +-ANYcase-+
```

### 11.86 strfrlabel

```
/** strfrlable
    +-FRLABEL---+-----+-----+
    |      +-string-+      |
    >>--+-STRFRLABEL--+-delimitedString-+-----><
                +-ANYcase-+
```

Purpose: read records searching for a string starting in column 1. copy all records thereafter (including the record containing the label) to stream 0. copy all preceding records to stream 1 (if it exists).

a null argument causes stream 0 to be shorted to output (0).

FRLABLE Contributed by Chuck Moore.

## 11.87 strliteral

```
/** Distributed under the ICU 1.8.1 Licence with NO WARRANTIES of ANY kind.
 * See LICENSE for the licence and information on using, copying, modifying,
/** strliteral
```

```
    +-LITERAL--+-+-----+-----+-----+
    |           +-string-+           |
    |           +-PREFACE-+           |
>>--+-STRLITERAL--+-+-----+-----+-----+-----+-----+-----+-----><
                                +-APPEND--+  +-delimitedString-+
```

## 11.88 strnfind

```
/** strnfind
```

```
    +-NFIND--+-+-----+-----+-----+
    |           +-string-+           |
>>--+-STRNFIND--+-+-----+-----+delimitedString-+-----+-----+-----><
                                +-ANYcase-+
```

## 11.89 strtolabel

```
/** strtolabel
```

```
    +-TOLABel--+-+-----+-----+-----+
    |           +-string-+           |
>>--+-STRTOLABel--+-+-----+-----+delimitedString-+-----+-----+-----><
                                +-ANYcase-+
```

Purpose: read records up to a matching label (i.e. a string starting in column 1).  
copy all preceding records to stream 0.  
copy all following records (including the matched record) to stream 1  
(if it exists).

a null argument causes all records to be shorted to output stream 1.

**11.90 take**

```
/** take
```

```

      +-FIRST--+  +-1-----+
>>--TAKE-+-+-----+-----+-----+-----+-----+-----+----->
      +-LAST--+   +-number--+  +-BYTES--+
              +-*-----+

```

### 11.91 task

## 11.92 tcpclient

```
/** tcpclient
```

Simple tcpclient implementation. The options implemented are similiar to the cms definition.

```
linger      - wait a bit before terminating the last read (units SECONDS)
timeout     - wait this long before timing reads out (units MS)
deblock     - If deblock is ommited a copy stage is used.
group       - similiar to cms. A delimited string containing a stage is
              expected. You can use a run of stages, but its is dangerous
              since you to know the stage sep character being used...
greeting    - expect a greeting message and discard it
nodelay     - use the nodelay option
keepalive   - enable keep alive socket option
oneresponse - synchronize cmds/replys
```

## 11.93 tcpdata

```
/** tcpdata
```

## Simple tcpdata implementation.

```
linger      - wait a bit before terminating the last read (units SECONDS)
timeout     - wait this long before timing reads out (units MS)
deblock     - If deblock is ommited a copy stage is used.
group       - similiar to cms. A delimited string containing a stage is
              expected. You can use a run of stages, but its is dangerous
              since you to know the stage sep character being used...
nodelay     - use the nodelay option
onresponse  - synchronize requests/replies
```

## 11.94 tcplisten

```
/** tcplisten
```

Simple tcplisten implementation. You can only supply the port and a timeout value. Its ignored unless tcplisten's output stream has been severed, in which case tcplisten terminates.

If input stream 0 is connected, tcplisten does a peekto before calling the accept method. The object is consumed after the output of the socket object returns.

## 11.95 timestamp

```
/**
```

```
timestamp--Prefix the Date and Time to Records
```

timestamp prefixes each record with a timestamp showing when the record was read by t

```
+-----+
|                                     |
|               +-8-----+         |
| >>--TIMEstamp--+-+-----+----->< |
|               +-number--+         |
|                                     |
+-----+
```

Type: Filter.

Syntax Description: The arguments are optional. The default is 8.

Operation: A 16-character timestamp is developed whenever a record has been read. It consists of the year (including the century), the month, day, hour, minute, second, and hundredth of a second. Unlike CMS, the java interface reports hundredths of a second. The specified number of characters are taken from the right-hand side of this number and prefixed to the input record.

## 11.96 tokenize

```
/** tokenize  
  
    >>--+-TOKENISE-+---delimitedString--+-----+-----><  
        +-TOKENISE-+                        +-delimitedString-+
```

## 11.97 tolabel

```
/** tolabel  
  
    Purpose: read records up to a matching label (i.e. a string starting in column 1).  
             copy all preceding records to stream 0.  
             copy all following records (including the matched record) to stream 1  
             (if it exists).  
  
             a null argument causes all records to be shorted to output stream 1.
```

## 11.98 totarget

```
/** totarget
```

## 11.99 unique

```
/** unique.nrx

                                +-NOPAD-----+
>>--UNIQUE--+-+-----+--+-----+--+-----+--+-----+----->
              +-COUNT-+  +-PAD--xorc-+  +-ANYcase-+

                                +-LAST-----+
>--+-----+--+-----+--+-----+-----><
  +-+ uniqueRanges +-+ +-SINGLEs--+
                        +-FIRST-----+
                        +-MULTiple-+
                        +-PAIRwise-+

uniqueRanges:
+-+--inputRange-----+-----+-----+-----+-----+
|   <-----+-----+   |
+-(----inputRange--+-+-----+---+--)-+
                        +-NOPAD-----+
                        +-PAD--xorc-+
```

## 11.100 var

## 11.101 vector

```
/** vector

Call vectorr at the start of a pipe segment
```

## 11.102 vectora

### 11.103 vectorr

### 11.104 vectorw

### 11.105 watchp

### 11.106 xconsole

### 11.107 xlate

```
/** xlate

>>--+-XLATE-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
+-TRANSlate-+ +-inputRange-----+ +-+ default-table +-+
      | <-----+ |
      +---(--inputRange--)-++

<-----+
>--+-----+-----+-----+-----+-----+-----+-----+-----+-----+><
+-xrange--xrange-+

default-table:
+-+UPper-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
+-LOWer-----+
+-INput-----+
+-OUTput-----+
```



```
+++TO-----+---number--+  
+-FROM+  +-CODEPAGE-+
```

Not yet in njPipes

XLATE Contributed by Rene Jansen

## **11.108 zone**

## Appendix A

---

- .50 - Released May 30, 1999
  - Fixed a stall occurring when interrupted threads, with the interrupt caught by ThreadPool, were reused.
  - Fixed a thread safety problem in ELASTIC
  - Improved the timeout options in TCPDATA and TCPCLIENT, they also byte[] instead of strings. This was done since converting to and from strings sometimes scrambles binary data (more research on encodings...)
  - Changed DELBLOCK it now handles byte[] to help keep tcpdata and tcpclient efficient. The EOF option was broken, its fixed now.
  - Changed DISKR, DISKW and DISKA to handle byte[] when using streams.
  - Added INSERT which handles byte[]. This should be used instead of SPECS to add LF or CR .
  - Changes SERIALIZE to use byte[].
- 0.49 - Released May 21, 1999
  - compiled with 1.2.1 and NetRexx 1.148
  - Added preliminary support added to .njp compiler for files containing java source! See the (some what messy) java samples in vectort1.njp, overtest.njp and addtest4.njp
  - Added code to generate a dummy .nrx file containing the public class in a .java file. This allows NetRexx to compile class that depend on the java source.
  - Modified sort to accept arguments in the same order as CMS
  - Fixed rc logic in drop stage
  - Fixed shortcut code for {n} where n is numeric.
- 0.48 - Released May 16, 1999
  - Fixed a (nasty) bug involving reusing pipe objects.
  - Added the reuse() method to the stage class. To use it override it in your stage. It was added so there was a foolproof way to reset a stage when its pipe object is reused. (doSetup is intended for use with dynamic arguments in call or added pipes)
  - Added the cont option and defaulted it to comma.
  - fixed return code logic in some stages and in selectInput/Output
  - Added the Emsg methods
  - Added argument debug option (128)
  - There are no more final methods
  - Much improved error reporting from stages via new Emsg method
- 0.47 - Released Jan 3, 1999

- recompiled with 1.1.7A and netrexx 1.148
- UNIQUE repaired?
- Added stages to access java objects easily  
 VECTOR, VECTERR, VECTORW, VECTORA for java.util.Vector  
 ARRAY, ARRAYR, ARRAYW, ARRAYA for Object[]  
 HASH, HASHR, HASHW, HASHA for java.util.Hashtable  
 DICT, DICTR, DICTW, DICTA for java.util.Dictionary  
 The hash stages mostly map directly to DICT stages. The exception  
 is HASHW which uses the clear() method of Hashtable.
- Modified LITERAL to be able to put any object into a pipe
- Modified pipe package to store arguments in a hashtable instead of  
 a rexx stem - arguments can now be of any class. Use the arg(null)  
 method to get an object argument.
- 0.46a - Released Oct 14, 1998
  - recompiled with 1.1.7
  - TCPLISTEN now supports an input stream to be used to pace accepts
- 0.46 - Released Sept 20, 1998
  - COMMAND, CHANGE, FILE, LOCATE, DROP, LOOKUP, TCPCLIENT, TCPLISTEN  
 SQLSELECT, CONSOLE, TCPDATA, NOEOFBACK improved.
  - Jeff improved the testing process with the addition of the COMPARE  
 stage, he also upgraded many of the tests.
  - Added the buildtests pipe, it builds a test script to be run with:  
 test > output < console.data
  - Unexpected exceptions should no longer hang pipes
- 0.45 - Released Sept 9, 1998
  - \* Recompile all your stages. To fix a commit problem I had to  
 change the \_stage interface class...
  - tcpclient restart problems with oneresp active fixed.
  - commit now returns the current return code of the pipe.
  - fixed minor errors in tcpclient and disk.
- 0.44 - Released Sept 8, 1998
  - \* a recompile of pipes using STEM is required
  - smart DISK, FILE and STEM stages now exist.
  - Made to and from synonyms for in and out in REXX and STRING stages.
  - Added stream option to DISKR and DISKW to read raw streams.
  - Added DISKSLow and SERIALIZE stages.
  - Now DISK, DISKR, DISKW, DISKA and DISKSLow have FILE synonyms.
  - Deadlock detection improvements.
  - TCPDATA & TCPCLIENT optimized once again.
  - selectAnyInput could deadlock - fixed.
  - interrupting a pipe now kills it - use this with care (ie. kill -9)
  - Pseudo methods njpRC() and njpObject() are recognized by the pipes  
 compiler and return the pipe's RC or object respectively.
- 0.43 - Released August 30, 1998
  - Fixed deadlock detection to see commit deadlocks.
  - Added rest of code to handle improved StageError logic.
  - Added stage templates (template\*.nrx) in the njpipes directory.

- Added a debug flag (64) to trace all StageError rasied by the stage class.
- 0.42 - Not released
  - \* A recompile of pipes using TCPCLIENT, TCPDATA is required.
  - \* A recompile of pipes using REXX, STRING, ZONE, CASEI is recommended.
  - Updated the comments in \_stage to reflect the possible StageError and return codes that can be issued.
  - Added the DEBLOCK stage and reworked TCPDATA, TCPCLIENT & GATE.
  - Improved eofReport processing and added a new option 'either' that will trigger a StageError when any stream, input or output, severs.
  - Fixed variable substitution so multiple variables passed to a stage will work.
  - Added the ability to pass thru arguements to callpipe and addpipe.
  - Fixed a problem with some StageExits requiring stage\_reset methods.
  - Added a function to utils to help assign smarter name to classes generated by StageExits.
  - Added counter method to stage. use to count external waits so deadlock/stall detection is not fooled.
- 0.41 - Released August 23, 1998
  - \* removed OBJ2REXX, OBJ2STRING stages, use REXX and STRING stage modifiers.
  - \* pipes using TCPDATA, TCPCLIENT & LOOKUP should be recompiled
  - exhanced REXX stage modifier via an object2rexex improvement in pipes/utils.nrx
  - optimized ThreadPool startup times. No setName and only use setPriority when its required.
  - made it possible to optimized stage startup time when arguements are static. See TCPDATA, TCPCLIENT & LOOKUP
  - faq.txt enhanced
- 0.40 - Released August 14, 1998
  - \* All pipes MUST be recompiled. Old pipe class files will stall.
  - OBJ2REXX is depreciated and will be removed, use the REXX stage.
  - added REXX and STRING stages to convert objects entering and leaving a stage to rexx or string. Inorder to avoid nasty class conflicts, REXX and STRING are implemented in \_rexex and \_string. The compler adds the '\_' when necessary (any stage can use this feature).
  - fixed an intermitant stall in callpipe (was completing too fast :-)
  - fixed a stall occuring between shortStreams and COMMAND
  - optimized pipe startup time in pipe.class and via the compiler.
  - optimized rc, commit, deadlock, threadpool code
- 0.39 - Released August 9, 1998
  - WAIT\_COMMIT and WAIT\_ANY are now used in the call/addpipe logic
  - callpipe was not notifying its pipe when ending leading to an very intermitant hang.
- 0.38 - Released August 3, 1998
  - \* All your stages must be recompiled. Recompile your pipes to exploit the pipe & thread pool performance improvements.

- fixed and optimized commit logic.
- implement a pool for pipes to decrease overhead.
- implement a pool for threads to decrease overhead.
- compiler fix to propagate return codes from stageExits (thanks Jeff).
- signal StageError('... in all stageExits modified to  
signal StageError(13,'Error - 'pInfo' - ...
- UNIQUE stage added by Jeff. It exploits stageExit.
- COMMAND stage was not starting its threads correctly.
- SORTs in different pipes could corrupt each other. Thanks René,
- 0.37 - Released July 25, 1998
  - \* A recompile of pipes using SORT is required
  - added NOEOFBACK, TOTARGET and FRTARGET.
  - removed a protected method from dump(), added arg() to the dump
  - upgraded SORT, sortRexx to exploit IRange and stageExit, optimized use, and factored the sort algorithm out of sort/sortRexx.
  - multiple sort stages no longer try to share static variables...
  - the compiler just uses the stage name (not args) when naming stages
- 0.36 - Released July 19, 1998
  - \* A recompile of ALL pipes with stages using IRANGE is required. (CHANGE, DEAL, JOINCONT, LOCATE, LOOKUP, PICK, XLATE & ZONE)
  - \* pipes using NFIND, NLOCATE, STRNFIND or SORT also need to be recompiled
  - Added BuildIRangeExit and other methods to an updated IRange class. Using 'zone range stage ...' will be faster than 'stage range ...' when the range consists of n.c or n-c (s).
  - NFIND, NLOCATE, STRNFIND implemented via stageExit and NOT
  - Fixed bugs in, JUXTAPOSE, FIND, STRFIND, SORT, COMMAND, CHANGE
  - The compiler was not calling stageExit in the correct order when several calls were needed to build the stage. (zone w1 nfind..)
- 0.35 - Released July 16, 1998
  - Jeff Hennick pointed out a bugglet that effected LOOKUP, ZONE and PICK that could occur with complex ranges, I found another bug in strliteral
  - Jeff Hennick updated this doc with information on IRange and DString
- 0.35 - Released July 15, 1998
  - \* A recompile of ALL pipes using ZONE, TCPCLIENT, TCPDATA, PREFIX and APPEND is required.
  - prefix and append can now be labeled, tcpclient and tcpdata now use a stage, instead of a pipe, to group data.
  - added compiler support for negative stream numbers. This is intended to be used by stageExit. See append, prefix, tcpdata and tcpclient.
  - Redefined rexxArg() and stageArg() to simplify the compiler.
  - selection stages are no longer defined as final.
  - SelectInput(0) and selectOutput(0) are always called by the stage implementation so they can be overridden...
  - Reimplemented ZONE using stageExit, added CASEI using the same

- technique. In theory NOT could be done the same way but, to avoid some recursion problems NOT is staying in the compiler.
- StageExit modified to allow it to pass back another stage to call. see ZONE, CASEI and NOT.
- 0.34 - Released July 11, 1998
- minor reportEOF(any) logic fix
  - improved command stage, threads used to process stdout and stderr. added zone, pad, lookup, pick, upgraded juxtapose, fixed bugs in specs & buffer.
  - added pad option to setIRange method
- 0.33 - Released July 5, 1998
- added rexxArg() and stageArg() methods to utils.nrx for use by the compiler to query stages about what they expect their arguments to contain. This allowed the compiler to be simplified.
- \$
- locate now handles null arguments correctly. literals now include leading blanks. Thanks for pointing out the problem René.
- \$
- René Jansen contributed the timestamp stage.
  - logic modified to stop output() from getting an EOF when the output object has been peeked. The peek status is also displayed by the dump() method and hence by deadlocks.
  - minor specs bug fixes (next.n and nextw.n output specs now work)
  - modified the compiler to invoke stageExit(rexx, rexx) method. This allows stages to generate code and/or change the pipe topology. See specs, append, prefix, change and xnop, in the stages directory.
  - modified StageError in preparation for usage changes.
  - removed the Range class - Jeff's code is better and anything that could be done with Range can be done using stageExit.
  - Jeff fixed bugs in change and join and added:
 

fblock	joincont	notininside	outside
inside			
- 0.32 - Released June 20, 1998
- Jeff updated these stages adding a few new ones too:
- |         |          |         |        |
|---------|----------|---------|--------|
| abbrev  | between  | split   | locate |
| nlocate | strnfind | strfind | nfind  |
| find    | chop     |         |        |
- minor documentation updates
  - the Range class is depreciated and will be removed. Use the replacements Jeff created (see pipes\utils.nrx and stages\).
- 0.31 - Released June 17, 1998
- modified count, drop, take and deal to handle non rexx objects when possible
- 0.31 - Released June 16, 1998
- improved eofReport(ANY) logic to trigger when waiting on output and a different output stream severs.
  - factored the source for utils.class out of stages so there is a class to add (probably static) shared methods for all stages
  - fixed a deadlock that occurred between shortStreams and exit

(severInput)

- Jeff Hennick updated many stages to work at CMS or near CMS levels.

append	deal	join	strfrlabel	xlate
buffer	drop	literal	strliteral	
change	fanin	locate	strtolabel	
console	fanout	split	take	
count	frrlabel	strfind	tokenize	

All of Jeff's changes are GNUed. See CopyLeft.txt in the njpipes directory.

- 0.30 - Released May 24, 1998
  - fixed logic in core classes to post all pending severs and not clear them too early either, this corrects a problem seen on Multiprocessor machines.
- 0.29 - www page update (docuemention) May 20
  - deadlock section updated
  - installation verification example corrected!
- 0.29 - Released May 17, 1998
  - added obj2rexx stage, tolabel stage courtesy of Chuck Moore.
  - enhanced change to support a single range
  - Added setJITCache(Hashtable) method to pipes. This can be used to build a global object cache in programs calling pipes. The name of the Hasttable is passed to pipe/callpipe/addpipe via a cache parameter.
  - Added support for reportEof options. This support is not too well tested - some good testcases are needed.
- 0.28 - Released May 9, 1998
  - Enhanced parsing in specs (word2.1 would work, word 2.1 would not)
  - Fixed COPY for a NT jit bug, fixed locate so NOT LOCATE would work, updated LITERAL not to use more than one exit(rc)
  - Fixed a compiler problem that would hit multistreamed pipes using append or prefix.
  - Any options not consumed by njp are passed on to nrc and java. Mainly for use from the command line, use with care in .njp files...
  - Fixed shortStreams() so it works correctly when shorting streams in a stage with multiple streams.
  - Tested all 8 addpipe forms and fixed runtime to work with all test cases
  - modified filternjp to accept \*in and \*out without additional labels
  - reenabled stop() in exit code...
  - added gate, dam, tokenize, juxtapose and courtesy of Chuck Moore, frrlabel stages
- 0.27 - Released May 3, 1998
  - Automated the generation of in/outStream calls. For this to work the labels need to be of the form \*in0: or \*out0: where the '0' is replaced by the input or output stream to connect to.
  - Fixed compiler/filter problems with stema

- Tightened range checking code in specs, fixed problem with delimited ranges. Specs was compiling the NetRexx EXIT command...
  - Fixed a problem where output was not see that objects were consumed when using sipping pipes...
  - Fixed a problem where severing an output stream did not cause the stages stacked on the node's outlist to see the sever
  - Fixed a problem where the stage issuing a callpipe was not seeing the called pipe end
  - Added debug option to pipes compiler
  - Repaired commit and added commit levels to dump() method
  - Fixed problems with callpipe severing several outputs, unstacking the saved stream was selecting it...
  - Modified tcpclient and tcpdata to use a secondary thread to recieve the tcpip inputs.
  - Now keep a referenced object for each pipe/stage so the JIT does not throw away its work and call/addpipes in loops work faster.
  - in/outStreamState now return -1 when autocommit is enabled and the stream is unused.
- 0.26 - Released April 26, 1998
- Added selection methods to compiler (see getRange in section 4 and the locate stage an example#
  - Added the specs stage. The compiler builds a stage to process the specs, reducing overhead.
  - Added tcp/ip stages
  - Fixed problems with severs using addpipe
- 0.25 - Optimized some stages using jinsight from [www.alphaworks.ibm.com](http://www.alphaworks.ibm.com). This more than doubled the speed of some stages.
- fixed bugs in fanin, diskw
  - Added netrexx filters to extract pipes, extended the functions of .njp files (multiple pipes in a file and .njp files can now contain netrexx code with pipe/callpipe/addpipe)
  - fixed a timing bug in deadlock detection.
  - xlate and sqlselect stages contributed by René Jansen added
- 0.24 - Release Feb 98
- modified the compiler so the syntax of pipes from the command line is the same as pipes from .njp files
  - added the sort stage, the sortClass interface and the sortRexx example implementation
  - added the timer stage
- 0.23 - fixed minor compiler errors (20 Dec 97)
- not stage modifier added.
  - errors in this page corrected, NT install information added.
  - modified diskr/diskw to use Buffered Streams.
- 0.22 - second public release
- 0.21 - enabled auto commit, stages start at a commit level of -2 and commit to a level of -1 at the first readto, peekto or output. nocommit disables the auto commit. This feature has not been



- completely tested (yet).
- fixed compiler not to call netrexx if one of its pipes deadlocks
- 0.20 - Upgraded to May version of the NetRexx compiler (Thanks Mike!)  
this changed the compiler interface. NetRexx from May 10 or  
later is now required.
- nocommit added to \_stages, though its a nop for now
- modified the compiler class to use the May 10th NetRexx compiler
- 0.19 - initial public release (4 May 97)

---

## List of Figures



---

## List of Tables



---

## Listings

Example Listing . . . . .	iii
Hello World . . . . .	4
njpipes.stdout . . . . .	4
njpipes.stdout . . . . .	5
Hello World 2 . . . . .	5
njpipes.stdout . . . . .	5
Hello World3 . . . . .	5
Hello World4 . . . . .	5
Count Words . . . . .	13
Test Dup . . . . .	13
abbrev example . . . . .	25
njpipes.stdout . . . . .	25
njpipes.stdout . . . . .	25
append example . . . . .	26
njpipes.stdout . . . . .	26
njpipes.stdout . . . . .	26



---

# Index

Rexx, 17, 19  
arg, 17, 18  
catch, 18, 19  
class, 17, 18  
do, 18  
end, 17-19  
exit, 18  
extends, 17, 18  
final, 17, 18  
forever, 18, 19  
import, 18  
loop, 17-19  
method, 17, 18  
over, 17  
public, 17, 18  
say, iii, 17  
static, 17  
to, 17  
  
abbrev, 25  
append, 26  
  
between, 26  
buffer, 27  
  
casei, 27  
change, 27  
chop, 27  
command, 28  
compare, 28  
console, 29  
copy, 29  
count, 29  
  
dam, 30  
deal, 30  
deblock, 30  
dict, 30  
dicta, 31  
dictr, 31  
dictw, 31  
disk, 31  
diska, 31  
diskr, 31  
diskslow, 32  
diskw, 32  
drop, 32  
dup, 32  
  
elastic, 32  
  
fanin, 33  
faninany, 33  
fanout, 33  
fblock, 33  
file, 33  
filea, 34  
filer, 34  
fileslow, 34  
filew, 34  
find, 34  
frlabel, 35  
frtarget, 35  
  
gate, 35  
gen, 35  
getfiles, 36  
getovers, 36  
getstems, 36  
  
hash, 36  
hasha, 37  
hashr, 37  
hashw, 37  
hole, 37  
  
insert, 37  
inside, 38  
  
join, 38  
joincont, 38  
juxtapose, 39  
  
literal, 39  
locate, 39  
lookup, 40  
  
nfind, 41  
nlocate, 41  
noeofback, 41  
nop, 42  
not, 42  
notininside, 42  
  
outside, 42  
over, 42  
overlay, 43



pad, 43  
pick, 43  
prefix, 44  
ptimer, 44  
  
qsort, 44  
  
random, 44  
reverse, 44  
  
serialize, 45  
sort, 45  
sortClass, 45  
sortRexx, 45  
specs, 46  
split, 46  
sqlselect, 46  
stem, 46  
stema, 46  
stemr, 47  
stemw, 47  
strfind, 47  
strfrlabel, 47  
strliteral, 48  
strnfind, 48  
strtolabel, 48  
  
take, 49  
task, 49  
tcpclient, 49  
tcpdata, 49  
tcplisten, 50  
timestamp, 50  
tokenize, 51  
tolabel, 51  
totarget, 51  
  
unique, 52  
  
var, 52  
vector, 52  
vectora, 52  
vectorr, 53  
vectorw, 53  
  
watchp, 53  
  
xconsole, 53  
xlate, 53  
  
zone, 54

ISBN 978-90-819090-3-7

