

Introduction to Computerized Cost Index

This computer cost escalation software program is based on the Government Monthly Cost Index Program, which started January 1974. The Cost Index has been used successfully for over 25 years by over 1,000 Engineers and Estimators for estimating unit prices, replacement costs, O&M cost studies, and project conceptual cost estimates for Government, Contractors, private industry, and Federal and State agencies. It provides a fast and easy tool to escalate cost data from 1974 to 2010 based on JAB's 8 volumes of Construction and GSE cost data, 5 Government Price Books and over 300 cost indexes. It is based on actual monthly cost indexes for labor and material from 1974. Also discussed is *how* to use it and *why*, plus it shows 11 purposes and benefits, with samples and analysis matrix. In addition, it shows analysis for escalation projections to year 2010 and manual versus computer escalation including a list of new exciting estimating tools and short comings of cost index systems, with independent analysis to improve accuracy of cost escalation estimates.

Key Words: Cost Index, Construction Index, EXCEL Index, Aerospace Cost Data, Estimating Tools, Cost Escalation, GSE, Escalation, Index Successes

COMPUTERIZED ESCALATION

Background – What is a Construction Cost Index?

It is a tool to measure the cost increases of construction labor and materials. A good cost index can also be used to adjust previous bids and cost estimates to the present time and project their future costs one to twenty years, based on past cost increases and experience. An example: the cost of the North/South Shuttle Landing Facility, built in 1974, can be indexed or escalated to 2004. The cost of the East/West runway could be projected to 2004 to allow for more orbital and/or liquid fly back booster landings at KSC and more timely shuttle launches. Another example, the cost of the world's largest building, the VAB, could also be indexed, escalated, and projected to the future. This is a management overview of the unique Aerospace Construction and Ground Support Equipment (GSE) cost escalation since 1974, with cost comparisons and analysis of labor and material costs.

This report will show eleven purposes and seven reasons why it is important and a summary of eight reasons how it helped to improve KSC cost estimating accuracy—some surprising and some unanticipated. This graphic presentation will show charts of annual and monthly cost escalation, sample aerospace price book index and low and high unit prices for faster conceptual estimating, the real aerospace cost increases since 1974 and one of the largest cost items in estimating, a graphic chart of payroll tax rates, which includes Workman's Compensation, and a list of 12 new exciting estimating tools to improve cost estimating speed and accuracy. It also includes a list of fifty-five of the larger and more accurate estimates since 1974, totaling over \$200,000,000, with 6% of low bid estimates. This report discusses the cost index for "Long Term Escalation," "Short Comings and Analysis." This report is the 23rd technical paper published in a one-of-a-kind series on aerospace construction and government cost estimating building—and includes "Estimating and Bidding for the Space Station Processing Facility," completed June 23, 1994. Some other papers are: "Aerospace Construction Cost Estimating," 1992, "Government Bid Estimate Compared to Contractors Estimate," 1989, and "Government Conceptual Estimating for Aerospace," 1986, which explains the purpose, use, and importance of the system summaries for conceptual estimates. These 15 reports should be helpful in understanding some of the complexities of government estimating. This report is about one of the most basic of over twenty-four aerospace estimating tools being developed at KSC to prove the benefit of the KSC team work efforts. Also included are special prices for aerospace commodities, such as LH2, Gn2, and HFC 134A costs and a more timely report of

Index for new project =	7328
Index ratio new/known =	3.6639

Projected cost of new project (will cost) =
 Cost of known project x ratio =

\$ 81,153,368

ECBC
 OTHER

NOTES:

1. All escalation factors from June 1999 to Dec 2010 are based on 4% per year estimated escalation.
2. Use unit price chart (next sheet) for square feet and cubic foot unit prices
3. Enter date formats as first three letters of month and last two digits of year. For dates beyond 2000, enter date format with all four digits of the year.

GENERAL COMMENTS BY JOE BROWN

This is a fast and easy Aerospace Cost Escalation Chart. It may be used as is. However, on major cost estimating items of projects, it should be used with caution. An independent analysis should also be used. On some projects, this escalation chart may vary by 25% (plus or minus).

For other analysis:

- A. Vol. VI, p. 6 - 8, JAB Seminar Workbook and Workbook Supplement, p. 109-110A, and Vol. III, p. 167 – 168.
- B. Engineering News Record (Cost Indexes – Building Cost Index and Construction Cost Indexes from 1917 to present)
- C. Be sure to have all cost estimates checked and reviewed and approved by someone else.
- D. Remember - July 1999 to Dec 2010 escalation rates have been estimated. Reference Vol. V, p. 97 to 109, JAB's "Aerospace, Government, and Contractors' Cost Estimating."

This chart was developed by Gene Hajdaj and Joe Brown – 1998 and 1999.

Last updated 7/1/99.

More Detailed Instructions – 17 Steps

1. Assemble your cost – evaluate data -
 - Bid prices
 - close out cost (coc)
 - government estimate
 - average of all bids
 - unit prices
2. Determine which chart to use – unit price to 3 decimal places or lump sum project cost to \$1 billion.

3. Determine the month and year of the data
4. Determine when you want to escalate the data to. If you have several items to be escalated, consider escalating them all to a present date, then you can further escalate all the project items to a future date – 2000 – 2010. This method makes it easier to re-escalate your data to the future if your project is delayed a year or two.
5. Enter the proper chart – unit price or Lump Sum (LS) – project total
6. Enter a new project title
7. Enter today's date
8. Enter original date of cost you want escalated
9. Enter amount unit price of lump sum
10. Enter date you want to escalate - month and year. Note: After 2000 – enter 4 digits (Y2K)
11. Check the computer answer. You may want to check Joe A. Brown's (JAB) Volume V, page 97 – 110, or CD ROM #1, "Historical Cost Data," or CD ROM #3, "8 Volumes," or Joe A. Brown's Estimating Books
12. Do a comparison with Engineering New Record Cost Indexes for Buildings or Civil Construction
13. Make an independent analysis yourself
14. Do analysis matrix. See sample chart of mark-ups. Number of bidders, design environment, new design requirements, labor productivity, or other unique items.
15. Note your confidence factor – example: plus or minus 10% to 50%
16. All cost estimates should be checked, reviewed, and approved
17. Enclose a copy of your back-data and charts with your estimates. It adds credibility, believability. See a chart of Runway, c.o.c. #22, 149, 153 to July 2004 or \$81,153,368.

See sample of unit price escalation Chart "B," four processing facilities cost reduction from \$437/SF to \$200/SF form, "50 Aerospace Cost Factors."

Why Use This Computer Escalation Program?

The four biggest and most important reasons are:

1. It is easy
2. It is fast – up to 10 times faster than using the manual method, looking up charts in 300 indexes, 4 Aerospace Price Books, or JAB's Vol. V and VI, or using CD ROMs #1 and #3.
3. This computerized cost index escalation program keeps the government's multi-billion dollar cost data base for construction and ground support equipment CURRENT!
4. It's electronic, uses Excel™, can be sent as an e-mail attachment, is on CD ROMs, can be put on computer discs, is accessible from the Network server.

The Eleven Purposes of Cost Index are:

1. To provide current work hours – (Davis Bacon) rates (37) and material prices (24)
2. To show rates of change in labor and material price and a graphic **number**/month
3. To record and measure past escalation and project future escalation
4. To establish budget/PER conceptual rule of thumb costs and cross check detailed estimates
5. To help establish uniformity for the in-house and A&E cost estimates, etc.
6. As important communication tools, timely PT&I rates, mark-ups, etc., and new cost items
7. To keep it simple and easy to use
8. To index unit prices and bid prices in Government or owner price books
9. As a timely communication news bulletin on current bid projects, markets, and bid strategy, low bidders, and government estimates
10. Education on cost escalation and labor productivity
11. To escalate the cost of similar bids and estimates from the past to the present. This is also being used for replacement costs, O & M cost studies, logistics, public, private, and government agencies.

Computerized Escalation - Excel™ Computerized Escalation Program

The computerized cost index for construction and ground support equipment (GSE) is based on using Micro\$oft's Excel™ spreadsheet program and, in particular, the "Lookup Wizard." If you go to "HELP – Look Up," you can create your own program. Lotus™ and other spreadsheet programs have similar programs. These programs can also be used with Apple MacIntosh™ computers by using an appropriate translator, such as, Apple Works™ or Claris™.

This computerized cost index for escalation used Excel™ "lookup Wizard" by putting in the near 900 labor, material, and total labor and material index numbers and the formulas necessary to make it as simple, fast, and automatic as possible. See the following description from Micro\$oft Excel™ about looking up values in list and formulas. This escalation index program was made Y2K compliant in July 1999 with escalation to December 2010. Note: You may have to go to "HELP" to find information about this. (Reference #24 Micro\$oft Excel™ 2000 version No. 9.0, "Spreadsheet Software.")

About Looking Up Values In Lists

Lookup Wizard You can find a value in a worksheet list that has row and column labels. The Lookup Wizard helps you find other values in a row when you know the value in one column, and vice versa. For example, if you have an inventory list of product numbers, descriptions, and prices, you can quickly find the description of the price of a product when you type in the appropriate product number. The Lookup Wizard creates the formula you need.

PART I

Seven Reasons Why Have a Government or Owner Cost Index

Why a government or owner Cost Index is important: The two most variable costs in construction are: 1) Location, which may vary from .75 to four times the ideal location, such as Washington, D. C. or New York City as an example. The major U.S. aerospace launch facilities are located at Kennedy Space Center, Florida, and Vandenberg Air Force Base, California, with some overseas locations for landing in Africa, Spain, Guam, etc. Therefore a cost index based on KSC is a most important factor to increase the accuracy and timeliness of KSC aerospace facilities estimates. Another most important variable cost in construction cost estimates is: 2) in types of industries – from residential to commercial, industrial, petro, chemical, and aerospace with many unique costs as noted in the technical paper, "Aerospace Construction Cost Estimating," presented at the First World Cost Engineering Congress, listing over 25 of KSC significant cost factors with a cost of 5 to 30%, normally and 30 to 200% for special requirements. The major cost indexes do not index a number for KSC or Brevard County. Therefore, these were two of the major reasons for creating and developing the KSC cost index in 1974. Another important variable is in labor payroll taxes, or PT&I, which varied from 12% in 1961 (Ref. No. 19 – "How Did the Low Bidder Get Low?") to 55% or more in October 15, 2000, cost index. Its importance is also noted in fine tuning PT&I in Ref. No. 18, "33 Aerospace Spin-Offs in Construction Cost Estimating."

1. For one-of-a-kind projects – Detailed labor and material prices are especially important
2. No published cost data for aerospace/GSE facility costs existed
3. Governments need to budget projects one month to 30 years in advance of their need
4. To take projects/system unit bid prices, bid, and build since January 1974 and escalate to now and escalate future costs for faster budget estimates and cross check current project government estimates
5. This index is specific for KSC, Florida, however it is used not only throughout Florida, but is used world wide
6. This index is specific for Aerospace Industry
7. This index includes PT&I rates for Florida

Some special features have been construction cost alerts, in bidding markets with rising and falling prices, a market analysis of low bidder estimates—how the low bidder got low—an analysis of the government estimates and

differences between bidder estimates. New detailed mechanical cost estimating guideline, NASA headquarters' six year cost escalation guidelines, special prices for aerospace commodities, such as, liquid hydrogen, oxygen, and gaseous nitrogen, et., CAD estimating updates, the Joe Brown "on the spot" award for 1992, 1993, and 1994, recent bids and upcoming bid projects and, currently, a list of sixty-five KSC projects recognized for government estimate accuracy—totaling \$303,578,791, all within 5.9% of the low successful bid. (Ref. Nos. 2, 3, & 7) (See Figure #1)

The "Basic Cost Index" Consists of Five Major Graphic Charts and Tables

1. The "Monthly Graphic Chart Cost Index," as an example shows the escalation from January 1994 to December 1995 (Ref #2)

For labor, from 2883 to 3181
 For materials, from 2329 to 2606
 Total labor and materials, from 5212 to 5747 or + 10.3% change

"Monthly Graphic Chart of Labor and Material Cost," March 1974 was 2000. Note: Orbital Landing Facility (OLF), bid in early 1974, could be escalated by dividing:

$$\frac{7328}{2000} = 3.6639 \times \$21,812,737 = \$81,153,368$$

Original bid price to budget cost of \$81,153,368 in July 2004, the same way any one of 1055 projects bid since 1974 could be escalated. If the VAB was built in 1974 at \$117,000,000, what would the budget cost be in December 1995?

$$\frac{5747}{2000} = 2.8735 \times \$117,000,000 = \$336,199,500 \text{ in December 1995}$$

2. The "KSC Annual Construction Cost Index Chart" (Figure II) shows the labor, material, and composite labor and material escalation with an erratic high climb since Jan. 1974 – Dec. 1995:

	<u>Number</u>	<u>Escalated Number</u>	<u>Change</u>
Labor	1000	3128	+3.128
Material	1000	2550	+2.55
Composite	2000	5678	+2.839

Note the flat materials line 1989-1993, which confirms the "number of bidders" concept, which notes the number of bidders had average 5.5. bids increased to an average of 11.14 bids per KSC project during building recessions October 1989 to September 1994. Recent number of bidders has dropped to 6.3 bids and may be the reason for the increase in bid cost of 5 to 17%—a new estimating tool—number of bidder concept—as detailed in case study at the 33rd AACE annual meeting "Estimating and Bidding Space Station Processing Facility," Dearborn, Michigan.

3. The “**Department of Labor Wage Rates for NASA Construction Projects**” shows the current wage rate for 25 skill trades, such as, plumbers, electricians, iron workers, asbestos workers, cable splicing, crane operations, etc. It also shows fringe benefits and allowances for foremen. (Ref #2)
4. “**KSC Labor Cost Index for December 1994 Chart**” shows suggested crew work hour rates for nineteen typical specification sections with a total of 100 work hours. Example: electrical, \$30.66/hr x 10 work hours = \$306.60. Also note electrical rate in January 1974 was \$9.38, and in January 1979 was \$15.27, or the average cost for 100 work hours would be \$2,687.28 for December 1994 or an average of \$26.897 per work hours.
5. “**KSC Material cost Index for December 1994 Chart**” shows material prices with estimated typical quantities – example 8 x 8 x 16 concrete block at \$.78 ea x 339 = \$264.42 of material/equipment—total material price of \$5280.27.

Special Feature of the KSC Cost Index

A special feature of the KSC Cost Index is that it is also an index of the “Aerospace Price Book” with unit bid prices. (Ref #6). In the “KSC Cost Index,” is a 30-page index of the 1992 – 1994 “Aerospace Price Book” for Volume I, II, and III. (Ref #6)

Volume I – “Introduction and Sample – How to make a Budget Estimate,” “Architectural Structure – Civil and General,” and “Equipment Unit Prices and Rental Rates”

Volume II – “Mechanical and Electrical, Unit Prices and Elements/System Prices”

Volume III – “System Summary of Over 340 Bid Projects with Matrix Cross Index” (see Figure VII – Sample Summary for Restoring C5 Sub-Station)

Note; Volume IV is an over 110 page case study of the detailed government estimate for the space station processing facility, see “Estimating and Bidding SSPF,” references No. 3 and 4 – technical paper for government estimates summary and detailed breakdown.

Some Other Special Features and Comments

Our KSC Cost Index has helped us get the other important cost data, such as, Navy CES and the “Florida Department of Transportation Unit Bid Prices Quarterly,” which we summarized and published as part of the index. This is especially important for civil road projects, earthwork, paving, steel rebar, etc.

One of the largest cost items in construction estimation is the cost of payroll taxes and insurance which varies from 14.6% to 100% of labor costs. These are shown as backup data for the PT&I rate we use in our crew rates (see Figure VIII). Also included in the index is graphic chart 1979-1994 for Workman’s Compensation and PT&I (see Figure III).

Several technical papers have been written about the KSC Cost Index, starting in 1975. “KSC Cost Index for Construction Management”—presented at the 19th Annual ACE Meeting. Also “Conceptual Cost Estimating Using KSC Cost Index” for CM, presented at the 24th Annual Meeting, July 1980, in Washington, D. C., “Aerospace Construction Cost Estimating” at the 1st World Cost Engineering Congress, where the “KSC Cost Index” was featured as one of the 21 unique aerospace estimating tools for more accurate government estimating and, also, in the “Space Station Processing Facility Government Estimating and Analysis” as a case study documenting the use of these tools to increase the accuracy of the government estimates. More recently, at the ACE International 39th Annual meeting in June 1995, “240 Cost Indexes and Escalation” This is a good example of manual cost escalation.

New Exciting Estimating Tools – Special Feature of Cost Index

As a part of DE cost engineering continuous improvements, some new, exciting aerospace construction and GSE cost estimating tools are being developed, documented, and tested at KSC.

1. Optics Cable – (A) – Cost per fiber foot – John Shramko and Bob Lupo/DF-FED-22, J. A. Brown/NASA, team leader, Austin Durett/EG&G; (B) – Fiber Meter Graph, (Ref #2)
2. Cost per Panel Component Chart – Labor, Material, & Fabrication – for Budget and Cross Checking – Etherroy Jones/EG&G, J. A. Brown/NASA, team leader. (Ref #2)
3. Chart – Cost Per Panel Component Only – Kim Ballard/DM-MED-42 - Independent analysis as listed in step #14

KSC COST INDEX FOR LONG TERM ESCALATION SHORT COMINGS OF COST INDEX SYSTEM

1. Does not account for construction bid market, such as, contractor markups. These bids may vary from 25% to 90% of labor material prices.
2. Does not account for types and number of bidders – union/open shop, number of bidders concept: – 5% to a + 27%
3. Does not account for Design Environment – cost effective to gold plated. \mp 20%
4. Does not account for New Design Requirements or obsolete requirements – environment, asbestos, lead, freon, storm water, wind loading, ADA, energy conservation, etc. \mp 20%
5. Does not account for labor productivity—then and now. May vary from 38% to over 90% with 70% being the norm.

However, it is a most fast and easy system that can be more accurate when major cost considerations are used. These considerations and cost analysis are documented in the case study of “SSPF Government Estimating” presented at the AACE International Meeting at the Society of Cost Estimating and Cost Analysis Workshop, October 8, 1993, (References #3 and #4). See the following example of an analysis to evaluate the short comings of Long Term Cost Index Escalation.

EXAMPLE OF ANALYSIS MATRIX

	When Original Bid Date	Today's Bid Date	When Expected to Bid	Adjustment %
1. Mark-Ups 25 – 90% Ref. #9	_____ %	_____ %	_____ %	_____ %
2. Number of Bidders -5% to +27% See factor affecting accuracy of bidding Ref. #10, 3, & 4	_____ %	_____ %	_____ %	_____ %
3. Design Environment ± 20% See "Aero- space Construction Cost Estimating" Ref. #5	_____ %	_____ %	_____ %	_____ %
4. New Design Require- ment – Wind Loading, Flood Levels, Earth- Quakes, Storm water, ± 20%. Ref. #5	_____ %	_____ %	_____ %	_____ %
5. Labor Productivity See "Estimating Labor Productivity Survey" - 30 th AACE. 38% to 90%, 70% norm. Ref. #11 & #13	_____ %	_____ %	_____ %	_____ %
6. Other _____ % <u>You name it</u> Special Conditions Ref. #9		_____ %	_____ %	_____ %
			Total	_____ %

Therefore, this project may cost _____ % more or less than the escalated totals

Computerized Escalation

Additional comments about confidence factors based on over 26 years of using the KSC Cost Index and Computerized Escalation Index: If bid prices are used, the actual cost may be plus or minus 15%. If close out costs (coc) are used, the actual cost may vary from a minus 20% to a plus 10%.

Future Escalation

In July 1999, the Excel Escalation Tables were based on 4% per year escalation. However, it is being re-evaluated as follows:

As noted in the table, average annual increase for labor material – 1974 – 1999, the average increase has been:

Labor	5.3%
Material	4.5%
Total Average	4.9%

Therefore, with an average increase of 4.9%, volatile oil, energy, and other critical factors, a 5% estimated increase over 3 to 10 years is being considered when the computer escalation index is updated.

AVG INCRE.	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
LABOR	10.3	9.3	13.6	9.3	5.0	8.8	8.4	4.4	1.7	6.7	3.0	2.9
MATER.	36.0	4.3	- 0.5	2.2	7.9	9.5	10.2	5.3	-1.2	5.5	5.0	0.2
T L&M	23.2	6.8	6.6	5.8	6.5	9.2	9.3	4.9	0.3	6.1	4.0	1.6

AVG. INCRE.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
LABOR	3.2	5.1	4.2	5.6	3.6	-14.	6.1	3.3	10.0	6.8	2.3	1.6
MATER.	-2.6	-1.0	8.7	5.7	0.9	-0.2	0.8	3.0	1.5	8.7	2.4	1.7
T L&M	0.3	2.1	6.5	5.7	2.3	-0.8	3.5	3.2	0.8	7.8	2.4	1.7

AVG. INCRE.	1998	1999	AVG. 1974-1999
LABOR	5.2	8.4	5.3
MATER	-0.1	4.2	4.5
T L&M	2.6	6.3	4.9

Unit Costs Computerized Cost Escalation

Unit price or cost estimating is especially important in Europe and in North America in civil road projects and building construction for conceptual estimates and bidding. An example of new technology is Fiber Optics Cable - estimating it by the unit price, by Fiber Meter (FM) or Fiber Foot (FF) or buildings by Square Meter (SM) or Square Foot (SF) as noted in "50 Cost Factors." A cost reduction in building square foot shows a 14-46% decrease from 1975 to 1986 and 1991.

Sample Facilities Cost Reduction – 1975 to 1996, using unit prices for comparisons:

Escalated to January 2000		
#1. Processing Facility Bid – 5/14/75	Cost - \$ 165.40/SF	\$ 431.07/SF
#3. Processing Facility Bid – 1/26/86	Cost - \$ 240.65/SF	\$ 374.49/SF
#4. Processing Facility Bid – 1/23/91	Cost - \$ 150.03/SF	\$ 200.22/SF
#5. Processing Facility Bid – 8/15/96	Cost - \$ 217.31/SF	\$ 244.11/SF*
*Facility #5 was a much smaller modification and addition to Facility #3.		
Therefore, cost reductions of 15% to 46% are possible		

You can see cost reductions of 15% to 46% - See Chart B, Attachment A.

Notes:

1. Using Excel Escalation Chart Cost Index 1974 – 2000 by Gene Hajdaj and Joe Brown, July 1999
2. Facility #4 had economy of scales – being much larger
3. Facility #5 was much smaller – mods, rebars, and additions, however, activation costs was only 31% of bid price.
4. Facility #4 and #5 had different requirements.

In Summary

1. The KSC Cost Index has been tested and used successfully for over 26 years with over 300 monthly cost indexes.
2. It has accurately recorded and documented KSC construction and Ground Support Equipment (GSE) escalation.
3. Per list of top 65 government estimates for \$179,231,000, where a low responsive bid was within 6% of government estimate. Note: 37 were within 4% of government estimate – a **great** record for research and developing one-of-a-kind projects (see Figure X).
4. It has helped improve cost estimating accuracy.
5. It has made the Lead Cost Engineer's job a lot easier by: 1. saving time; 2. proving and justifying the thousands of cost estimates and negotiations – an especially nice surprise.
6. As one of KSC's important cost engineering teamwork tools, it is responsible for saving time, money, and improving performance.
7. Has been an important part of the development of our new exciting cost estimating tools, such as, fiber optics on the information superhighway, labor hours, and material cost on special aerospace control panels for our space program, fine tuning PT&I, number of bidder concept—one of the most pleasant surprises and most rewarding. (See Figure XII - "New Exciting Estimating Tools.")
8. Has provided a means of exchanging and sharing important, cost data and teamwork with others: Florida Department of Transportation, Navy CES, and A&E firm, and consultants—an important unanticipated benefit.
9. Has been an important means of proving KSC cost engineering cost data integrity with facts and figures to backup cost estimates in negotiations, low bidders, and non-responsive bidders, to help avoid protests, etc. This has been one of the pleasant surprises and major benefits, saving lots of wasted time.
10. The "KSC Monthly Index" has helped make it possible to publish the current and projected Workman's Compensation Rates and Payroll Taxes, and Insurance Rates—9 to 18 months before weekly engineering magazines and annual building cost data publications. This is one of the most beneficial and surprising

benefits. It is also responsible for developing another new exciting estimating tool—"Fine Tuning PT&I Rates for Office, Trades, and Marine Construction."

This report is about one of the most basic of our over 90 estimating tools being developed and documented at KSC to prove the benefits of the KSC teamwork efforts which are contributing to our goals of continuing space exploration and development

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